

Table 1. Technical expert panel (continued)

Appendix A. Technical experts and peer reviewers

Table 1. Technical expert panel

Name	Title	Specialty	Organization	Address	Phone	email
Elizabeth Steiner, MD	Assistant Professor of Family Medicine	Family Medicine	OHSU	OHSU Family Medicine 3181 S.W. Sam Jackson Park Road Mail Code: FM, Portland, Oregon 97239-3098	503-494-6605	steinere@ohsu.edu
Patty Carney, PhD	Professor of Family Medicine, and Associate Director for Population Studies at the OHSU Cancer Institute	Family Medicine	OHSU	OHSU Family Medicine 3181 S.W. Sam Jackson Park Road Mail Code: FM, Portland, Oregon 97239-3098	Phone: 503-494-7591 Fax: 503-494-2746	carneyp@ohsu.edu
Joanne Elmore, MD, MPH	Section Head, Division of General Internal Medicine Professor of Medicine Adjunct Associate Professor of Epidemiology Associate Director UW Robert Wood Johnson Clinical Scholars Program	Internal Medicine/ Epidemiology	University of Washington	Harborview Medical Center 325 Ninth Avenue Campus Box 359780 Seattle, WA 98104	Phone: 206-731-3680 Fax: 206-731-6097	jelmore@u.washington.edu
Bonnie Yankaskas, PhD, MPH (Dr. Yankaskas was not able to join the call)	Professor of Radiology, Adjunct Professor of Epidemiology, Principal Investigator for the Carolina Mammography Registry (CMR)	Radiology	University of North Carolina	Department of Radiology Radiology Research Lab CB# 7515 106 Mason Farm Road Chapel Hill, North Carolina 27599-7515	919-966-0492	bcy@med.unc.edu

Table 1. Technical expert panel (continued)

Name	Title	Specialty	Organization	Address	Phone	email
Bev Parker, PhD	Research Analyst	Consumer	Y-ME National Breast Cancer Organization	212 West Van Buren Suite 1000 Chicago, IL 60607	312-294-8513	bparker@y-me.org
Maria Wetzel, BS	Clinical Laboratory Scientist	Consumer	National Breast Cancer Coalition	1101 17th St. NW Suite 1300 Washington, DC 20036	707-964-7048	mwetzel@mcn.org
R. James Brenner, MD, JD, FACR, FCLM	Professor, Clinical Radiology and Chief, Breast Imaging, UCSF	Radiology	UCSF	Box 1667, UCSF; San Francisco, CA 94143-1667	Voice: (415) 885-7898 Fax: (415) 885-7829	james.brenner@radiology.ucsf.edu
Richard E. Fine, MD, FACS	Director	Clinical Expert	Surgeon-Oncology	Advanced Breast Care of Georgia, 790 Church St., NE Suite 410 Marietta, GA 30060	(770) 422-1988	Rfinemd@aol.com
Wendie Berg, MD, PhD	American Radiology Services Johns Hopkins at Greenspring Lutherville, Maryland	Radiology	American College of Radiology representative	Lutherville, Maryland		wendieberg@hotmail.com
Carol Lee, MD	Yale University School of Medicine Chair of the American College of Radiology Breast Commission	Radiology	Yale University School of Medicine	Yale University School of Medicine 333 Cedar Street New Haven, CT 06520	203-785-5590	carol.lee@yale.edu
Pamela Wilcox - cancelled day of call due to last minute conflict, but interested in TEG	Assistant Exec. Dir. of ACR	Radiology	American College of Radiology representative		800-227-5463 ext 4494	PWilcox@acr.org

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Appendix B. Methods of identifying the literature

Electronic Database Searches

The following databases have been searched for relevant information:

Name	Date Limits	Platform/Provider
CINAHL (Cumulative Index to Nursing and Allied Health Literature)	1990 through May 1, 2008	OVID
The Cochrane Central Register of Controlled Trials (CENTRAL)	Through 2008, Issue 2	www.thecochranelibrary.com
The Cochrane Database of Methodology Reviews (Methodology Reviews)	Through 2008, Issue 2	www.thecochranelibrary.com
The Cochrane Database of Systematic Reviews (Cochrane Reviews)	Through 2008, Issue 2	www.thecochranelibrary.com
Database of Abstracts of Reviews of Effects (DARE)	Through 2008, Issue 2	www.thecochranelibrary.com
ECRI Institute Library Catalog	Through May 2008	ECRI Institute
EMBASE (Excerpta Medica)	1990 through May 1, 2008	OVID
Health Technology Assessment Database (HTA)	Through 2008, Issue 2	www.thecochranelibrary.com
Healthcare Standards	1990 through May 2008	ECRI
International Health Technology Assessment (IHTA)	Through May 2008	ECRI
MEDLINE	1990 through May 1, 2008	OVID
PreMEDLINE	Searched May 1, 2008	OVID
U.K. National Health Service Economic Evaluation Database (NHS EED)	Through 2008, Issue 2	www.thecochranelibrary.com
U.S. National Guideline Clearinghouse™ (NGC)	Searched May 2008	www.ngc.gov

Hand Searches of Journal and Nonjournal Literature

Journals and supplements maintained in ECRI Institute's collections were routinely reviewed. Nonjournal publications and conference proceedings from professional organizations, private agencies, and government agencies were also screened. Other mechanisms used to retrieve additional relevant information included review of bibliographies/reference lists from peer-reviewed and gray literature.

Search Strategies

The search strategies employed combinations of freetext keywords as well as controlled vocabulary terms including (but not limited to) the following concepts. The strategy below is presented in OVID syntax; the search was simultaneously conducted across EMBASE, MEDLINE, and PsycINFO. A parallel strategy was used to search the databases comprising the Cochrane Library.

Medical Subject Headings (MeSH), Emtree, PsycINFO and Keywords

Conventions:

OVID

- \$ = truncation character (wildcard)
- exp = “explodes” controlled vocabulary term (e.g., expands search to all more specific related terms in the vocabulary’s hierarchy)
- .de. = limit controlled vocabulary heading
- .fs. = floating subheading
- .hw. = limit to heading word
- .md. = type of methodology (PsycINFO)
- .mp. = combined search fields (default if no fields are specified)
- .pt. = publication Type
- .ti. = limit to title
- .tw. = limit to title and abstract fields

PubMed

- [mh] = MeSH heading
- [majr] = MeSH heading designated as major topic
- [pt] = Publication Type
- [sb] = Subset of PubMed database (PreMEDLINE, Systematic, OldMEDLINE)
- [sh] = MeSH subheading (qualifiers used in conjunction with MeSH headings)
- [tiab] = keyword in title or abstract
- [tw] = Text word

Topic-specific Search Terms

Concept	Controlled Vocabulary	Keywords
Adverse events	Ae.fs. Co.fs. Cross infection Drainage Surgical wound infection	
Breast and breast diseases	Breast Breast cancer/di exp Breast disease/di exp Breast diseases/di Breast neoplasms/di	Breast\$ Calcification\$ Calcinosis Cancer Carcinoma\$ Lesion\$ Lump\$ Mammar\$ Papilloma Tum?or\$
Breast biopsy	Biopsy Biopsy needle Breast biopsy Directional vaccum assisted biopsy Needle biopsy Percutaneous biopsy Stereotactic breast biopsy Tumor biopsy	Large core Mammatome Mammotome Needle Vacuum
Open biopsy	Breast/su Breast tumor/su Su.fs.	Excision\$ Incision\$ Open Surgical
Patient Satisfaction/QOL	Pain assessment Pain measurement Patient satisfaction Quality of life Visual analog scale	Preference\$ QOL Satisf\$
Seeding		seeding

CINAHL/EMBASE/MEDLINE

English language, human

Set N	Concept	Search statement
1	Breast biopsy	(breast biopsy or stereotactic breast biopsy or directional vacuum assisted biopsy).de.
2	Breast	Breast
3	Breast diseases	Exp breast cancer/di or exp breast neoplasms/di or exp breast disease/di or exp breast diseases/di
4		(breast or mammar\$) and (Papilloma or calcification\$ or calcinosis or tum?or\$ or lesion\$ or cancer or carcinoma\$ or lump\$)
5	Combine sets	or/2-4
6	Biopsy	5 and ((Biopsy or tumor biopsy).de. or biops\$)
7	Large core needle biopsy	6 and ((needle biopsy or biopsy needle or percutaneous biopsy).de. or (large core or needle or mammotome or mammatome or vacuum))
8	Open biopsy	6 and (breast/su or breast tumor/su)
9		6 and (su.fs. or open or excision\$ or incision\$ or surgical)
10	Combine sets	8 or 9
11	Combine sets	or/1,7,10
12	Limit by publication type	11 not ((letter or editorial or news or comment or case reports or note or conference paper).de. or (letter or editorial or news or comment or case reports).pt.)
13	Diagnostics filter	12 and (exp prediction and forecasting/ or (predictive value of tests or receiver operating characteristic or ROC curve or sensitivity and specificity or accuracy or diagnostic accuracy or precision or likelihood).de. or ((false or true) adj (positive or negative)))
14	Clinical trials filter	13 and ((Randomized controlled trials or random allocation or double-blind method or single-blind method or placebos or cross-over studies or crossover procedure or double blind procedure or single blind procedure or placebos or latin square design or crossover design or double-blind studies or single-blind studies or triple-blind studies or random assignment or exp controlled study/ or exp clinical trial/ or exp comparative study/ or cohort analysis or follow-up studies.de. or intermethod comparison or parallel design or control group or prospective study or retrospective study or case control study or major clinical study).de. or Case control studies/ or Cohort/ or Longitudinal studies/ or Evaluation studies/ or Follow-up studies/ or Prospective studies/ or Retrospective studies/ or Case control study/ or Cohort analysis/ or Longitudinal study/ or Follow up/ or Cohort analysis/ or Followup studies/ or random\$.hw. or random\$.ti. or placebo\$.mp. or ((singl\$ or doubl\$ or tripl\$ or trebl\$) and (dummy or blind or sham or mask)).mp. or latin square.mp. or (time adj series) or (case adj (study or studies) or ISRCTN\$.mp. or ACTRN\$.mp. or (NCT\$ not nctc\$)))
15	Combine sets	13 or 14
16	Eliminate overlap	
17	Seeding	12 and seeding.ti,ab.
18	Patient satisfaction/QOL	12 and ((patient satisfaction or pain measurement or pain assessment or visual analog scale or quality of life).de. or satisf\$ or QOL or preference\$)
19	Adverse events	12 and ((ae or co).fs. or (cross infection or drainage or surgical wound infection).de.)
20	Disfiguration	12 and (disfigur\$ or deform\$)
21	Combine sets	or/16-20

Appendix C. Excluded studies

Table 2. Studies that did not meet the inclusion criteria for key question 1

Study	Primary Reason for Exclusion
Brem et al. 2008 ¹	Retrospective case study
Eun et al. 2008 ²	Enrolled patients with benign masses
Hauth et al. 2008 ³	Enrolled a high-risk population
Hemmer et al. 2008 ⁴	Did not address Key Question 1
Ji et al. 2008 ⁵	Duplicate report of Youk et al. 2008 ⁶
Kim et al. 2008 ⁷	Did not verify benign diagnoses
Michalopoulos et al. 2008 ⁸	Did not address Key Question 1
Peter et al. 2008 ⁹	Fewer than 50% of enrolled patients completed the study
Rizzo et al. 2008 ¹⁰	Retrospective case study
Shin et al. 2008 ¹¹	Retrospective case study
Sigal-Zafrani et al. 2008 ¹²	Fewer than 50% of enrolled patients completed the study
Sohn et al. 2008 ¹³	Retrospective case study
Tagaya et al. 2008 ¹⁴	Enrolled patients with benign masses
Zagouri et al. 2008 ¹⁵	Did not address Key Question 1
Andreu et al. 2007 ¹⁶	Fewer than 50% of enrolled patients completed the study
Arora et al. 2007 ¹⁷	Retrospective case study
Ashkenazi et al. 2007 ¹⁸	Retrospective case study
Bode et al. 2007 ¹⁹	Retrospective case study
Cassano et al. 2007 ²⁰	Patients were selected for core-needle biopsy on the basis of prior fine-needle aspiration results
Ciatto et al. 2007 ²¹	Enrolled a high-risk population
Dillon et al. 2007 ²²	Retrospective case study
Douglas-Jones et al. 2007 ²³	Retrospective case study
Duchesne et al. 2007 ²⁴	Fewer than 50% of enrolled patients completed the study
Duijm et al. 2007 ²⁵	Fewer than 50% of enrolled patients completed the study
Easley et al. 2007 ²⁶	Fewer than 50% of enrolled patients completed the study
Esserman et al. 2007 ²⁷	Retrospective case study
Foxcroft et al. 2007 ²⁸	Retrospective case study
Garg et al. 2007 ²⁹	Patients were selected for core-needle biopsy on the basis of prior fine-needle aspiration results
Holloway et al. 2007 ³⁰	Did not verify benign diagnoses
Houssami et al. 2007 ³¹	Retrospective case study
Karabakhtsian et al. 2007 ³²	Retrospective case study

Table 2. Studies that did not meet the inclusion criteria for key question 1 (continued)

Study	Primary Reason for Exclusion
Kikuchi et al. 2007 ³³	Did not verify benign diagnoses
Kim et al. 2007 ³⁴	Fewer than 50% of enrolled patients completed the study
Ko et al. 2007 ³⁵	Retrospective case study
Krainick-Strobel et al. 2007 ³⁶	Enrolled patients with benign masses
Kumaraswamy and Carder 2007 ³⁷	Fewer than 50% of enrolled patients completed the study
u and Kleer 2007 ³⁸	Retrospective case study
Lavoue et al. 2007 ³⁹	Retrospective case study
Lee et al. 2007 ⁴⁰	Enrolled a high-risk population
Lee et al. 2007 ⁴¹	Enrolled a high-risk population
Leikola et al. 2007 ⁴²	Retrospective case study
Lieberman et al. 2007 ⁴³	Enrolled a high-risk population
Londero et al. 2007 ⁴⁴	Retrospective case study
Lourenco et al. 2007 ⁴⁵	Retrospective case study
Luczynska et al. 2007 ⁴⁶	Did not verify benign diagnoses
Martel et al. 2007 ⁴⁷	Retrospective case study
Mathew et al. 2007 ⁴⁸	Enrolled patients with benign masses
Mendel et al. 2007 ⁴⁹	Fewer than 10 patients enrolled
Murta De Lucena et al. 2007 ⁵⁰	Did not verify benign diagnoses
Nakano et al. 2007 ⁵¹	Patients were selected for core-needle biopsy on the basis of prior fine-needle aspiration results
Popiela et al. 2007 ⁵²	Enrolled a high-risk population
Povoski and Jimenez 2007 ⁵³	Did not report sufficient data to address Key Question 1
Rustein et al. 2007 ⁵⁴	Retrospective case study
Schaefer et al. 2007 ⁵⁵	Did not address any of the Key Questions
Smitt and Horst 2007 ⁵⁶	Enrolled patients with malignant masses
Sohn et al. 2007 ⁵⁷	Retrospective case study
Sydnor et al. 2007 ⁵⁸	Retrospective case study
Uematsu and Kasami 2007 ⁵⁹	Did not address Key Question 1
Uematsu et al. 2007 ⁶⁰	Did not verify benign diagnoses
Usami et al. 2007 ⁶¹	Enrolled patients with malignant masses
Zagouri et al. 2007 ⁶²	Retrospective case study
Zografos et al. 2007 ⁶³	Did not verify benign diagnoses
Zuiani et al. 2007 ⁶⁴	Enrolled a high-risk population
Al-Attar et al. 2006 ⁶⁵	Did not address Key Question 1
Becker et al. 2006 ⁶⁶	Retrospective case study

Table 2. Studies that did not meet the inclusion criteria for key question 1 (continued)

Study	Primary Reason for Exclusion
Bedei et al. 2006 ⁶⁷	Retrospective case study
Chrzan et al. 2006 ⁶⁸	Retrospective case study
Cox et al. 2006 ⁶⁹	Retrospective case study
Dillon et al. 2006 ⁷⁰	Retrospective case study
Dillon et al. 2006 ⁷¹	Retrospective case study
Fine and Staren 2006 ⁷²	Enrolled patients with benign masses
Fitzal et al. 2006 ⁷³	Did not address Key Question 1
Gebauer et al. 2006 ⁷⁴	Less than 50% of enrolled patients completed the study
Ghate et al. 2006 ⁷⁵	Did not verify benign diagnoses
Govindarajulu et al. 2006 ⁷⁶	Enrolled patients with malignant masses
Hanley and Kessaram 2006 ⁷⁷	Enrolled patients with malignant masses
Hoffmann 2006 ⁷⁸	Did not address Key Question 1
Huo et al. 2006 ⁷⁹	Retrospective case study
Jackman and Rodriguez-Soto 2006 ⁸⁰	Did not address Key Question 1
Jensen et al. 2006 ⁸¹	Fine-needle aspiration results were used in decisions about verification of results
Kamer et al. 2006 ⁸²	Fewer than 10 patients enrolled
Killebrew and Oneson 2006 ⁸³	Did not verify benign diagnoses
Koskela et al. 2006 ⁸⁴	Did not report sufficient data to address Key Question 1
Lam et al. 2006 ⁸⁵	Retrospective case study
Lannin et al. 2006 ⁸⁶	Did not address Key Question 1
Lieberman et al. 2006 ⁸⁷	Retrospective case study
Lieske et al. 2006 ⁸⁸	Fine-needle aspiration results were used in decisions about verification of results
Lim et al. 2006 ⁸⁹	Retrospective case study
Lopez-Medina et al. 2006 ⁹⁰	Retrospective case study
Margenthaler et al. 2006 ⁹¹	Enrolled a high-risk population
Mercado et al. 2006 ⁹²	Retrospective case study
Newman et al. 2006 ⁹³	Enrolled patients with malignant masses
Orel et al. 2006 ⁹⁴	Enrolled a high-risk population
Perlet et al. 2006 ⁹⁵	Enrolled a high-risk population
Popiela et al. 2006 ⁹⁶	Less than 50% of enrolled patients completed the study
Renshaw et al. 2006 ⁹⁷	Retrospective case study
Renshaw et al. 2006 ⁹⁸	Retrospective case study
Senn et al. 2006 ⁹⁹	Did not verify benign diagnoses

Table 2. Studies that did not meet the inclusion criteria for key question 1 (continued)

Study	Primary Reason for Exclusion
Shin et al. 2006 ¹⁰⁰	Did not address Key Question 1
Sie et al. 2006 ¹⁰¹	Retrospective case study
Uriburu et al. 2006 ¹⁰²	Did not address Key Question 1
Valdes et al. 2006 ¹⁰³	Retrospective case study
Vargas et al. 2006 ¹⁰⁴	Did not address Key Question 1
Viehweg et al. 2006 ¹⁰⁵	Enrolled a high-risk population
Wu et al. 2006 ¹⁰⁶	Less than 50% of enrolled patients completed the study
Yazici et al. 2006 ¹⁰⁷	Did not address Key Question 1
Altomare et al. 2005 ¹⁰⁸	Did not verify benign diagnoses
Badoual et al. 2005 ¹⁰⁹	Enrolled patients with malignant masses
Bonifacino et al. 2005 ¹¹⁰	Fine-needle aspiration results were used in decisions about verification of results
Brem et al. 2005 ¹¹¹	Retrospective case study
Caines et al. 2005 ¹¹²	Did not address Key Question 1
Cho et al. 2005 ¹¹³	Unresolvable multiple discrepancies in reported data
Costantini et al. 2005 ¹¹⁴	Did not verify benign diagnoses
Diebold et al. 2005 ¹¹⁵	Did not report sufficient data to address Key Question 1
Doridot et al. 2005 ¹¹⁶	Used a core-needle instrument that is no longer commercially available
Doyle et al. 2005 ¹¹⁷	Did not address Key Question 1
Elsheikh et al. 2005 ¹¹⁸	Retrospective case study
Gambos et al. 2005 ¹¹⁹	Retrospective case study
Grady et al. 2005 ¹²⁰	Retrospective case study
Hanna et al. 2005 ¹²¹	Used a core-needle instrument that is no longer commercially available
Homesh et al. 2005 ¹²²	Fine-needle aspiration results were used in decisions about verification of results
Lehman et al. 2005 ¹²³	Did not verify benign diagnoses
Monticciolo 2005 ¹²⁴	Enrolled patients with malignant masses
Pilgrim and Ravichandran 2005 ¹²⁵	Fine-needle aspiration results were used in decisions about verification of results
Qazi and Mohayuddin 2005 ¹²⁶	Fine-needle aspiration results were used in decisions about verification of results
Riedl et al. 2005 ¹²⁷	Did not address Key Question 1
Rulli et al. 2005 ¹²⁸	Used a core-needle instrument that is no longer commercially available
Satchithananda et al. 2005 ¹²⁹	Did not address Key Question 1
Schneider et al. 2005 ¹³⁰	Used a core-needle instrument that is no longer commercially available
Soo et al. 2005 ¹³¹	Did not address Key Question 1

Table 2. Studies that did not meet the inclusion criteria for key question 1 (continued)

Study	Primary Reason for Exclusion
Wahner-Roedler et al. 2005 ¹³²	Fewer than 10 patients enrolled
Wiratkapun et al. 2005 ¹³³	Retrospective case study
Wong et al. 2005 ¹³⁴	Did not verify benign diagnoses
You et al. 2005 ¹³⁵	Retrospective case study
Zuiani et al. 2005 ¹³⁶	Retrospective case study
Agoff et al. 2004 ¹³⁷	Retrospective case study
Arpino et al. 2004 ¹³⁸	Retrospective case study
Carmon et al. 2004 ¹³⁹	Did not address Key Question 1
Chagpar et al. 2004 ¹⁴⁰	Enrolled patients with malignant masses
Chen et al. 2004 ¹⁴¹	Did not verify benign diagnoses
Collins et al. 2004 ¹⁴²	Did not address Key Question 1
Docktor et al. 2004 ¹⁴³	Did not address Key Question 1
Foster et al. 2004 ¹⁴⁴	Retrospective case study
Gan et al. 2004 ¹⁴⁵	Did not address Key Question 1
Geller et al. 2004 ¹⁴⁶	Did not address Key Question 1
Gendler et al. 2004 ¹⁴⁷	Retrospective case study
Georgina-Smith et al. 2004 ¹⁴⁸	Retrospective case study
Golshan et al. 2004 ¹⁴⁹	Enrolled patients with malignant masses
Golub et al. 2004 ¹⁵⁰	Did not address Key Question 1
Hansen et al. 2004 ¹⁵¹	Did not address Key Question 1
Hoorntje et al. 2004 ¹⁵²	Did not address Key Question 1
Hoorntje et al. 2004 ¹⁵³	Did not address Key Question 1
Ivan et al. 2004 ¹⁵⁴	Retrospective case study
Margolin et al. 2004 ¹⁵⁵	Did not address Key Question 1
Mendez et al. 2004 ¹⁵⁶	Did not confirm benign diagnoses
O'Leary et al. 2004 ¹⁵⁷	Did not address Key Question 1
Peters-Engl et al. 2004 ¹⁵⁸	Enrolled patients with malignant masses
Piana et al. 2004 ¹⁵⁹	Enrolled patients with malignant masses
Pijnappel et al. 2004 ¹⁶⁰	Enrolled a high-risk population
Renshaw 2004 ¹⁶¹	Did not address Key Question 1
Renshaw et al. 2004 ¹⁶²	Retrospective case study
Rotenberg et al. 2004 ¹⁶³	Did not confirm benign diagnoses
Agarwal et al. 2003 ¹⁶⁴	Enrolled patients with malignant masses
Baez et al. 2003 ¹⁶⁵	Enrolled patients with benign masses
Bauer et al. 2003 ¹⁶⁶	Retrospective case study

Table 2. Studies that did not meet the inclusion criteria for key question 1 (continued)

Study	Primary Reason for Exclusion
Berg et al. 2003 ¹⁶⁷	Retrospective case study
Bonnett et al. 2003 ¹⁶⁸	Retrospective case study
Brenner et al. 2003 ¹⁶⁹	Retrospective case study
Carder and Liston 2003 ¹⁷⁰	Enrolled patients with a benign mass
Cawson et al. 2003 ¹⁷¹	Retrospective case study
Charles et al. 2003 ¹⁷²	Enrolled patients with a malignant mass
Chen et al. 2003 ¹⁷³	Did not report sufficient data to address Key Question 1
Corn 2003 ¹⁷⁴	Used a core-needle instrument that is no longer commercially available
Crisi et al. 2003 ¹⁷⁵	Retrospective case study
Crowe et al. 2003 ¹⁷⁶	Did not verify benign diagnoses
Dennison et al. 2003 ¹⁷⁷	Fine-needle aspiration results were used in decisions about verification of results
Dmytrasz et al. 2003 ¹⁷⁸	Retrospective case study
Farshid and Rush 2003 ¹⁷⁹	Fine-needle aspiration results were used in decisions about verification of results
Fine et al. 2003 ¹⁸⁰	Enrolled patients with benign masses
Fures et al. 2003 ¹⁸¹	Did not verify benign diagnoses
Harris et al. 2003 ¹⁸²	Enrolled patients with a malignant mass
Hoorntje et al. 2003 ¹⁸³	Retrospective case study
Jackman and Marzoni 2003 ¹⁸⁴	Did not address Key Question 1
Kneeshaw et al. 2003 ¹⁸⁵	Retrospective case study
Komenaka et al. 2003 ¹⁸⁶	Retrospective case study
Lee et al. 2003 ¹⁸⁷	Enrolled patients with malignant masses
Leifland et al. 2003 ¹⁸⁸	Fine-needle aspiration results were used in decisions about verification of results
Leifland et al. 2003 ¹⁸⁹	Fine-needle aspiration results were used in decisions about verification of results
Liberman et al. 2003 ¹⁹⁰	Enrolled a high-risk population
Mariotti et al. 2003 ¹⁹¹	Did not verify benign diagnoses
Masood et al. 2003 ¹⁹²	Retrospective case study
Middleton et al. 2003 ¹⁹³	Retrospective case study
Miller et al. 2003 ¹⁹⁴	Retrospective case study
Puglisi et al. 2003 ¹⁹⁵	Retrospective case study
Shah et al. 2003 ¹⁹⁶	Retrospective case study
Sneige et al. 2003 ¹⁹⁷	Retrospective case study
Sperber et al. 2003 ¹⁹⁸	Enrolled patients with benign masses

Table 2. Studies that did not meet the inclusion criteria for key question 1 (continued)

Study	Primary Reason for Exclusion
Tsang et al. 2003 ¹⁹⁹	Used a core-needle instrument that is no longer commercially available
Verkooijen et al. 2003 ²⁰⁰	Did not address Key Question 1
Winchester et al. 2003 ²⁰¹	Retrospective case study
Witt et al. 2003 ²⁰²	Did not address Key Question 1
Yeh et al. 2003 ²⁰³	Retrospective case study
Zhao et al. 2003 ²⁰⁴	Retrospective case study
Acheson et al. 2002 ²⁰⁵	Retrospective case study
Bonnett et al. 2002 ²⁰⁶	Retrospective case study
Chen et al. 2002 ²⁰⁷	Enrolled patients with recurrent breast cancer
Chun and Velanovich et al. 2002 ²⁰⁸	Did not address Key Question 1
Fine et al. 2002 ²⁰⁹	Enrolled patients with benign masses
Gal-Gombos et al. 2002 ²¹⁰	Retrospective case study
Giardina et al. 2002 ²¹¹	Did not verify benign diagnoses
Haj et al. 2002 ²¹²	Used a core-needle instrument that is no longer commercially available
Harvey et al. 2002 ²¹³	Retrospective case study
Hoorntje et al. 2002 ²¹⁴	Did not verify benign diagnoses
Hui et al. 2002 ²¹⁵	Did not address Key Question 1
Insausti et al. 2002 ²¹⁶	Used a core-needle instrument that is no longer commercially available
Jackman et al. 2002 ²¹⁷	Retrospective case study
Jan et al. 2002 ²¹⁸	Fine-needle aspiration results were used in decisions about verification of results
Knight et al. 2002 ²¹⁹	Did not address Key Question 1
Lieberman et al. 2002 ²²⁰	Did not address Key Question 1
Lifrange et al. 2002 ²²¹	Used a core-needle instrument that is no longer commercially available
Mainiero et al. 2002 ²²²	Did not address Key Question 1
McKee et al. 2002 ²²³	Did not address Key Question 1
Perlet et al. 2002 ²²⁴	Not published in English
Pijnappel et al. 2002 ²²⁵	Enrolled a high-risk population
Popiela et al. 2002 ²²⁶	Did not verify benign diagnoses
Rao et al. 2002 ²²⁷	Retrospective case study
Renshaw 2002 ²²⁸	Retrospective case study
Renshaw et al. 2002 ²²⁹	Retrospective case study
Rosen et al. 2002 ²³⁰	Retrospective case study
Schneider et al. 2002 ²³¹	Enrolled a high-risk population
Shin and Rosen 2002 ²³²	Retrospective case study

Table 2. Studies that did not meet the inclusion criteria for key question 1 (continued)

Study	Primary Reason for Exclusion
Smyczek-Gargya et al. 2002 ²³³	Did not verify benign diagnoses
Soo et al. 2002 ²³⁴	Did not verify benign diagnoses
Tan et al. 2002 ²³⁵	Fine-needle aspiration results were used in decisions about verification of results
Tse et al. 2002 ²³⁶	Retrospective case study
Verkooijen and Peeters 2002 ²³⁷	Enrolled a high-risk population
Verkooijen et al. 2002 ²³⁸	Did not address Key Question 1
Watermann et al. 2002 ²³⁹	Used a core-needle instrument that is no longer commercially available
Wunderbaldinger et al. 2002 ²⁴⁰	Enrolled patients with malignant masses
Bagnall et al. 2001 ²⁴¹	Enrolled patients with malignant masses
Berg et al. 2001 ²⁴²	Enrolled a high-risk population
Berg et al. 2001 ²⁴³	Retrospective case study
Brem et al. 2001 ²⁴⁴	Did not verify benign diagnoses
Chao et al. 2001 ²⁴⁵	Not published in English
Clarke et al. 2001 ²⁴⁶	Fine-needle aspiration results were used in decisions about verification of results
Daniel et al. 2001 ²⁴⁷	Did not verify benign diagnoses
Deurloo et al. 2001 ²⁴⁸	Did not address Key Question 1
Ely et al. 2001 ²⁴⁹	Retrospective case study
Fine et al. 2001 ²⁵⁰	Did not address Key Question 1
Grimes et al. 2001 ²⁵¹	Did not address Key Question 1
Hung et al. 2001 ²⁵²	Fine-needle aspiration results were used in decisions about verification of results
Ibrahim et al. 2001 ²⁵³	Fine-needle aspiration results were used in decisions about verification of results
Jackman et al. 2001 ²⁵⁴	Retrospective case study
Jacobs et al. 2001 ²⁵⁵	Core-needle biopsies were performed with a device that is no longer commercially available
Joshi et al. 2001 ²⁵⁶	Did not verify benign diagnoses
Kaufman et al. 2001 ²⁵⁷	Did not address Key Question 1
King et al. 2001 ²⁵⁸	Did not address Key Question 1
Kuhl et al. 2001 ²⁵⁹	Enrolled high-risk patients
Lieberman et al. 2001 ²⁶⁰	Did not address Key Question 1
Lieberman et al. 2001 ²⁶¹	Did not address Key Question 1
Lifrange et al. 2001 ²⁶²	Used a core-needle instrument that is no longer commercially available
Maganini et al. 2001 ²⁶³	Retrospective case study
Marti et al. 2001 ²⁶⁴	Used a core-needle instrument that is no longer commercially available

Table 2. Studies that did not meet the inclusion criteria for key question 1 (continued)

Study	Primary Reason for Exclusion
Meloni et al. 2001 ²⁶⁵	Fine-needle aspiration results were used in decisions about verification of results
Mendez et al. 2001 ²⁶⁶	Retrospective case study
Mercado et al. 2001 ²⁶⁷	Retrospective case study
Morrow et al. 2001 ²⁶⁸	Did not address Key Question 1
O'Driscoll et al. 2001 ²⁶⁹	Fewer than 10 patients enrolled
Parker et al. 2001 ²⁷⁰	Less than 50% of enrolled patients completed the study
Parker et al. 2001 ²⁷¹	Did not address Key Question 1
Renshaw 2001 ²⁷²	Retrospective case study
Renshaw et al. 2001 ²⁷³	Retrospective case study
Saarenmaa et al. 2001 ²⁷⁴	Enrolled patients with malignant masses
Schneider et al. 2001 ²⁷⁵	Did not verify benign diagnoses
Schoonjans and Brem 2001 ²⁷⁶	Less than 50% of enrolled patients completed the study
Shannon et al. 2001 ²⁷⁷	Fine-needle aspiration results were used in decisions about verification of results
Sklair-Levy et al. 2001 ²⁷⁸	Retrospective case study
Smith et al. 2001 ²⁷⁹	Enrolled patients at high risk
Sun et al. 2001 ²⁸⁰	Fine-needle aspiration results were used in decisions about verification of results
Verkooijen et al. 2001 ²⁸¹	Did not address Key Question 1
Westenend et al. 2001 ²⁸²	Fine-needle aspiration results were used in decisions about verification of results
Adrales et al. 2000 ²⁸³	Did not verify benign diagnoses
Bagnall et al. 2000 ²⁸⁴	Enrolled patients with malignant masses
Burns et al. 2000 ²⁸⁵	Did not verify benign diagnoses
Darling et al. 2000 ²⁸⁶	Retrospective case study
Cangiarella et al. 2000 ²⁸⁷	Fine-needle aspiration results were used in decisions about verification of results
Cangiarella et al. 2000 ²⁸⁸	Did not address Key Question 1
Gukas et al. 2000 ²⁸⁹	Less than 50% of enrolled patients completed the study
Hatada et al. 2000 ²⁹⁰	Fine-needle aspiration results were used in decisions about verification of results
Lamm et al. 2000 ²⁹¹	Did not address Key Question 1
Lee et al. 2000 ²⁹²	Retrospective case study
Liberman et al. 2000 ²⁹³	Retrospective case study
Melotti et al. 2000 ²⁹⁴	Did not address Key Question 1
Mok and Keepin 2000 ²⁹⁵	Enrolled a high-risk population

Table 2. Studies that did not meet the inclusion criteria for key question 1 (continued)

Study	Primary Reason for Exclusion
Moritz et al. 2000 ²⁹⁶	Did not address any of the Key Questions
Nisbet et al. 2000 ²⁹⁷	Did not verify diagnoses
O'hea and Tornos 2000 ²⁹⁸	Retrospective case study
Philpotts et al. 2000 ²⁹⁹	Retrospective case study
Philpotts et al. 2000 ³⁰⁰	Retrospective case study
Portincasa et al. 2000 ³⁰¹	Used a core-needle instrument that is no longer commercially available
Schwartzberg et al. 2000 ³⁰²	Used a core-needle instrument that is no longer commercially available
Simon et al. 2000 ³⁰³	Less than 50% of enrolled patients completed the study
Sneige and Tulbah 2000 ³⁰⁴	Did not address Key Question 1
Stolier et al. 2000 ³⁰⁵	Did not address Key Question 1
Teh et al. 2000 ³⁰⁶	Did not verify benign diagnoses
Whitlock et al. 2000 ³⁰⁷	Less than 50% of enrolled patients completed the study
Yang et al. 2000 ³⁰⁸	Used a core-needle instrument that is no longer commercially available
Al-Sobhi et al. 1999 ³⁰⁹	Did not address Key Question 1
Baker et al. 1999 ³¹⁰	Fewer than 10 patients enrolled
Bloomston et al. 1999 ³¹¹	Used a core-needle instrument that is no longer commercially available
Bokran et al. 1999 ³¹²	Retrospective case study
Brem et al. 1999 ³¹³	Retrospective case study
Britton and McCann 1999 ³¹⁴	Did not address Key Question 1
Damascelli et al. 1999 ³¹⁵	Used a core-needle instrument that is no longer commercially available
Deschryver et al. 1999 ³¹⁶	Retrospective case study
Diaz et al. 1999 ³¹⁷	Did not address Key Question 1
DiPiro et al. 1999 ³¹⁸	Retrospective case study
El-Tamer et al. 1999 ³¹⁹	Enrolled patients with malignant masses
Evans et al. 1999 ³²⁰	Did not verify benign diagnoses
Ferzli et al. 1999 ³²¹	Used a core-needle instrument that is no longer commercially available
Fraser et al. 1999 ³²²	Fine-needle aspiration results were used in decisions about verification of results
Gajdos et al. 1999 ³²³	Did not address Key Question 1
Gentry and Henry 1999 ³²⁴	Did not address Key Question 1
Gray et al. 1999 ³²⁵	Did not address Key Question 1
Harlow et al. 1999 ³²⁶	Did not address Key Question 1
Harvey et al. 1999 ³²⁷	Retrospective case study
Johnson et al. 1999 ³²⁸	Retrospective case study
Klem et al. 1999 ³²⁹	Did not verify benign diagnoses

Table 2. Studies that did not meet the inclusion criteria for key question 1 (continued)

Study	Primary Reason for Exclusion
LaRaja et al. 1999 ³³⁰	Used a core-needle instrument that is no longer commercially available
Lee et al. 1999 ³²⁸	Enrolled patients with benign masses
Lieberman et al. 1999 ³³¹	Retrospective case study
Lieberman et al. 1999 ³³²	Retrospective case study
Lieberman et al. 1999 ³³³	Did not address Key Question 1
Matthews and Williams 1999 ³³⁴	Used a core-needle instrument that is no longer commercially available
Mitnick et al. 1999 ³³⁵	Retrospective case study
Philpotts et al. 1999 ³³⁶	Did not address Key Question 1
Rebner et al. 1999 ³³⁷	Used a core-needle instrument that is no longer commercially available
Rich et al. 1999 ³³⁸	Did not verify benign diagnoses
Rosen et al. 1999 ³³⁹	Retrospective case study
Roth et al. 1999 ³⁴⁰	Enrolled patients with malignant masses
Sharifi et al. 1999 ³⁴¹	Did not address Key Question 1
Sheth et al. 1999 ³⁴²	Used a core-needle instrument that is no longer commercially available
Shin et al. 1999 ³⁴³	The results of fine-needle aspiration were used to decide who underwent core-needle biopsy
Staren et al. 1999 ³⁴⁴	Fine-needle aspiration results were used in decisions about verification of results
Tran et al. 1999 ³⁴⁵	Does not address any of the Key Questions
Velanovich et al. 1999 ³⁴⁶	Did not verify benign diagnoses
Williams et al. 1999 ³⁴⁷	Did not verify benign diagnoses
Won et al. 1999 ³⁴⁸	Retrospective case study
Yong et al. 1999 ³⁴⁹	Fine-needle aspiration results were used in decisions about verification of results
Andreu et al. 1998 ³⁵⁰	Fine-needle aspiration results were used in decisions about verification of results
Antley et al. 1998 ³⁵¹	Did not report sufficient data to address Key Question 1
Bleznak et al. 1998 ³⁵²	Did not address Key Question 1
Damascelli et al. 1998 ³⁵³	Used a core-needle instrument that is no longer commercially available
Doyle et al. 1998 ³⁵⁴	Fine-needle aspiration results were used in decisions about verification of results
Goodman et al. 1998 ³⁵⁵	Did not address Key Question 1
Helbich et al. 1998 ³⁵⁶	Did not address Key Question 1
Jackman et al. 1998 ³⁵⁷	Enrolled patients with benign masses
Johnson et al. 1998 ³⁵⁸	Did not verify benign diagnoses
Kaufman et al. 1998 ³⁵⁹	Did not address Key Question 1
Kelley et al. 1998 ³⁶⁰	Used a core-needle instrument that is no longer commercially available

Table 2. Studies that did not meet the inclusion criteria for key question 1 (continued)

Study	Primary Reason for Exclusion
King et al. 1998 ³⁶¹	Retrospective case study
Lieberman et al. 1998 ³⁶²	Enrolled patients with malignant masses
Lieberman et al. 1998 ³⁶³	Did not address Key Question 1
Lin et al. 1998 ³⁶⁴	Retrospective case study
Lind et al. 1998 ³⁶⁵	Enrolled patients with benign masses
Meyer et al. 1998 ³⁶⁶	Enrolled patients with benign masses
Mitnick et al. 1998 ³⁶⁷	Retrospective case study
Seoudi et al. 1998 ³⁶⁸	Did not verify benign diagnoses
Slanetz et al. 1998 ³⁶⁹	Did not address Key Question 1
Soo et al. 1998 ³⁷⁰	Fewer than 10 patients enrolled
Woodcock et al. 1998 ³⁷¹	Did not verify benign diagnoses
Zardawi 1998 ³⁷²	Did not verify benign diagnoses
Zonderland et al. 1998 ³⁷³	Fine-needle aspiration results were used in decisions about verification of results
Acheson et a. 1997 ³⁷⁴	Less than 50% of enrolled patients completed the study
Anania et al. 1997 ³⁷⁵	Did not address Key Question 1
Burbank 1997 ³⁷⁶	Retrospective case study
Burbank 1997 ³⁷⁷	Did not address Key Question 1
Burbank 1997 ³⁷⁸	Enrolled patients with benign masses
Cerwenka et al. 1997 ³⁷⁹	Did not verify benign diagnoses
D'Angelo et al. 1997 ³⁸⁰	Used a core-needle instrument that is no longer commercially available
Devia et al. 1997 ³⁸¹	Did not address Key Question 1
Fenoglio et al. 1997 ³⁸²	Did not address Key Question 1
Ferzli et al. 1997 ³⁸³	Used a core-needle instrument that is no longer commercially available
Florentine et al. 1997 ³⁸⁴	Fine-needle aspiration results were used in decisions about verification of results
Gadzala et al. 1997 ³⁸⁵	Retrospective case study
Hirst and Davis 1997 ³⁸⁶	Did not verify benign diagnoses
Howisey et al. 1997 ³⁸⁷	Did not address Key Question 1
Jackman and Marzoni 1997 ³⁸⁸	Did not address Key Question 1
Jackman et al. 1997 ³⁸⁹	Retrospective case study
Lieberman et al. 1997 ³⁹⁰	Did not address Key Question 1
Lieberman et al. 1997 ³⁹¹	Did not address Key Question 1
Lifrange et al. 1997 ³⁹²	Fine-needle aspiration results were used in decisions about verification of results
Meyer et al. 1997 ³⁹³	Did not address Key Question 1

Table 2. Studies that did not meet the inclusion criteria for key question 1 (continued)

Study	Primary Reason for Exclusion
Pijnappel et al. 1997 ³⁹⁴	Fine-needle aspiration results were used in decisions about verification of results
Roe et al. 1997 ³⁹⁵	Did not report sufficient data to address Key Question 1
Smith et al. 1997 ³⁹⁶	Did not address Key Question 1
Stolier et al. 1997 ³⁹⁷	Did not address Key Question 1
Whitten et al. 1997 ³⁹⁸	Did not address Key Question 1
Written et al. 1997 ³⁹⁹	Did not address Key Question 1
Ballo and Sneige 1996 ⁴⁰⁰	Fine-needle aspiration results were used in decisions about verification of results
Burbank et al. 1996 ⁴⁰¹	Did not address Key Question 1
Caines et al. 1996 ⁴⁰²	Did not verify benign diagnoses
Chare et al. 1996 ⁴⁰³	Fine-needle aspiration results were used in decisions about verification of results
Crotch-Harvey and Loughran 1996 ⁴⁰⁴	Fine-needle aspiration results were used in decisions about verification of results
Dershaw et al. 1996 ⁴⁰⁵	Did not address Key Question 1
Di et al. 1996 ⁴⁰⁶	Enrolled patients with malignant masses
Frayne et al. 1996 ⁴⁰⁷	Fine-needle aspiration results were used in decisions about verification of results
Handy et al. 1996 ⁴⁰⁸	Did not address Key Question 1
Hillhouse et al. 1996 ⁴⁰⁹	Did not address Key Question 1
Hunter et al. 1996 ⁴¹⁰	Did not address Key Question 1
Lieberman et al. 1996 ⁴¹¹	Did not address Key Question 1
Pillsbury et al. 1996 ⁴¹²	Did not verify benign diagnoses
Poole et al. 1996 ⁴¹³	Fine-needle aspiration results were used in decisions about verification of results
Taft et al. 1996 ⁴¹⁴	Did not verify benign diagnoses
Tocino et al. 1996 ⁴¹⁵	Retrospective case study
Wallace et al. 1996 ⁴¹⁶	Did not verify benign diagnoses
Yim et al. 1996 ⁴¹⁷	Did not address Key Question 1
Hann et al. 1995 ⁴¹⁸	Did not address Key Question 1
Israel and Fine 1995 ⁴¹⁹	Did not verify benign diagnoses
Lieberman et al. 1995 ⁴²⁰	Retrospective case study
Lieberman et al. 1995 ⁴²¹	Retrospective case study
Lieberman et al. 1995 ⁴²²	Enrolled patients with recurrent breast cancer
McCombs et al. 1995 ⁴²³	Did not verify benign diagnoses
Nath et al. 1995 ⁴²⁴	Fewer than 10 patients enrolled

Table 2. Studies that did not meet the inclusion criteria for key question 1 (continued)

Study	Primary Reason for Exclusion
Rubin et al. 1995 ⁴²⁵	Did not address Key Question 1
Strong et al. 1995 ⁴²⁶	Did not verify benign diagnoses
Vega et al. 1995 ⁴²⁷	Enrolled high-risk patients
Vega et al. 1995 ⁴²⁸	Did not verify benign diagnoses
Youngson et al. 1995 ⁴²⁹	Did not address Key Question 1
Caines et al. 1994 ⁴³⁰	Did not verify benign diagnoses
Jackman et al. 1994 ⁴³¹	Did not verify benign diagnoses
Janes and Bouton 1994 ⁴³²	Did not verify benign diagnoses
Kaye et al. 1994 ⁴³³	Did not address Key Question 1
Lieberman et al. 1994 ⁴³⁴	Did not address Key Question 1
Lieberman et al. 1994 ⁴³⁵	Did not address Key Question 1
Mikhail et al. 1994 ⁴³⁶	Enrolled a high-risk population
Morrow et al. 1994 ⁴³⁷	Did not verify benign diagnoses
Sadler et al. 1994 ⁴³⁸	Fine-needle aspiration results were used in decisions about verification of results
Youngson et al. 1994 ⁴³⁹	Did not address Key Question 1
Rotten et al. 1993 ⁴⁴⁰	Fine-needle aspiration results were used in decisions about verification of results
Dronkers 1992 ⁴⁴¹	Did not verify benign diagnoses
Elliot et al. 1992 ⁴⁴²	Did not verify benign diagnoses
Harter et al. 1992 ⁴⁴³	Fewer than 10 patients enrolled
Pezner et al. 1992 ⁴⁴⁴	Did not address any of the Key Questions
Khanna et al. 1991 ⁴⁴⁵	Fine-needle aspiration results were used in decisions about verification of results

Appendix D. Data abstraction forms

Quality Assessment

- Was patient recruitment either consecutive or random?
- Were the patient inclusion/ exclusion criteria consistently applied to all patients?
- Was the study free from obvious spectrum bias? Obvious spectrum bias was defined as more than 40% or less than 10% of the breast lesions were diagnosed as malignant; and/or the mean or median age of the enrolled population was less than 50 or greater than 70.
- Was the study prospective in design?
- Was a complete set of data reported for at least 85% of enrolled lesions?
- Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?
- Were patients assessed by a reference standard regardless of the biopsy results?
- Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?
- Did the study account for inter-reader/score differences?
- Were the reader(s) of the biopsies blinded to the results of the reference standard?
- Were readers of the reference standard blinded to the results of the biopsy?
- Were the readers of the biopsy blinded to all other clinical information?
- Were readers of the reference standard blinded to all other clinical information?

Study Design

- Design of study
- Study was prospective or retrospective?
- Number of centers
- Care setting
- Country study conducted in
- Study funded by
- How many different people performed core-needle biopsies during the course of the study?
- What is the training of the persons performing the core-needle biopsies?
- What is the experience of the persons performing the core-needle biopsies?
- Describe in detail the methods used to perform the biopsies
- Who is interpreting the biopsy specimens, and what kind of training do they have?
- Biopsy results confirmed by comparing them to what?
- Describe in detail the reference standard

Patient Details

- Describe the inclusion criteria
- Describe the exclusion criteria
- Number of patients recruited/approached about enrollment
- Number of patients and lesions enrolled
- Number of lesions completing the study
- Age, median or mean, range
- Other reported age descriptors such as % post-menopausal
- Ethnicity
- Types of lesions enrolled and number of each

Accuracy Data

- Enter the type of biopsy being used for the following set of data
- How many lesions were biopsied?
- How many technical failures/ inadequate biopsies occurred?
- How many were lost to followup?
- How many lesions were diagnosed as benign and what was the final diagnosis for each
- How many lesions were diagnosed as invasive and what was the final diagnosis for each
- How many lesions were diagnosed as DCIS and what was the final diagnosis for each
- How many lesions were diagnosed as Atypical, Suspicious, or High Risk, and what was the final diagnosis for each
- Where there any other diagnoses on core-needle biopsy and if so what were they and what was the final diagnosis for each
- Enter information about accuracy by lesion characteristics
- Enter information about accuracy by patient characteristics
- Enter information about accuracy by biopsy methodology characteristics
- Enter any other reported information affected biopsy accuracy

Harms Data

- Requirement for a repeated biopsy procedure, rate
- Complications of the biopsy procedure, types and rates of
- Time to recovery or time to return to work
- Use of pain medications
- Patient satisfaction, quality of life data
- Impact of biopsy procedure on accuracy of subsequent mammography procedures
- Any other harms info reported by the study

Appendix E. Evidence tables

Table 3. Previously published systematic reviews: design

Study	Search Dates	Types of Biopsy Evaluated	Types of Breast Abnormalities Evaluated	Reference Standard Required	Other Inclusion Criteria	Method of Rating the Quality	Statistical Methods
Fahrbach et al. 2006 ⁴⁴⁶	1996 to June 2004	Stereotactic vacuum-assisted core-needle biopsy and stereotactic core-needle biopsy	All-comer populations referred after screening mammography	Surgical biopsy or patient followup	English language; ten or more patients; conducted in North America, Europe, Australia, or New Zealand; reported absolute numbers of each lesion type on biopsy; studies of devices no longer on the market- SiteSelect, MIBB device, ABBI device- were excluded	Narrative discussion, no overall rating given	Random-effects models in SAS and SPSS, multivariate regression models
Verkooyen et al. 2000 ⁴⁴⁷	1975 to May 1999	Large-core needle biopsy under stereotactic or ultrasound guidance	Non-palpable lesions detected on mammography	Surgical biopsy or a minimum of 2 years of followup in at least 90% of patients	The absolute number of benign and malignant lesions had to be derivable; a minimum of five large-core biopsy specimens per lesion had to be obtained; studies of fine-needle aspiration were excluded.	Not rated	Pooled by meta-analysis using SPSS. No further details provided.

Table 4. Previously published systematic reviews: quality rating

Study	Was an 'a priori' design provided?	Was there duplicate study selection and data extraction?	Was a comprehensive literature search performed?	Was the status of publication (i.e., grey literature) used as an inclusion criterion?	Was a list of studies (included/excluded) provided?	Were the characteristics of the included studies provided?	Was the scientific quality of the included studies used appropriately in formulating conclusions?	Was the quality of the studies assessed and documented?	Were the methods used to combine the finding of studies appropriate?	Was the likelihood of publication bias assessed?	Was the conflict of interest stated?	Quality Rating
Fahrbach et al. 2006 ⁴⁴⁶	Can't tell	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	No	Moderate
Verkooijen et al. 2000 ⁴⁴⁷	Can't tell	Yes	Yes	Yes	Yes	No	No	No	Can't tell	No	No	Moderate

Table 5. Previously published systematic reviews: results

Study	N Studies	N Patients	Accuracy	Accuracy Affected by Patient Type/ Breast Abnormality Types	Accuracy Affected by Procedure-related Factors	Accuracy Affected by Personnel/ Facility Factors	Harms	Conclusion
Fahrbach et al. 2006 ⁴⁴⁶	12 of vacuum assisted biopsy and 25 of core-needle biopsy	11,355 patients, 5,119 with vacuum assisted biopsy and 6,236 patients with automated gun core-needle biopsy	Overall agreement between vacuum-assisted and reference standard was 97.3%; overall agreement between core-needle and reference standard was 93.5%. Rate of benign lesions turning out to be malignant: vacuum-assisted: 2.02% (95% CI: 0.00 to 4.35), core-needle: 2.36% (95% CI: 1.15 to 3.58). Rate of atypia lesions turning out to be malignant: vacuum-assisted: 20.38% (15.25 to 25.52), core-needle: 36.69% (26.53 to 46.84)	For atypia to malignant upgrades the type of procedure was a significant predictor, with more underestimations occurring with core-needle as compared to vacuum-assisted	Reference standard and patient position did not influence accuracy	For benign to malignant upgrades, more benign to malignant upgrades occurred in non-North American locations than in North American locations	Frequency of technical failures: 5.7% for core-needle, 1.5% for vacuum-assisted	Vacuum-assisted biopsy may provide lower miss and underestimation rates than automated gun core-needle biopsy.

Table5. Previously published systematic reviews: results (continued)

Study	N Studies	N Patients	Accuracy	Accuracy Affected by Patient Type/ Breast Abnormality Types	Accuracy Affected by Procedure-related Factors	Accuracy Affected by Personnel/ Facility Factors	Harms	Conclusion
Verkooijen et al. 2000 ⁴⁴⁷	5	865 biopsies performed	DCIS on needle biopsy upgraded to invasive cancer: 15% (95% CI: 8.0 to 26); ADH on needle biopsy upgraded to invasive cancer: 40% (95% CI: 26 to 56); sensitivity of core-needle for detecting malignancies: 97% (95% CI: 95 to 99)	Not performed	Not performed	Not performed	2 complications reported: 1 hematoma 1 infection	In a setting such as the US where about 20% of cases referred for biopsy are malignant, the risk of breast cancer despite a benign diagnosis on core-needle biopsy is less than 1%. However, in a setting such as Europe where about 60% of cases referred for biopsy are malignant, the risk of breast cancer despite a benign diagnosis on core-needle biopsy is 4%.

Table 6. Studies included to address key question 1: design details

Study	Design of Study	Type of Study	Number of Centers	Care Setting	Country Conducted in	Funded by	Type(s) Core Biopsy	Core Biopsy Results Confirmed by	Number of Lesions Enrolled	Followup	% Attrition
Peters et al. 2008 ⁴⁴⁸	Single group (cohort or case series study)	Retrospective	4	General hospital	Netherlands	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	948	2 years	5%
Tonegutti and Girardi 2008 ⁴⁴⁹	Single group (cohort or case series study)	Retrospective	1	General hospital	Italy	NR	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	268	2 years	0%
Youk et al. 2008 ⁶	Single group (cohort or case series study)	Retrospective	1	General hospital	South Korea	NR	US guidance automated gun 14G	Combination of surgery and patient followup	4,359	2 years	44%
Ciatto et al. 2007 ⁴⁵⁰	Single group (cohort or case series study)	Retrospective	1	Dedicated breast cancer center	Italy	Funded in part by a National Health and Medical Research Council (NHMRC) grant	Multiple methods	Combination of surgery and patient followup	4,035	1 year	26%
de Lucena et al. 2007 ⁴⁵¹	Single group (cohort or case series study)	Prospective	1	General hospital	Brazil	NR	US guidance automated gun 14G	Open surgery or surgical biopsy only	150	Immediate surgery	0%
Uematsu et al. 2007 ⁴⁵²	Single group (cohort or case series study)	Prospective	1	General cancer center	Japan	NR	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	100	Mean: 26 months Range: 5 to 44 months	0%
Vag et al. 2007 ⁴⁵³	Single group (cohort or case series study)	Prospective	1	General hospital	Germany	NR	US guidance vacuum-assisted 10G	Combination of surgery and patient followup	70	2 years	0%
Chapellier et al. 2006 ⁴⁵⁴	Single group (cohort or case series study)	Prospective	1	General cancer center	France	NR	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	318	Range: 4 to 16 months	0%
Cipolla et al. 2006 ⁴⁵⁵	Single group (cohort or case series study)	NR	1	General hospital	Italy	NR	Multiple methods	Combination of surgery and patient followup	426	1 year	0%
Dhillon et al. 2006 ⁴⁵⁶	Single group (cohort or case series study)	Prospective	1	General hospital	UK	NR	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	150	Median: 48 months	0%
Bolivar et al. 2005 ⁴⁵⁷	Single group (cohort or case series study)	Prospective	1	General hospital	Spain	NR	US guidance automated gun 14G	Combination of surgery and patient followup	214	2 years	5%

Table 6. Studies included to address key question 1: design details (continued)

Study	Design of Study	Type of Study	Number of Centers	Care Setting	Country Conducted in	Funded by	Type(s) Core Biopsy	Core Biopsy Results Confirmed by	Number of Lesions Enrolled	Followup	% Attrition
Crystal et al. 2005 ⁴⁵⁸	Single group (cohort or case series study)	NR	1	General hospital	Israel	NR	US guidance automated gun 14G	Combination of surgery and patient followup	715	Median: 39 months Range: 27 to 60 months	0%
Dillon et al. 2005 ⁴⁵⁹	Single group (cohort or case series study)	Retrospective	1	General hospital	Ireland	NR	Multiple methods	Combination of surgery and patient followup	2,427	Median: 24 months Range: 3 to 67 months	19%
Koskela et al. 2005 ⁴⁶⁰	Single group (cohort or case series study)	Prospective	1	General hospital	Finland	Kuopio University Hospital (the center it was conducted in)	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	213	Mean: 24 months Range: 6 to 39 months	4%
Sauer et al. 2005 ⁴⁶¹	Single group (cohort or case series study)	Retrospective	1	General hospital	Germany	NR	US guidance automated gun 14G	Combination of surgery and patient followup	962	Mean: 22.2 months Median: 21 months Range : 8 to 36 months	13%
Weber et al. 2005 ⁴⁶²	Non-randomized multiple groups study	Prospective	1	General hospital	Switzerland	NR	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	225	Median: 2.1 years Range: 0.5 to 4.4 years	15%
Wu et al. 2005 ⁴⁶³	Single group (cohort or case series study)	NR	1	General hospital	Taiwan	NR	US guidance vacuum-assisted 11G	Combination of surgery and patient followup	113	1 year	0%
Alonso-Bartolome et al. 2004 ⁴⁶⁴	Single group (cohort or case series study)	Prospective	2	General hospital	Spain	NR	US guidance vacuum-assisted 11G	Combination of surgery and patient followup	102	6 to 12 months	0%
Delle and Terinde 2004 ⁴⁶⁵	Single group (cohort or case series study)	NR	1	General hospital	Germany	NR	US guidance automated gun 14G	Combination of surgery and patient followup	169	2 years	0%
Fajardo et al. 2004 ⁴⁶⁶	Some patients were randomized to stereotactic or US guidance but data were reported as if the study was a single-group cohort study	Prospective	22	Academic and community practice clinical sites	USA	National Cancer Institute	Multiple methods	Combination of surgery and patient followup	2,403	2 years	30%

Table 6. Studies included to address key question 1: design details (continued)

Study	Design of Study	Type of Study	Number of Centers	Care Setting	Country Conducted in	Funded by	Type(s) Core Biopsy	Core Biopsy Results Confirmed by	Number of Lesions Enrolled	Followup	% Attrition
Kettritz et al. 2004 ⁴⁶⁷	Single group (cohort or case series study)	Prospective	5	General hospital	Germany	NR	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	2,893	Mean: 25 months Range: 6 to 67 months	22%
Lomoschitz et al. 2004 ⁴⁶⁸	Non-randomized multiple groups study	Prospective	1	General hospital	Austria	One author partially supported by both Ethicon Edonsurgery and Biopsys Medical	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	100	2 years	0%
Abdsaleh et al. 2003 ⁴⁶⁹	Single group (cohort or case series study)	Prospective	1	General hospital	Sweden	NR	Multiple methods	Combination of surgery and patient followup	180	1 year	21%
Ambrogetti et al. 2003 ⁴⁷⁰	Single group (cohort or case series study)	Retrospective	1	General hospital	France	NR	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	364	Mean: 15.8 months Range: 6 to 36 months	35%
Fishman et al. 2003 ⁴⁷¹	Single group (cohort or case series study)	Prospective	1	General hospital	USA	NR	US guidance automated gun 14G	Combination of surgery and patient followup	73	Mammographic and US followup Median: 21 months Range: 4 to 30 months	33%
Han et al. 2003 ⁴⁷²	Single group (cohort or case series study)	Retrospective	1	General hospital	Korea	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	271	At least 6 months	27%
Kirshenbaum et al. 2003 ⁴⁷³	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	NR	Multiple methods	Combination of surgery and patient followup	506	Mean: 2.1 years Range: 3 months to five years	23%
March et al. 2003 ⁴⁷⁴	Single group (cohort or case series study)	Prospective	2	Dedicated breast cancer center	USA	RSNA Seed Grant and the Rays of Hope charitable fund	US guidance vacuum-assisted 11G	Combination of surgery and patient followup	34	6 months	9%
Pfleiderer et al. 2003 ⁴⁷⁵	Single group (cohort or case series study)	Prospective	1	General hospital	Germany	NR	MRI guidance automated gun 14G	Combination of surgery and patient followup	14	2 years	0%

Table 6. Studies included to address key question 1: design details (continued)

Study	Design of Study	Type of Study	Number of Centers	Care Setting	Country Conducted in	Funded by	Type(s) Core Biopsy	Core Biopsy Results Confirmed by	Number of Lesions Enrolled	Followup	% Attrition
Philpotts et al. 2003 ⁴⁷⁶	Non-randomized multiple groups study	Retrospective	1	General hospital	USA	NR	Multiple methods	Combination of surgery and patient followup	281	Mean: 19 months Range: 3 to 53 months for 14G Mean: 13 months Range: 1 to 24 for 11G	24%
Wong and Hisham 2003 ⁴⁷⁷	Single group (cohort or case series study)	Prospective	1	General hospital	Malaysia	NR	Freehand automated gun 14 or 16G	Combination of surgery and patient followup	150	Range: 6 to 13 months	0%
Apestequia et al. 2002 ⁴⁷⁸	Single group (cohort or case series study)	Prospective	1	General hospital	Spain	NR	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	132	1 year	0%
Georgian-Smith et al. 2002 ⁴⁷⁹	Single group (cohort or case series study)	Retrospective	4	General hospital	USA	NR	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	185	Range: 6 to 12 months	21%
Jackman and Lamm 2002 ⁴⁸⁰	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	Funded in part by Biopsys Medical	Multiple methods	Combination of surgery and patient followup	31	At least 6 months	0%
Johnson et al. 2002 ⁴⁸¹	Single group (cohort or case series study)	NR	1	General hospital	USA	Fashion Footwear of NY	US guidance vacuum-assisted 11 or 8G	Combination of surgery and patient followup	101	Mean: 9.5 months	24%
Liberman et al. 2002 ⁴⁸²	Single group (cohort or case series study)	Retrospective	1	General cancer senter	USA	NR	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	800	At least 1 year	29%
Meloni et al. 2002 ⁴⁸³	Single group (cohort or case series study)	Retrospective	1	General hospital	Italy	NR	Stereotactic guidance vacuum-assisted	Combination of surgery and patient followup	129	Mean: 18.7 months Range: 14 to 26 months	0%
Morris et al. 2002 ⁴⁸⁴	Single group (cohort or case series study)	Prospective	1	Dedicated breast cancer center	USA	NR	Stereotactic guidance vacuum-assisted 14G	Combination of surgery and patient followup	21	Median: 46 months Range: 40-54 months	10%
Pfarl et al. 2002 ⁴⁸⁵	Single group (cohort or case series study)	Retrospective	1	General hospital	Austria	NR	Stereotactic guidance vacuum-assisted 11G	Open surgery or surgical biopsy only	332	Immediate surgery	4%

Table 6. Studies included to address key question 1: design details (continued)

Study	Design of Study	Type of Study	Number of Centers	Care Setting	Country Conducted in	Funded by	Type(s) Core Biopsy	Core Biopsy Results Confirmed by	Number of Lesions Enrolled	Followup	% Attrition
Verkooijen et al. COBRA 2002 ⁴⁸⁶	Single group (cohort or case series study)	Prospective	5	General hospital	Netherlands	Dutch National Health Insurance Fund Council	Stereotactic guidance automated gun 14G	Open surgery or surgical biopsy only	984	Immediate surgery	11%
Becker et al. 2001 ⁴⁸⁷	Single group (cohort or case series study)	Retrospective	1	General hospital	Canada	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	232	Range: 6 to 12 months	27%
Brenner et al. 2001 ⁴⁸⁸	Single group (cohort or case series study)	Prospective	7	Cancer centers and hospitals	USA	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	1,003	Mean: 19.3 months Range: 0 to 36 months	1%
Cangiarella et al. 2001 ⁴⁸⁹	Single group (cohort or case series study)	NR	1	General hospital	USA	NR	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	160	Mean: 20.5 months Range: 6 to 35 months	38%
Dahlstrom and Jain 2001 ⁴⁹⁰	Single group (cohort or case series study)	NR	1	General hospital	Australia	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	301	Range: 2.4 to 7.5 years	0%
Lai et al. 2001 ⁴⁹¹	Single group (cohort or case series study)	NR	1	General hospital	Canada	NR	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	673	Mean: 6.7 months Range: 6 to 24 months	29%
Levin et al. 2001 ⁴⁹²	Single group (cohort or case series study)	Prospective	1	General hospital	Canada	Physician's Services Incorporated Foundation	Stereotactic guidance automated gun 14G	Open surgery or surgical biopsy only	70	Immediate surgery	0%
Margolin et al. 2001 ⁴⁹³	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	NR	Multiple methods	Combination of surgery and patient followup	1,333	Mean: 14 months Range: 6 to 24 months; missing data was collected from SEER database; at the time of accession of SEER data followup ranged from 15 to 75 months	3%

Table 6. Studies included to address key question 1: design details (continued)

Study	Design of Study	Type of Study	Number of Centers	Care Setting	Country Conducted in	Funded by	Type(s) Core Biopsy	Core Biopsy Results Confirmed by	Number of Lesions Enrolled	Followup	% Attrition
Perez-Fuentes et al. 2001 ⁴⁹⁴	Single group (cohort or case series study)	NR	1	Dedicated breast cancer center	Venezuela	NR	US guidance vacuum-assisted 11G	Combination of surgery and patient followup	88	Median: 11.1 months Range: 4 to 24 months	33%
Smith et al. 2001 ⁴⁹⁵	Single group (cohort or case series study)	NR	1	General hospital	USA	NR	US guidance automated gun 14G	Combination of surgery and patient followup	500	Mean: 22 months Median: 14 months Range: 12 to 60 months	21%
White et al. 2001 ⁴⁹⁶	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	NR	Multiple methods	Combination of surgery and patient followup	1,042	Median: 29 months, at least 1 year	29%
Wunderbaldinger et al. 2001 ⁴⁹⁷	Single group (cohort or case series study)	Prospective	1	General hospital	Austria	author supported by Erwin Schroedinger Auslandsstipenium of the Austrian Science Fund	US guidance automated gun 14G	Open surgery or surgical biopsy only	45	Immediate surgery	0%
Yeow et al. 2001 ⁴⁹⁸	Single group (cohort or case series study)	Prospective	1	General hospital	China	NR	US guidance automated gun 14 or 16G	Combination of surgery and patient followup	98	Mean: 4 years Range: 3 to 5 years	0%
Beck et al. 2000 ⁴⁹⁹	Single group (cohort or case series study)	NR	1	General hospital	Germany	NR	Stereotactic guidance vacuum-assisted 11G	Combination of surgery and patient followup	594	1 year	0%
Kirwan et al. 2000 ⁵⁰⁰	Single group (cohort or case series study)	Retrospective	1	General hospital	UK	NR	Stereotactic guidance automated gun 14G	Open surgery or surgical biopsy only	72	Immediate surgery	13%
Latosinsky et al. 2000 ⁵⁰¹	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	NIH grant	Multiple methods	Combination of surgery and patient followup	692	Median: 17.2 months Range: 2.8 to 43 months	42%
Liberman et al. 2000 ⁵⁰²	Single group (cohort or case series study)	Retrospective	1	General cancer center	USA	NR	Multiple methods	Combination of surgery and patient followup	155	Median: 53 months Range: 24 to 69 months	32%

Table 6. Studies included to address key question 1: design details (continued)

Study	Design of Study	Type of Study	Number of Centers	Care Setting	Country Conducted in	Funded by	Type(s) Core Biopsy	Core Biopsy Results Confirmed by	Number of Lesions Enrolled	Followup	% Attrition
Makoske et al. 2000 ⁵⁰³	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	NR	Multiple methods	Combination of surgery and patient followup	817	Mean: 1.7 years	30%
Ward et al. 2000 ⁵⁰⁴	Single group (cohort or case series study)	NR	1	General hospital	Canada	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	121	Mean: 16 months Range: 4 to 36 months	7%
Welle et al. 2000 ⁵⁰⁵	Single group (cohort or case series study)	Retrospective	3	General hospital	USA	NR	Multiple methods	Combination of surgery and patient followup	225	Range: 6 to 24 months	20%
Helbich et al. 1999 ⁵⁰⁶	Randomized controlled trial	Prospective	1	General hospital	Vienna	Ludwig-Boltzmann Institute for Radiologic Tumor Research; one author was supported by a grant from the Max Kade Foundation	Multiple methods	Open surgery or surgical biopsy only	44	Immediate surgery	0%
Jackman et al. 1999 ⁵⁰⁷	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	483	Median: 55 months	1%
Meyer et al. 1999 ⁵⁰⁸	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	NR	Multiple methods	Combination of surgery and patient followup	1,836	At least 1 year	25%
Puglisi et al. 1999 ⁵⁰⁹	Single group (cohort or case series study)	Retrospective	1	General hospital	Italy	NR	Perforated compression grid automated gun 14G	Combination of surgery and patient followup	106	At least 6 months	1%
Soo et al. 1999 ⁵¹⁰	Non-randomized multiple groups study	Retrospective	1	General hospital	USA	NR	Multiple methods	Combination of surgery and patient followup	116	Mean: 16 months Range: 5 to 31 months	19%
Caruso et al. 1998 ⁵¹¹	Single group (cohort or case series study)	Prospective	1	General hospital	Italy	NR	Multiple methods	Open surgery or surgical biopsy only	92	Immediate surgery	13%

Table 6. Studies included to address key question 1: design details (continued)

Study	Design of Study	Type of Study	Number of Centers	Care Setting	Country Conducted in	Funded by	Type(s) Core Biopsy	Core Biopsy Results Confirmed by	Number of Lesions Enrolled	Followup	% Attrition
Doyle et al. 1998 ⁵¹²	Single group (cohort or case series study)	Retrospective	1	Dedicated breast cancer center	New Zealand	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	151	Range: 6 to 36 months	11%
Fuhrman et al. 1998 ⁵¹³	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	NR	Multiple methods	Combination of surgery and patient followup	1,440	At least 6 months	18%
Heywang-Kobrunner et al. 1998 ⁵¹⁴	Single group (cohort or case series study)	NR	1	General hospital	Germany	NR	Stereotactic guidance vacuum-assisted 11 or 14G	Combination of surgery and patient followup	261	6 months	31%
Ioffe et al. 1998 ⁵¹⁵	Single group (cohort or case series study)	NR	1	General hospital	USA	NR	Multiple methods	Combination of surgery and patient followup	224	Range: 6 to 12 months	14%
Liberman et al. 1998 ⁵¹⁶	Single group (cohort or case series study)	NR	1	General cancer center	USA	NR	US guidance automated gun 14G	Combination of surgery and patient followup	151	Median: 20 months Range: 6 to 48 months	23%
Schulz-Wendtland et al. 1998 ⁵¹⁷	Single group (cohort or case series study)	NR	1	General hospital	Germany	NR	US guidance automated gun 14G	Combination of surgery and patient followup	307	2 years	0%
Vega-Bolivar et al. 1998 ⁵¹⁸	Single group (cohort or case series study)	Retrospective	1	General hospital	Spain	NR	Stereotactic guidance Surecut 15G	Combination of surgery and patient followup	182	Mean: 27 months Range: 6 to 47 months	6%
Whitman et al. 1998 ⁵¹⁹	Single group (cohort or case series study)	Retrospective	2	General hospital	USA	NR	Stereotactic guidance automated gun 16G	Open surgery or surgical biopsy only	12	Immediate surgery	0%
Zannis and AliaNo 1998 ⁵²⁰	Non-randomized multiple groups study	Retrospective	1	Ambulatory surgical center	USA	NR	Multiple methods	Combination of surgery and patient followup	424	At least 6 months	31%
Bauer et al. 1997 ⁵²¹	Single group (cohort or case series study)	Retrospective	NR	NR	USA	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	799	Mean: 9 months	0%

Table 6. Studies included to address key question 1: design details (continued)

Study	Design of Study	Type of Study	Number of Centers	Care Setting	Country Conducted in	Funded by	Type(s) Core Biopsy	Core Biopsy Results Confirmed by	Number of Lesions Enrolled	Followup	% Attrition
Britton et al. 1997 ⁵²²	Single group (cohort or case series study)	NR	1	General hospital	UK	NR	Multiple methods	Combination of surgery and patient followup	202	Mean: 20.1 months Range: 5.3 to 30.8 months	2%
Helbich et al. 1997 ⁵²³	Single group (cohort or case series study)	Prospective	1	General hospital	Vienna	NR	Multiple methods	Open surgery or surgical biopsy only	210	Immediate surgery	0%
Khattar et al. 1997 ⁵²⁴	Single group (cohort or case series study)	Prospective	1	General hospital	Denmark	NR	US guidance automated gun	Open surgery or surgical biopsy only	106	Immediate surgery	43%
Liberman et al. 1997 ⁵²⁵	Single group (cohort or case series study)	Retrospective	1	General cancer center	USA	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	442	Median: 18 months Range: 6 to 46 months	34%
Pitre et al. 1997 ⁵²⁶	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	NR	Stereotactic guidance automated gun	Combination of surgery and patient followup	128	1 year	8%
Stolier et al. 1997 ⁵²⁷	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	NR	Multiple methods	Combination of surgery and patient followup	244	Mean: 12.8 months Range: 6 to 39 months	NR
Sutton, et al. 1997 ⁵²⁸	Single group (cohort or case series study)	Retrospective	1	Screening clinic	Australia	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	206	1 year	32%
Walker et al. 1997 ⁵²⁹	Single group (cohort or case series study)	NR	1	General hospital	UK	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	200	Range: 6 to 36 months	10%
Frazeo et al. 1996 ⁵³⁰	Non-randomized multiple groups study	Prospective	1	General hospital	USA	NR	Stereotactic guidance automated gun	Combination of surgery and patient followup	103	At least 6 months	0%
Fuhrman et al. 1996 ⁵³¹	Single group (cohort or case series study)	NR	1	General hospital	USA	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	451	1 year	22%

Table 6. Studies included to address key question 1: design details (continued)

Study	Design of Study	Type of Study	Number of Centers	Care Setting	Country Conducted in	Funded by	Type(s) Core Biopsy	Core Biopsy Results Confirmed by	Number of Lesions Enrolled	Followup	% Attrition
Head and Haynes 1996 ⁵³²	Single group (cohort or case series study)	Prospective	1	Dedicated breast cancer center	USA	NR	Stereotactic guidance automated gun 18G	Combination of surgery and patient followup	115	2 years	8%
Mainiero et al. 1996 ⁵³³	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	138	At least 6 months	14%
Meyer et al. 1996 ⁵³⁴	Single group (cohort or case series study)	NR	1	General hospital	USA	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	388	1 year	30%
Nguyen et al. 1996 ⁵³⁵	Single group (cohort or case series study)	NR	1	General hospital	USA	American Cancer Society, UCLA Jonsson Comprehensive Cancer Center, and the Stein-Oppenheim Foundation	Multiple methods	Combination of surgery and patient followup	431	At least 6 months	10%
Pettine et al. 1996 ⁵³⁶	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	NR	Stereotactic guidance automated gun 14G	Open surgery or surgical biopsy only	25	6 month repeat mammography for benign	0%
Rosenblatt et al. 1996 ⁵³⁷	Single group (cohort or case series study)	Retrospective	1	General hospital	USA	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	25	1 year	16%
Scopa et al. 1996 ⁵³⁸	Non-randomized multiple groups study	NR	1	General hospital	Greece	NR	Freehand TruCut	Open surgery or surgical biopsy only	120	Immediate surgery	0%
Cross et al. 1995 ⁵³⁹	Single group (cohort or case series study)	NR	1	Dedicated breast cancer center	USA	NR	Stereotactic guidance automated gun 14G	Combination of surgery and patient followup	250	1 year	12%
Doyle et al. 1995 ⁵⁴⁰	Non-randomized multiple groups study	Prospective	1	General Hospital	USA	NR	Multiple methods	Combination of surgery and patient followup	150	Range: 6 to 24 months	3%

Table 6. Studies included to address key question 1: design details (continued)

Study	Design of Study	Type of Study	Number of Centers	Care Setting	Country Conducted in	Funded by	Type(s) Core Biopsy	Core Biopsy Results Confirmed by	Number of Lesions Enrolled	Followup	% Attrition
Hamed et al. 1995 ⁵⁴¹	Randomized controlled trial	Prospective	1	General hospital	United Kingdom	NR	Freehand Biopsy-cut	Open surgery or surgical biopsy only	122	Immediate surgery	0%
Burbank et al. 1994 ⁵⁴²	Non-randomized multiple groups study	NR	1	General hospital	USA	NR	Multiple methods	Combination of surgery and patient followup	105	At least 6 months	0%
Gisvold et al. 1994 ⁵⁴³	Single group (cohort or case series study)	Prospective	1	General hospital	USA	NR	Stereotactic guidance automated gun 14G	Open surgery or surgical biopsy only	160	Immediate surgery	0%
Parker et al. 1994 ⁵⁴⁴	Non-randomized multiple groups study	Retrospective	20	Various hospitals, breast care centers, clinics	USA	NR	Multiple methods	Combination of surgery and patient followup	6,152	At least 6 months	39%
Smyth and Cederbom 1994 ⁵⁴⁵	Single group (cohort or case series study)	NR	1	General hospital	USA	NR	Stereotactic guidance automated gun 14G	Open surgery or surgical biopsy only	58	Immediate surgery	0%
Elvecrog et al. 1993 ⁵⁴⁶	Non-randomized multiple groups study	Prospective	1	General hospital	USA	NR	Stereotactic guidance automated gun 14G	Open surgery or surgical biopsy only	100	Immediate surgery	0%
Parker et al. 1993 ⁵⁴⁷	Single group (cohort or case series study)	NR	1	Specialized imaging center	USA	NR	US guidance automated gun 14G	Combination of surgery and patient followup	181	Range: 12 to 36 months	0%
McMahon et al. 1992 ⁵⁴⁸	Randomized controlled trial	Prospective	1	General hospital	UK	NR	Multiple methods	Combination of surgery and patient followup	151	Median: 11 months Range: 1 to 24 months	0%
Hamed et al. 1991 ⁵⁴⁹	Single group (cohort or case series study)	NR	1	General hospital	UK	NR	Freehand automated gun 18G	Open surgery or surgical biopsy only	107	Immediate surgery	0%
Cusick et al. 1990 ⁵⁵⁰	Single group (cohort or case series study)	NR	1	General hospital	USA	NR	Freehand	Open surgery or surgical biopsy only	96	Immediate surgery	0%

Table 6. Studies included to address key question 1: design details (continued)

Study	Design of Study	Type of Study	Number of Centers	Care Setting	Country Conducted in	Funded by	Type(s) Core Biopsy	Core Biopsy Results Confirmed by	Number of Lesions Enrolled	Followup	% Attrition
Parker et al. 1990 ⁵⁵¹	Single group (cohort or case series study)	NR	1	General hospital	USA	NR	Stereotactic guidance automated gun	Open surgery or surgical biopsy only	103	Immediate surgery	0%

NR = Not Reported
 US = Ultrasound

Table 7. Quality of studies addressing key question 1

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/ exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Peters et al. 2008 ⁴⁴⁸	Yes	NR	Yes	No: over 40% malignant	No	Yes	No	Yes	NR	No	Yes	No	No	No	5	5.9
Tonegutti and Girardi 2008 ⁴⁴⁹	Yes	Yes	Yes	No: 41.6% malignant	No	Yes	No	Yes	NR	NR	NR	NR	NR	NR	5	5.9
Youk et al. 2008 ⁶	Yes	Yes	Yes	No: mean 45.3 years of age	No	No	No	Yes	NR	NR	Yes	No	No	No	5	5.9

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Ciatto et al. 2007 ⁴⁵⁰	Yes	Yes	Yes	NR	No	No	No	Yes	Yes	No	Yes	No	No	No	6	6.1
de Lucena et al. 2007 ⁴⁵¹	NR	NR	NR	No: 67% malignant	Yes	Yes	Yes	Yes	NR	NR	Yes	NR	NR	NR	5	5.9
Uematsu et al. 2007 ⁴⁵²	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	No	Yes	NR	NR	NR	8	6.4
Vag et al. 2007 ⁴⁵³	NR	NR	NR	No: 41.4% malignant	Yes	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	4	5.7

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Chapellier et al. 2006 ⁴⁵⁴	NR	NR	NR	Yes	Yes	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	5	5.9
Cipolla et al. 2006 ⁴⁵⁵	Yes	Yes	Yes	No: 43% malignant	NR	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	6	6.1
Dhillon et al. 2006 ⁴⁵⁶	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	8	6.4
Bolivar et al. 2005 ⁴⁵⁷	Yes	Yes	Yes	No: 58% malignant	Yes	Yes	No	Yes	NR	No	Yes	NR	NR	NR	7	6.3

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Crystal et al. 2005 ⁴⁵⁸	Yes	Yes	Yes	No: 45% malignant	NR	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	6	6.1
Dillon et al. 2005 ⁴⁵⁹	Yes	Yes	Yes	No: 57% malignant	No	No	No	Yes	NR	NR	Yes	No	No	No	5	5.9
Koskela et al. 2005 ⁴⁶⁰	Yes	Yes	Yes	No: 42% malignant	Yes	Yes	No	Yes	Yes	No	Yes	No	No	No	8	6.4
Sauer et al. 2005 ⁴⁶¹	Yes	Yes	Yes	No: 64.2% malignant	No	Yes	No	Yes	NR	No	Yes	No	No	No	6	6.1

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Weber et al. 2005 ⁴⁶²	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	NR	NR	NR	9	6.6
Wu et al. 2005 ⁴⁶³	Yes	Yes	Yes	No: 0% malignant	NR	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	6	6.1
Alonso-Bartolome et al. 2004 ⁴⁶⁴	NR	Yes	Yes	No: 0.9% malignant, mean age 42	Yes	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	6	6.1
Delle and Terinde 2004 ⁴⁶⁵	Yes	Yes	Yes	No: 77% malignant	NR	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	6	6.1

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Fajardo et al. 2004 ⁴⁶⁶	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	NR	NR	NR	10	6.8
Kettritz et al. 2004 ⁴⁶⁷	NR	NR	No	NR	Yes	No	No	Yes	NR	NR	Yes	NR	No	NR	3	5.5
Lomoschitz et al. 2004 ⁴⁶⁸	Yes	Yes	Yes	No: 47% malignant	Yes	Yes	No	Yes	No	No	NR	NR	NR	NR	6	6.1
Abdsaleh et al. 2003 ⁴⁶⁹	Yes	Yes	Yes	No: 74% malignant	Yes	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	7	6.3

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Ambrogetti et al. 2003 ⁴⁷⁰	Yes	Yes	Yes	No: 43.4% malignant	No	No	No	Yes	NR	NR	Yes	No	No	No	5	5.9
Fishman et al. 2003 ⁴⁷¹	Yes	Yes	No	NR	Yes	No	No	Yes	NR	No	Yes	NR	Yes	NR	6	6.1
Han et al. 2003 ⁴⁷²	Yes	Yes	Yes	No: mean age 47 years	No	No	No	Yes	NR	NR	NR	NR	NR	NR	4	5.7
Kirshenbaum et al. 2003 ⁴⁷³	Yes	Yes	Yes	Yes	No	No	No	Yes	NR	NR	Yes	No	No	No	6	6.1

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
March et al. 2003 ⁴⁷⁴	Yes	No: 67%	Yes	NR	Yes	Yes	No	Yes	Yes	No	Yes	No	No	No	7	6.3
Pfleiderer et al. 2003 ⁴⁷⁵	No	NR	Yes	No: 42% malignant	Yes	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	5	5.9
Philpotts et al. 2003 ⁴⁷⁶	Yes	Yes	Yes	NR	No	No	No	Yes	NR	NR	Yes	No	No	No	5	5.9
Wong and Hisham 2003 ⁴⁷⁷	Yes	Yes	Yes	No: 46% malignant	Yes	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	7	6.3

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Apestequia et al. 2002 ⁴⁷⁸	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	NR	NR	NR	NR	NR	7	6.3
Georgian-Smith et al. 2002 ⁴⁷⁹	Yes	Yes	Yes	Yes	No	Yes	No	Yes	NR	NR	Yes	No	No	No	7	6.3
Jackman and Lamm 2002 ⁴⁸⁰	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	NR	Yes	No	No	No	7	6.3
Johnson et al. 2002 ⁴⁸¹	Yes	Yes	Yes	No: 5% malignant	NR	No	No	Yes	Yes	NR	Yes	NR	NR	NR	6	6.1

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Liberman et al. 2002 ⁴⁸²	Yes	Yes	Yes	No	No	No	No	Yes	NR	NR	Yes	No	No	No	5	5.9
Meloni et al. 2002 ⁴⁸³	Yes	Yes	Yes	NR	Yes	Yes	No	Yes	NR	NR	Yes	No	No	No	7	6.3
Morris et al. 2002 ⁴⁸⁴	NR	NR	Yes	Yes	Yes	Yes	No	Yes	NR	No	Yes	NR	NR	NR	6	6.1
Pfarl et al. 2002 ⁴⁸⁵	Yes	Yes	Yes	No: 65% malignant	No	Yes	Yes	Yes	NR	NR	Yes	No	No	No	7	6.3

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Verkooijen et al. COBRA 2002 ⁴⁸⁶	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	NR	NR	9	6.6
Becker et al. 2001 ⁴⁸⁷	Yes	Yes	Yes	Yes	No	No	No	Yes	NR	NR	Yes	No	No	No	6	6.1
Brenner et al. 2001 ⁴⁸⁸	NR	NR	NR	NR	Yes	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	4	5.7
Cangiarella et al. 2001 ⁴⁸⁹	Yes	Yes	Yes	No: 9% malignant	NR	No	No	Yes	NR	NR	Yes	NR	NR	NR	5	5.9

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Dahlstrom and Jain 2001 ⁴⁹⁰	Yes	Yes	Yes	NR	NR	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	6	6.1
Lai et al. 2001 ⁴⁹¹	Yes	Yes	Yes	Yes	NR	No	No	Yes	NR	NR	Yes	NR	NR	NR	6	6.1
Levin et al. 2001 ⁴⁹²	NR	NR	Yes	NR	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	NR	NR	7	6.3
Margolin et al. 2001 ⁴⁹³	Yes	Yes	Yes	No: mean age less than 50	No	Yes	No	Yes	NR	NR	Yes	No	No	No	6	6.1

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Perez-Fuentes et al. 2001 ⁴⁹⁴	No	NR	No	No: mean age 48	NR	No	No	Yes	NR	NR	Yes	NR	NR	NR	2	5.4
Smith et al. 2001 ⁴⁹⁵	Yes	Yes	Yes	No: mean age 47	NR	No	No	Yes	NR	NR	Yes	NR	NR	NR	5	5.9
White et al. 2001 ⁴⁹⁶	Yes	Yes	Yes	Yes	No	No	No	Yes	NR	No	Yes	No	No	No	6	6.1
Wunderbaldinger et al. 2001 ⁴⁹⁷	No	NR	Yes	No: 49% malignant	Yes	Yes	Yes	Yes	Yes	No	No	No	NR	NR	6	6.1
Yeow et al. 2001 ⁴⁹⁸	Yes	Yes	Yes	No: mean age 46	Yes	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	7	6.3

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Beck et al. 2000 ⁴⁹⁹	Yes	Yes	Yes	NR	NR	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	6	6.1
Kirwan et al. 2000 ⁵⁰⁰	NR	NR	NR	NR	No	Yes	Yes	Yes	NR	NR	Yes	No	No	No	4	5.7
Latosinsky et al. 2000 ⁵⁰¹	Yes	Yes	Yes	NR	No	No	No	Yes	Yes	NR	NR	Yes	No	No	6	6.1
Liberman et al. 2000 ⁵⁰²	Yes	Yes	Yes	No: median age 47 years	No	No	No	Yes	NR	NR	Yes	No	No	No	5	5.9

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Makoske et al. 2000 ⁵⁰³	Yes	Yes	Yes	NR	Yes	No	No	Yes	NR	NR	Yes	No	No	No	6	6.1
Ward et al. 2000 ⁵⁰⁴	Yes	Yes	Yes	Yes	NR	Yes	No	Yes	NR	NR	Yes	No	No	No	7	6.3
Welle et al. 2000 ⁵⁰⁵	NR	NR	NR	NR	No	No	No	Yes	NR	NR	Yes	No	No	No	2	5.4
Helbich et al. 1999 ⁵⁰⁶	Yes	NR	Yes	No: 86% malignant	Yes	Yes	Yes	No	NR	No	Yes	NR	No	NR	6	6.1

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Jackman et al. 1999 ⁵⁰⁷	Yes	Yes	Yes	Yes	No	Yes	No	Yes	NR	Yes	No	No	No	No	6	6.1
Meyer et al. 1999 ⁵⁰⁸	Yes	Yes	Yes	Yes	No	No	No	Yes	NR	No	Yes	No	No	No	6	6.1
Puglisi et al. 1999 ⁵⁰⁹	Yes	Yes	Yes	Yes	No	Yes	No	Yes	NR	No	Yes	No	No	No	7	6.3
Soo et al. 1999 ⁵¹⁰	Yes	Yes	Yes	NR	No	No	No	Yes	NR	Yes	Yes	No	No	No	6	6.1

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Caruso et al. 1998 ⁵¹¹	Yes	NR	Yes	No: 85% malignant	Yes	Yes	Yes	Yes	NR	No	Yes	NR	No	NR	7	6.3
Doyle et al. 1998 ⁵¹²	Yes	Yes	Yes	NR	No	Yes	No	Yes	NR	No	Yes	No	No	No	6	6.1
Fuhrman et al. 1998 ⁵¹³	Yes	Yes	Yes	Yes	No	No	No	Yes	NR	No	Yes	No	No	No	6	6.1
Heywang-Kobrunner et al. 1998 ⁵¹⁴	Yes	Yes	Yes	NR	NR	No	No	Yes	NR	NR	Yes	NR	NR	NR	5	5.9

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Ioffe et al. 1998 ⁵¹⁵	Yes	NR	Yes	Yes	NR	NR	No	Yes	NR	NR	NR	NR	NR	NR	4	5.7
Liberman et al. 1998 ⁵¹⁶	Yes	Yes	Yes	Yes	NR	No	No	Yes	NR	NR	Yes	NR	NR	NR	6	6.1
Schulz-Wendtland et al. 1998 ⁵¹⁷	Yes	Yes	Yes	No: 52% malignant	NR	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	6	6.1
Vega-Bolivar et al. 1998 ⁵¹⁸	Yes	NR	Yes	No: over 40% were malignant	No	Yes	No	Yes	NR	No	Yes	No	No	No	5	5.9

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Whitman et al. 1998 ⁵¹⁹	NR	Yes	NR	No: 50% malignant	No	Yes	No	Yes	NR	NR	NR	NR	NR	NR	3	5.5
Zannis and AliaNo 1998 ⁵²⁰	Yes	Yes	Yes	Yes	No	Yes	No	Yes	NR	NR	Yes	No	No	No	7	6.3
Bauer et al. 1997 ⁵²¹	Yes	Yes	Yes	Yes	No	Yes	No	Yes	NR	Yes	Yes	No	No	No	7	6.3
Britton et al. 1997 ⁵²²	Yes	Yes	Yes	No: 50% malignant	NR	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	6	6.1

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Helbich et al. 1997 ⁵²³	Yes	Yes	Yes	No: 47% malignant	Yes	Yes	Yes	Yes	NR	No	Yes	No	NR	NR	8	6.4
Khattar et al. 1997 ⁵²⁴	NR	NR	Yes	No: 44% malignant	Yes	No	Yes	Yes	NR	NR	Yes	NR	NR	NR	5	5.9
Liberman et al. 1997 ⁵²⁵	Yes	NR	Yes	NR	No	No	No	Yes	NR	NR	Yes	No	No	No	4	5.7
Pitre et al. 1997 ⁵²⁶	Yes	Yes	Yes	No: 8.6% malignant	No	Yes	No	Yes	NR	NR	Yes	No	No	No	6	6.1

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Stolier et al. 1997 ⁵²⁷	Yes	Yes	Yes	NR	No	Yes	No	Yes	NR	NR	Yes	No	No	No	6	6.1
Sutton, et al. 1997 ⁵²⁸	NR	NR	No	Yes	No	No	No	Yes	NR	NR	Yes	No	No	No	3	5.5
Walker et al. 1997 ⁵²⁹	Yes	Yes	Yes	No: 54% malignant	NR	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	6	6.1
Fraze et al. 1996 ⁵³⁰	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	NR	NR	NR	NR	NR	7	6.3

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Fuhrman et al. 1996 ⁵³¹	NR	Yes	Yes	NR	NR	No	No	Yes	NR	NR	NR	NR	NR	NR	3	5.5
Head and Haynes 1996 ⁵³²	NR	NR	NR	Yes	Yes	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	5	5.9
Mainiero et al. 1996 ⁵³³	NR	Yes	Yes	Yes	No	Yes	No	Yes	NR	NR	NR	NR	NR	NR	5	5.9
Meyer et al. 1996 ⁵³⁴	Yes	No: 67.7%	Yes	No: median age 49	NR	No	No	Yes	NR	NR	NR	NR	NR	NR	3	5.5

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Nguyen et al. 1996 ⁵³⁵	NR	NR	Yes	No: 43% malignant	NR	Yes	No	Yes	Yes	NR	Yes	NR	NR	NR	5	5.9
Pettine et al. 1996 ⁵³⁶	NR	Yes	Yes	NR	No	Yes	Yes	NR	NR	NR	NR	NR	NR	NR	4	5.7
Rosenblatt et al. 1996 ⁵³⁷	Yes	Yes	Yes	No: 52% malignant	No	No	No	Yes	NR	NR	Yes	No	No	No	5	5.9
Scopa et al. 1996 ⁵³⁸	NR	Yes	Yes	No: 65% malignant	NR	Yes	Yes	Yes	NR	NR	NR	NR	NR	NR	5	5.9

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Cross et al. 1995 ⁵³⁹	NR	NR	NR	Yes	NR	Yes	No	Yes	NR	NR	Yes	No	No	No	4	5.7
Doyle et al. 1995 ⁵⁴⁰	Yes	Yes	Yes	Yes	Yes	No	No	Yes	NR	NR	NR	NR	NR	NR	6	6.1
Hamed et al. 1995 ⁵⁴¹	Yes	Yes	Yes	No: 88% malignant	Yes	Yes	No	No	NR	NR	NR	NR	NR	NR	5	5.9
Burbank et al. 1994 ⁵⁴²	NR	Yes	NR	NR	NR	Yes	No	Yes	NR	NR	NR	NR	NR	NR	3	5.5

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Gisvold et al. 1994 ⁵⁴³	Yes	No: 33.6%	No	No: 42% malignant	Yes	Yes	Yes	Yes	NR	No	Yes	NR	NR	NR	6	6.1
Parker et al. 1994 ⁵⁴⁴	NR	NR	Yes	NR	No	No	No	Yes	NR	NR	No	No	NR	NR	2	5.4
Smyth and Cederbom 1994 ⁵⁴⁵	NR	NR	NR	Yes	NR	Yes	Yes	No	NR	No	No	No	NR	NR	3	5.5
Elvecrog et al. 1993 ⁵⁴⁶	Yes	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	NR	NR	NR	NR	NR	8	6.4

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Parker et al. 1993 ⁵⁴⁷	Yes	Yes	Yes	NR	NR	Yes	No	Yes	NR	NR	Yes	NR	NR	NR	6	6.1
McMahon et al. 1992 ⁵⁴⁸	Yes	Yes	Yes	NR	Yes	Yes	No	Yes	NR	No	Yes	NR	NR	NR	7	6.3
Hamed et al. 1991 ⁵⁴⁹	NR	NR	Yes	No: 90% malignant	NR	Yes	Yes	Yes	NR	NR	Yes	NR	NR	NR	5	5.9
Cusick et al. 1990 ⁵⁵⁰	NR	Yes	Yes	No: 81.3% malignant	NR	Yes	Yes	No	NR	NR	NR	NR	NR	NR	4	5.7

Table 7. Quality of studies addressing key question 1 (continued)

Study	Was patient recruitment either consecutive or random?	Were more than 85% of the patients who were approached for recruitment enrolled in the study?	Were the patient inclusion/exclusion criteria consistently applied to all patients?	Was the study free from obvious spectrum bias?	Was the study prospective in design?	Was a complete set of data reported for at least 85% of enrolled lesions?	Were the patients assessed by the gold standard (open surgical procedure) regardless of the initial biopsy results?	Were patients assessed by a reference standard regardless of the biopsy results?	Was funding for this study provided by a source that doesn't have an obvious financial interest in the findings of the study?	Did the study account for inter-reader/score differences?	Where the reader(s) of the biopsies blinded to the results of the reference standard?	Were readers of the reference standard (patient followup, open surgical procedure) blinded to the results of the biopsy?	Were the readers of the biopsy blinded to all other clinical information (such as mammography results, patient history, other imaging study results)?	Were readers of the reference standard (patient followup, open surgical procedures) blinded to all other clinical information (such as mammography results, patient history, results of other imaging studies)?	Raw Score	Standardize
Parker et al. 1990 ⁵⁵¹	Yes	No	Yes	NR	NR	Yes	Yes	No	NR	NR	NR	NR	NR	NR	4	5.7

NR = Not Reported

Table 8. Details of the core-needle biopsies performed in the studies addressing key question 1

Study	Number of Different People Performing Biopsies	Training of Persons Performing Biopsies	Experience of Persons Performing Biopsies	Method of Imaging Guidance	Patient Position	Biopsy Device	Number of Cores
Peters et al. 2008 ⁴⁴⁸	NR	NR	NR	Stereotactic	Prone	Biopsy automated gun 14G	5 to 8
Tonegutti and Girardi 2008 ⁴⁴⁹	1	Radiologists	Short training period with 30 patients	Stereotactic	Prone	Mammotome 11G	20
Youk et al. 2008 ⁶	9	Radiologists	7 had fellowship training, 2 had extensive clinical experience in breast imaging and biopsy	US	Supine	Pro-Mag automated gun, 14G	Mean: 5.4 cores Range: 3 to 8
Ciatto et al. 2007 ⁴⁵⁰	13	Radiologists	NR	US or stereotactic guidance	NR	Automated gun 14G or Mammotome 11G	2 to 4
de Lucena et al. 2007 ⁴⁵¹	1	NR	NR	US	NR	Pro-Mag automated gun 14G	6
Uematsu et al. 2007 ⁴⁵²	1	Radiologists	1 year of prior experience with the procedure	Stereotactic	Prone	Mammotome 11G	NR
Vag et al. 2007 ⁴⁵³	NR	Radiologists	reports the device is new and they are trying it out, but the radiologist was highly experienced in breast interventions	US	NR	VACORA 10G	NR
Chapellier et al. 2006 ⁴⁵⁴	NR	Radiologists	Device was newly acquired at start of the study	Stereotactic	NR	Mammotome	NR
Cipolla et al. 2006 ⁴⁵⁵	NR	NR	NR	Stereotactic or US	NR	14G needle	Mean: 3 Range: 2 to 5
Dhillon et al. 2006 ⁴⁵⁶	NR	NR	NR	Stereotactic	Prone	Mammotome 11G	Mean: 12 Range: 6 to 18

Table 8. Details of the core-needle biopsies performed in the studies addressing key question 1 (continued)

Study	Number of Different People Performing Biopsies	Training of Persons Performing Biopsies	Experience of Persons Performing Biopsies	Method of Imaging Guidance	Patient Position	Biopsy Device	Number of Cores
Bolivar et al. 2005 ⁴⁵⁷	NR	NR	NR	US	Supine	Automated gun 14G	Mean: 3.5 cores Range: 1 to 7
Crystal et al. 2005 ⁴⁵⁸	NR	NR	NR	US	NR	Biopty automated gun 14G	Median: 4 cores Range: 1 to 8
Dillon et al. 2005 ⁴⁵⁹	NR	NR	NR	US or stereotactic guidance or freehand	Supine or seated	Automated 14G or 16G needles	NR
Koskela et al. 2005 ⁴⁶⁰	5	Radiologists	4 to 6 years of experience	Stereotactic	Seated	Biopty automated gun 14G	Mean: 7 cores Range: 4 to 15
Sauer et al. 2005 ⁴⁶¹	3	NR	Undergone dedicated training in the biopsy method	US	NR	Biopty automated gun 14G	Mean: 2
Weber et al. 2005 ⁴⁶²	NR	Surgeons	5 month training period with the device before the study commenced	Stereotactic	Prone	Mammotome 11G	NR
Wu et al. 2005 ⁴⁶³	1	Surgeons	Reported to be "skilled"	US	NR	Mammotome 11G	NR
Alonso-Bartolome et al. 2004 ⁴⁶⁴	NR	NR	NR	US	Supine	NR	NR
Delle and Terinde 2004 ⁴⁶⁵	NR	NR	NR	US	NR	Automated gun	Median: 2 Range: 1 to 4
Fajardo et al. 2004 ⁴⁶⁶	NR	Radiologists	Radiologists at each participating site performed at least 50 procedures before enrolling patients into the trial	Stereotactic	NR	14G needle	Minimum: 5

Table 8. Details of the core-needle biopsies performed in the studies addressing key question 1 (continued)

Study	Number of Different People Performing Biopsies	Training of Persons Performing Biopsies	Experience of Persons Performing Biopsies	Method of Imaging Guidance	Patient Position	Biopsy Device	Number of Cores
Kettritz et al. 2004 ⁴⁶⁷	NR	Radiologists	NR	Stereotactic	Prone	Mammotome 11G	At least 20 or remove entire lesion
Lomoschitz et al. 2004 ⁴⁶⁸	4	Radiologists	Two were highly experienced with the procedure, two were not	Stereotactic	Prone	Mammotome 11G	20
Abdsaleh et al. 2003 ⁴⁶⁹	1	Radiologists	NR	Stereotactic or US	NR	Semi-automated 14G	NR
Ambrogetti et al. 2003 ⁴⁷⁰	1	NR	NR	Stereotactic	Prone	NR	Mean: 10.2 Range: 4 to 25
Fishman et al. 2003 ⁴⁷¹	1	Radiologists	Person performing procedure was a resident supervised by an attending radiologist	US	NR	Bard automated gun 14G	5
Han et al. 2003 ⁴⁷²	2	Radiologists	NR	Stereotactic	Prone	Biopsy automated gun 14G	Mean: 7 Range: 5 to 20
Kirshenbaum et al. 2003 ⁴⁷³	3	Radiologists	NR	Stereotactic	72% seated	Bard automated gun 14G or Mammotome 11G	Bard gun Mean: 5.9 Range: 1 to 11 Mammotome Mean: 5.1 Range: 4 to 8
March et al. 2003 ⁴⁷⁴	3	Radiologists	Reports the procedure is not their usual practice	US	NR	Mammotome 11G	Mean: 29 Range: 10 to 70
Pfleiderer et al. 2003 ⁴⁷⁵	NR	NR	NR	MRI	Prone	Magnum automated gun 14G	Range: 3 to 6

Table 8. Details of the core-needle biopsies performed in the studies addressing key question 1 (continued)

Study	Number of Different People Performing Biopsies	Training of Persons Performing Biopsies	Experience of Persons Performing Biopsies	Method of Imaging Guidance	Patient Position	Biopsy Device	Number of Cores
Philpotts et al. 2003 ⁴⁷⁶	More than 5	Radiologists	Majority of the procedures appear to have been performed by fellows and residents under the supervision of 5 experienced breast radiologists	US	Supine	US Biopsy automated gun 14G or Mammotome 11G	Biopsy Mean: 4.7 Range: 1 to 17 Mammotome Mean: 5.8 Range: 1 to 12
Wong and Hisham 2003 ⁴⁷⁷	NR	NR	NR	Freehand	NR	Bard automated gun 14 or 16G	NR
Apesteguia et al. 2002 ⁴⁷⁸	NR	Radiologists	NR	Stereotactic	Prone	Mammotome 11G	Mean: 10.7 Range: 1 to 26
Georgian-Smith et al. 2002 ⁴⁷⁹	NR	Radiologists	NR	Stereotactic	Most seated	Mammotome 11G	Mean: 9.5 Range: 5 to 26
Jackman and Lamm 2002 ⁴⁸⁰	NR	Radiologists	NR	Stereotactic	Prone	Biopsy automated gun 14G or Mammotome 11G or 14G	Median 14 Range: 5 to 30
Johnson et al. 2002 ⁴⁸¹	NR	NR	No experience at the beginning of the study	US	Supine	Mammotome 11G or 8G	Attempt to completely remove lesion
Liberman et al. 2002 ⁴⁸²	NR	NR	NR	Stereotactic	Prone	Mammotome 11G	Median: 15 Range: 4 to 47
Meloni et al. 2002 ⁴⁸³	NR	NR	NR	Stereotactic	Seated	Vacuum-assisted	Mean: 12 Range: 3 to 14
Morris et al. 2002 ⁴⁸⁴	NR	NR	NR	Stereotactic	Prone	Mammotome 14G	NR

Table 8. Details of the core-needle biopsies performed in the studies addressing key question 1 (continued)

Study	Number of Different People Performing Biopsies	Training of Persons Performing Biopsies	Experience of Persons Performing Biopsies	Method of Imaging Guidance	Patient Position	Biopsy Device	Number of Cores
Pfarl et al. 2002 ⁴⁸⁵	More than 7	Radiologists	7 had an average of 2.6 (Range: 0 to 18) procedures before the study commenced; non specified number of residents in training had no experience before the study commenced	Stereotactic	Prone	Mammotome 11G	15 to 20
Verkooijen et al. COBRA 2002 ⁴⁸⁶	More than 5	Radiologists	radiologists first attended 10 biopsy procedures and subsequently they performed another 10 under the supervision of a radiologist with considerable experience	Stereotactic	Prone	Bard automated gun 14G	NR
Becker et al. 2001 ⁴⁸⁷	4	Radiologists	NR	Stereotactic	Seated	14G needle	NR
Brenner et al. 2001 ⁴⁸⁸	NR	NR	All took a two-day course	Stereotactic	Prone	Automated gun 14G	5 or more
Cangiarella et al. 2001 ⁴⁸⁹	NR	Radiologists	NR	Stereotactic	Prone	Mammotome 11G	Mean: 11 Range: 7 to 15
Dahlstrom and Jain 2001 ⁴⁹⁰	NR	NR	NR	Stereotactic	NR	Biopsy automated gun 14G	5
Lai et al. 2001 ⁴⁹¹	NR	NR	NR	Stereotactic	Prone	Mammotome 11G	Mean: 17.2
Levin et al. 2001 ⁴⁹²	3	Radiologists	Two of 3 radiologists had prior training in stereotactic core biopsy and attended a two-day course on use of the add-on unit; these two taught the third radiologist	Stereotactic	Seated	BIP automated gun 14G	5

Table 8. Details of the core-needle biopsies performed in the studies addressing key question 1 (continued)

Study	Number of Different People Performing Biopsies	Training of Persons Performing Biopsies	Experience of Persons Performing Biopsies	Method of Imaging Guidance	Patient Position	Biopsy Device	Number of Cores
Margolin et al. 2001 ⁴⁹³	3	Radiologists	NR	Stereotactic or US	Prone	Automated 14G, 16G, or 18G gun or Mammotome 11G or 14G	NR
Perez-Fuentes et al. 2001 ⁴⁹⁴	NR	NR	NR	US	Supine	Mammotome 11G	Median: 17 Range: 8 to 40
Smith et al. 2001 ⁴⁹⁵	NR	NR	NR	US	NR	Automated 14G gun	NR
White et al. 2001 ⁴⁹⁶	NR	Radiologists	NR	Stereotactic or US	Prone or supine	Automated 14G gun or Mammotome 11G or 14G	NR
Wunderbaldinger et al. 2001 ⁴⁹⁷	1	Radiologists	Performed 30 procedures on phantoms prior to the study	US	Seated	Magnum automated gun 14G	Mean: 6 Range: 3 to 10
Yeow et al. 2001 ⁴⁹⁸	1	Radiologists	NR	US	NR	Automated gun 14G or 16G	Mean: 3.4 Range: 1 to 7
Beck et al. 2000 ⁴⁹⁹	NR	NR	NR	Stereotactic	Prone	Mammotome 11G	NR
Kirwan et al. 2000 ⁵⁰⁰	NR	NR	NR	Stereotactic	Prone	Automated gun 14G	NR
Latosinsky et al. 2000 ⁵⁰¹	NR	NR	NR	Stereotactic or US	Prone for stereotactic	Automated gun or vacuum-assisted 14G	NR
Liberman et al. 2000 ⁵⁰²	NR	NR	NR	US or stereotactic	NR	Automated 14G gun	Median: 4 Range: 1 to 7
Makoske et al. 2000 ⁵⁰³	More than 1	Radiologists and surgeons	No experience in the procedure at the beginning of study; they were, however, trained and credentialed.	Stereotactic	NR	Automated gun or Mammotome	Minimum: 5

Table 8. Details of the core-needle biopsies performed in the studies addressing key question 1 (continued)

Study	Number of Different People Performing Biopsies	Training of Persons Performing Biopsies	Experience of Persons Performing Biopsies	Method of Imaging Guidance	Patient Position	Biopsy Device	Number of Cores
Ward et al. 2000 ⁵⁰⁴	2	Radiologists	Radiologists described as "specialize in breast imaging and diagnosis"	Stereotactic	NR	Bard automated gun 14G or 16G	Mean: 11 Range: 4 to 18
Welle et al. 2000 ⁵⁰⁵	NR	NR	NR	Stereotactic	Most decubitus	Bard automated gun 14G or Mammotome 11G	3 to 16
Helbich et al. 1999 ⁵⁰⁶	1	Radiologists	NR	Stereotactic	Seated	Patients randomized to various automated biopsy guns with different needle G	NR
Jackman et al. 1999 ⁵⁰⁷	NR	NR	NR	Stereotactic	Prone	Biopty automated gun 14G	Mean: 8.1 Range: 2 to 20
Meyer et al. 1999 ⁵⁰⁸	NR	NR	NR	Stereotactic	Prone	Automated gun 14G or Mammotome 11G or 14G	Mean: 5 to 8
Puglisi et al. 1999 ⁵⁰⁹	NR	NR	NR	Perforated compression grid	NR	Automated gun 14G	Median: 5
Soo et al. 1999 ⁵¹⁰	4	Radiologists	NR	Stereotactic	Prone	Magnum automated gun 14G or Mammotome 14G	Automated gun Mean: 5.8 Mammotome Mean: 15.8
Caruso et al. 1998 ⁵¹¹	1	Surgeons	Reports "experienced surgeon"	Freehand	NR	Trucut 18G	NR
Doyle et al. 1998 ⁵¹²	NR	NR	No experience with the procedure at the beginning of the study	Stereotactic	Decubitus	Pro-Mag automated gun 14G	NR
Fuhrman et al. 1998 ⁵¹³	3	Radiologists	reports " radiologists with expertise in breast imaging"	Stereotactic or US	Stereotactic prone, US supine	Automated gun 14G	At least 5
Heywang-Kobrunner et al. 1998 ⁵¹⁴	NR	NR	NR	Stereotactic	Prone	Mammotome 11G or 14G	NR

Table 8. Details of the core-needle biopsies performed in the studies addressing key question 1 (continued)

Study	Number of Different People Performing Biopsies	Training of Persons Performing Biopsies	Experience of Persons Performing Biopsies	Method of Imaging Guidance	Patient Position	Biopsy Device	Number of Cores
Ioffe et al. 1998 ⁵¹⁵	NR	NR	NR	Stereotactic or US	NR	Bard automated gun 14G	At least 5
Liberman et al. 1998 ⁵¹⁶	NR	NR	NR	US	Supine	Pro-Mag automated gun 14G	Median: 4 Range: 2 to 7
Schulz-Wendtland et al. 1998 ⁵¹⁷	NR	NR	NR	US	NR	14G needle	1 to 3
Vega-Bolivar et al. 1998 ⁵¹⁸	1	Radiologists	NR	Stereotactic	NR	Surecut 15G	At least 2
Whitman et al. 1998 ⁵¹⁹	NR	NR	NR	Stereotactic	NR	Monoptoy 16G	NR
Zannis and AliaNo 1998 ⁵²⁰	1	Surgeons	NR	Stereotactic	Prone	Trucut 14G or Mammotome 14G or 11G	Trucut Mean: 4.8 cores Range: 1 to 7 Mammotome at least 16
Bauer et al. 1997 ⁵²¹	NR	NR	NR	Stereotactic	Prone or seated	BIP automated gun 14G	Mean: 9 Range: 1 to 13
Britton et al. 1997 ⁵²²	4	Radiologists	NR	Stereotactic or US	Supine for US	Automated gun 14, 16, or 18G	Mean: 5
Helbich et al. 1997 ⁵²³	1	Radiologists	Described as an "expert"	Stereotactic or US	Prone or supine or seated	Automated gun 14G	NR
Khattar et al. 1997 ⁵²⁴	NR	Surgeons	NR	US	Supine	Pro-Mag automated gun	2 or 3
Liberman et al. 1997 ⁵²⁵	NR	NR	NR	Stereotactic	Prone	Biopty-cut 14G	Mean: 6 Range: 1 to 22
Pitre et al. 1997 ⁵²⁶	NR	NR	NR	Stereotactic	Prone	Pro-Mag automated gun	Mean: 5

Table 8. Details of the core-needle biopsies performed in the studies addressing key question 1 (continued)

Study	Number of Different People Performing Biopsies	Training of Persons Performing Biopsies	Experience of Persons Performing Biopsies	Method of Imaging Guidance	Patient Position	Biopsy Device	Number of Cores
Stolier et al. 1997 ⁵²⁷	1	Surgeons	No experience in the procedure at the beginning of study	Stereotactic	Prone	Automated gun 14G or Mammotome	Minimum: 5
Sutton, et al. 1997 ⁵²⁸	5	Radiologists	All involved radiologists have experience in mammography and interventional techniques in breast disease diagnosis	Stereotactic	Prone	Biopty automated gun 14G	NR
Walker et al. 1997 ⁵²⁹	NR	NR	NR	Stereotactic	NR	Automated gun 14G	Minimum: 5
Frazer et al. 1996 ⁵³⁰	NR	Radiologists	NR	Stereotactic	Prone	NR	Minimum: 5
Fuhrman et al. 1996 ⁵³¹	NR	NR	NR	Stereotactic	Prone	Automated gun 14G	Minimum: 5
Head and Haynes 1996 ⁵³²	NR	NR	NR	Stereotactic	Prone	Biopty automated gun 18G	NR
Mainiero et al. 1996 ⁵³³	NR	NR	NR	Stereotactic	Prone	Biopty automated gun 14G	NR
Meyer et al. 1996 ⁵³⁴	NR	Radiologists	NR	Stereotactic	Prone	Biopty automated gun 14G	NR
Nguyen et al. 1996 ⁵³⁵	NR	NR	NR	Stereotactic or US	Prone	Automated gun 14G	5 to 10
Pettine et al. 1996 ⁵³⁶	NR	NR	NR	Stereotactic	Prone	Biopty automated 14G gun	5 to 9
Rosenblatt et al. 1996 ⁵³⁷	NR	NR	NR	Stereotactic	Prone	Biopty automated gun 14G	NR
Scopa et al. 1996 ⁵³⁸	NR	NR	NR	Freehand	NR	TruCut	NR

Table 8. Details of the core-needle biopsies performed in the studies addressing key question 1 (continued)

Study	Number of Different People Performing Biopsies	Training of Persons Performing Biopsies	Experience of Persons Performing Biopsies	Method of Imaging Guidance	Patient Position	Biopsy Device	Number of Cores
Cross et al. 1995 ⁵³⁹	NR	NR	NR	Stereotactic	Prone	Bard automated gun 14G	Mean: 3.4 Range: 1 to 8
Doyle et al. 1995 ⁵⁴⁰	NR	NR	NR	Stereotactic or US	Prone	Automated gun 14G or 15G	NR
Hamed et al. 1995 ⁵⁴¹	NR	NR	NR	Freehand	NR	Biopty automated gun 14G or 18G	Mean: 3
Burbank et al. 1994 ⁵⁴²	NR	NR	NR	Stereotactic or US	NR	NR	NR
Gisvold et al. 1994 ⁵⁴³	7	Radiologists	All attended a training session before performing any procedures	Stereotactic	Prone	Biopty automated gun 14G	Minimum: 5
Parker et al. 1994 ⁵⁴⁴	NR	Radiologists	The radiologists participated in a two-day training session before the study commenced	Freehand	NR	Biopty automated gun 14G	NR
Smyth and Cederbom 1994 ⁵⁴⁵	NR	NR	NR	Stereotactic	Prone	Automated gun	NR
Elvecrog et al. 1993 ⁵⁴⁶	2	Radiologists	NR	Stereotactic	Prone	Biopty automated gun 14G	Minimum: 5
Parker et al. 1993 ⁵⁴⁷	NR	Radiologists	NR	US	Supine	Biopty automated gun 14G	4 to 5
McMahon et al. 1992 ⁵⁴⁸	More than 8	Surgeons	NR	Freehand	NR	Various 14 to 18G devices	1
Hamed et al. 1991 ⁵⁴⁹	NR	NR	No experience at the beginning of the study	Freehand	NR	Biopty automated gun 18G	1
Cusick et al. 1990 ⁵⁵⁰	NR	NR	NR	Freehand	NR	NR	NR

Table 8. Details of the core-needle biopsies performed in the studies addressing key question 1 (continued)

Study	Number of Different People Performing Biopsies	Training of Persons Performing Biopsies	Experience of Persons Performing Biopsies	Method of Imaging Guidance	Patient Position	Biopsy Device	Number of Cores
Parker et al. 1990 ⁵⁵¹	4	Radiologists	NR	Freehand	NR	Biopty automated gun 14, 16, or 18G	NR

NR = Not Reported

Table 9. Patient inclusion/exclusion criteria for studies addressing key question 1

Study	Patient Inclusion Criteria	Patient Exclusion Criteria
Peters et al. 2008 ⁴⁴⁸	All patients with nonpalpable lesions referred for core needle biopsy between February 2000 and June 2002	Coagulopathies or the use of anti-coagulants that could not be discontinued and an inability to stay in the prone position for one hour
Tonegutti and Girardi 2008 ⁴⁴⁹	Women with suspicious nonpalpable mammographic lesions (microcalcifications, mass with or without microcalcifications, architectural distortion) not recognisable by ultrasound	NR
Youk et al. 2008 ⁶	All patients undergoing US guided core needle biopsy between February 2000 and June 2005	NR
Ciatto et al. 2007 ⁴⁵⁰	All consecutive core needle biopsies performed at the study center between January 1996 and March 2005	NR
de Lucena et al. 2007 ⁴⁵¹	NR	NR
Uematsu et al. 2007 ⁴⁵²	Consecutive patients with mammographically detected microcalcifications BIRADS 3, 4, or 5 whose lesions were not visible on US	Unable to provide consent or undergo MRI imaging due to pacemaker, claustrophobia, or metallic clip; blood coagulation disorder; currently being treated with anti-coagulants; unable to cooperate with the biopsy procedure
Vag et al. 2007 ⁴⁵³	NR	NR
Chapellier et al. 2006 ⁴⁵⁴	Core-needle biopsies performed between January 2001 to November 2002	NR
Cipolla et al. 2006 ⁴⁵⁵	Consecutive patients undergoing core-needle biopsy at the center between September 1999 to February 2004	NR
Dhillon et al. 2006 ⁴⁵⁶	The first 150 consecutive patients who met these criteria: all indeterminate calcifications; distortions or masses not seen on US; a non-diagnostic biopsy on US; problem cases referred from other units	NR
Bolivar et al. 2005 ⁴⁵⁷	All patients with suspicious non-palpable breast lumps who underwent US guided biopsy between August 1997 to April 2001	NR
Crystal et al. 2005 ⁴⁵⁸	Patients with US visible solid breast lesions referred for biopsy between October 1, 1998 and September 1, 2001	Lesions that appeared to be radial scars were excluded
Dillon et al. 2005 ⁴⁵⁹	All women who underwent biopsy at the center between January 1999 to September 2003	NR

Table 9. Patient inclusion/exclusion criteria for studies addressing key question 1 (continued)

Study	Patient Inclusion Criteria	Patient Exclusion Criteria
Koskela et al. 2005 ⁴⁶⁰	Between June 1998 and January 2001, all patients with lesions not visible on US who were scheduled for core-needle stereotactic biopsy	Lesions located too high or too close to the chest wall such that it could not be reached by the stereotactic equipment
Sauer et al. 2005 ⁴⁶¹	All patients undergoing US biopsy of lesions detected on routine screening over a 28 month period	NR
Weber et al. 2005 ⁴⁶²	All patients between October 1999 to August 2003 with mammographically suspicious but nonpalpable lesions	Breast too small, lesion too close to the chest wall, lesion not evident on image
Wu et al. 2005 ⁴⁶³	Patients suspected of having benign lesions who underwent vacuum-assisted biopsy between July 2000 and July 2003	NR
Alonso-Bartolome et al. 2004 ⁴⁶⁴	Patients with "probably benign" lesions	NR
Delle and Terinde 2004 ⁴⁶⁵	Patients referred to the clinic because of palpable or non-palpable lesions or because of suspicion of cancer on mammography between September 2000 and September 2001	NR
Fajardo et al. 2004 ⁴⁶⁶	NR	Lesions located in prior lumpectomy or radiation therapy site, known bleeding disorder or anticoagulant therapy, pregnancy, allergy to local anesthesia, breast implants, psychiatric or neurologic conditions limiting patient's ability to cooperate during biopsy and/or provide informed consent
Kettritz et al. 2004 ⁴⁶⁷	NR	NR
Lomoschitz et al. 2004 ⁴⁶⁸	Consecutive women with solitary non-palpable lesions referred for 11G mammotome between February 1999 and July 2000, consecutive until 50 women with mammographic masses and 50 women with microcalcifications were enrolled	NR
Abdsaleh et al. 2003 ⁴⁶⁹	Consecutive patients between August 2000 and December 2001	NR
Ambrogetti et al. 2003 ⁴⁷⁰	Consecutive nonpalpable isolated microcalcifications detected in routine screening considered suspicious enough to warrant investigation between February 1999 and June 2002	NR
Fishman et al. 2003 ⁴⁷¹	Consecutive patients referred for an US guided biopsy over a 7 month period	Lesion turned out to be a cyst, pathological material was lost in one case, and in two cases ad hoc exclusion because the pathologist involved in the study had come to a different diagnosis than the "routine" pathology reading
Han et al. 2003 ⁴⁷²	Nonpalpable calcifications referred between April 1997- March 2002	NR

Table 9. Patient inclusion/exclusion criteria for studies addressing key question 1 (continued)

Study	Patient Inclusion Criteria	Patient Exclusion Criteria
Kirshenbaum et al. 2003 ⁴⁷³	All patients undergoing stereotactic core needle biopsy between October 1994 and February 2001 with nonpalpable lesions.	NR
March et al. 2003 ⁴⁷⁴	Patients referred to two outpatient centers between August 2000 and October 2001 for US guided biopsy of a single breast lesion well-visualized on US and located at least 0.5 cm from the skin and pectoralis margin and at least 2 cm from the nipple with the lesion measuring 1.2 cm or less in diameter	Lesion turned out to be a cyst
Pfleiderer et al. 2003 ⁴⁷⁵	Women were invited after an MRI exam that found lesions with suspicious contrast enhancement, reasons why they had the MRI exam not reported	Pregnancy or lactation, coagulation abnormalities, allergies to local anesthetics or MRI contrast agents, compressed breast thickness less than 25 mm
Philpotts et al. 2003 ⁴⁷⁶	All patients who underwent US guided biopsy between January 1997 and August 2001	NR
Wong and Hisham 2003 ⁴⁷⁷	Consecutive biopsies of palpable breast lesions from May 2000 to May 2001	Nonpalpable lesion, less than 6 months followup
Apesteguia et al. 2002 ⁴⁷⁸	All cases detected between April and December 1999 with suspicious non-palpable lesion which could not be reliably detected by US	NR
Georgian-Smith et al. 2002 ⁴⁷⁹	Consecutive patients between June 1999 and August 2000	NR
Jackman and Lamm 2002 ⁴⁸⁰	All patients who underwent core-needle biopsy between July 1991 and December 1999 who had breast implants	NR
Johnson et al. 2002 ⁴⁸¹	All patients with probably benign lesions scheduled for US guided mammotome excisional attempt between April 2000 to January 2002	NR
Liberman et al. 2002 ⁴⁸²	Consecutive lesions undergoing stereotactic biopsy between October 31, 1996 to March 8, 2001. Indications for biopsy were nonpalpable lesions suspicious of malignancy, calcifications or masses 0.5 cm or less or masses that could not be viewed on US	Bleeding diathesis, patient unable to cooperate, lesion could not be targeted
Meloni et al. 2002 ⁴⁸³	All cases of non-palpable mammographically detected lesions undergoing vacuum-assisted core needle biopsy at the center between December 1999 and November 2000	NR
Morris et al. 2002 ⁴⁸⁴	Twenty-one nonpalpable masses seen on mammography in 19 women who gave informed consent. The masses on mammography had no associated calcifications and were classified as either BI-RADS 4 (n = 17) or 5 (n = 4) lesions.	NR

Table 9. Patient inclusion/exclusion criteria for studies addressing key question 1 (continued)

Study	Patient Inclusion Criteria	Patient Exclusion Criteria
Pfarl et al. 2002 ⁴⁸⁵	All patients undergoing 11G Mammotome biopsy from September 1997 to December 2001	Unable to cooperate with the procedure, had a bleeding diathesis
Verkooijen et al. COBRA 2002 ⁴⁸⁶	Nonpalpable breast lesions requiring histologic exam enrolled in 19 dutch hospitals	Coagulotherapies or use of anticoagulants that could not be discontinued, inability to maintain prone position for one hour, inability to comprehend study protocol
Becker et al. 2001 ⁴⁸⁷	Biopsies performed for microcalcifications at the center between November 1993 and January 1997	NR
Brenner et al. 2001 ⁴⁸⁸	NR	NR
Cangiarella et al. 2001 ⁴⁸⁹	Patients with indeterminate microcalcifications that had been detected by routine screening and had no evidence of a mammographic density or mass biopsied between January 1997 and December 1997	NR
Dahlstrom and Jain 2001 ⁴⁹⁰	Women with suspicious calcifications detected on routine screened between July 1993 and August 1998	NR
Lai et al. 2001 ⁴⁹¹	Consecutive patients who underwent biopsy between September 1997 and March 2000	NR
Levin et al. 2001 ⁴⁹²	Women with a single non-palpable lesion detected during a routine mammography and scheduled for a lumpectomy. Spiculated lesions, indeterminate nodules, indeterminate calcifications, and localized asymmetric density were eligible.	Palpable lesion, radial scar, bleeding diathesis, lesion not well visualized, in a difficult location
Margolin et al. 2001 ⁴⁹³	All patients who underwent core biopsy between January 1994 and December 1998	NR
Perez-Fuentes et al. 2001 ⁴⁹⁴	All patients who underwent US-guided vacuum-assisted core needle biopsies at the center between August 1998 to December 2000. Criteria for deciding who got this type of core-biopsy rather than another type seemed vague and inconsistently applied. Listed below: palpable or nonpalpable masses that could be seen with US and that were suspicious or highly suggestive of malignancy. Also used for occasional lesions that appeared to probably be benign. Selectively used for solid lesions that were suspicious and measured 2 cm or less. Solid lesions that were suggestive of malignancy and measured 1 cm or less. Complex lesions, intraductal lesions, subtle lesions, cysts with mural thickening, intramural nodules, or thick septations regardless of size; lesions suspected of being radial scars or papillomas; other lesions; occasional probably benign lesions 2 cm or less.	Bleeding diathesis or unable to cooperate with the procedure.

Table 9. Patient inclusion/exclusion criteria for studies addressing key question 1 (continued)

Study	Patient Inclusion Criteria	Patient Exclusion Criteria
Smith et al. 2001 ⁴⁹⁵	Between August 1991 and February 1998, women referred for US guided biopsy because of non-calcificied US visible masses	NR
White et al. 2001 ⁴⁹⁶	All patients who had image-guided core needle biopsy at the center between August 1992 and February 1999	NR
Wunderbaldinger et al. 2001 ⁴⁹⁷	Patients scheduled to undergo open biopsy for non-palpable breast lesions	NR
Yeow et al. 2001 ⁴⁹⁸	Consecutive patients referred for needle biopsy January 1995 to October 1997 with palpable breast masses	Lesion was identified as a cyst
Beck et al. 2000 ⁴⁹⁹	Until April 1999 patients with indeterminate lesions who were sent for biopsy	NR
Kirwan et al. 2000 ⁵⁰⁰	Women with mammographically detected stellate lesions with or without microcalcifications	NR
Latosinsky et al. 2000 ⁵⁰¹	Between november 1994 to may 1998 all patients who underwent core biopsy	NR
Liberman et al. 2000 ⁵⁰²	Patients with palpable lesions who underwent core needle biopsy between August 1992 and May 1998	NR
Makoske et al. 2000 ⁵⁰³	All eligible patients from 1993 through 1998, those with nonpalpable lesions found on mammography who were sent for biopsy	NR
Ward et al. 2000 ⁵⁰⁴	Patients with indeterminate microcalcifications sent for core biopsy between November 1993 and January 1997	Cases with associated mass, distortion, or palpable lesion were excluded
Welle et al. 2000 ⁵⁰⁵	Patients with stereotactic core-needle biopies performed between September 1995 trhough March 1999	NR
Helbich et al. 1999 ⁵⁰⁶	NR	NR
Jackman et al. 1999 ⁵⁰⁷	Consecutive patients with nonpalpable lesions who had stereotactic core-needle biopsy between July 1991 and December 1993	NR
Meyer et al. 1999 ⁵⁰⁸	Patients seen between August 1991 and December 31, 1997 for suspicious nonpalpable breast abnormalities	NR
Puglisi et al. 1999 ⁵⁰⁹	Consecutive patients seen from July 1992-December 1997	US-guided procedures
Soo et al. 1999 ⁵¹⁰	Patients with noncalcified, nonpalpable, mammographically detected lesions referred for biopsy between October 1995 and August 1997	NR

Table 9. Patient inclusion/exclusion criteria for studies addressing key question 1 (continued)

Study	Patient Inclusion Criteria	Patient Exclusion Criteria
Caruso et al. 1998 ⁵¹¹	From 1990 to 1995, a consecutive series of 91 patients	NR
Doyle et al. 1998 ⁵¹²	Patients who underwent stereotactic core-needle biopsy between September 1994 and March 1998	NR
Fuhrman et al. 1998 ⁵¹³	All nonpalpable breast lesions from July 1993-February 1997 that underwent image guided core needle breast biopsy.	Palpable masses, lesions not clearly visualized in the stereotactic unit (usually lesions deep in the breast along the chest wall), lesions found in small breasts which compress to <2 cm in the stereotactic unit, asymmetric dense breast tissue, unable to tolerate the prone position for 30 minutes.
Heywang-Kobrunner et al. 1998 ⁵¹⁴	Patients referred for biopsy up to March 1997	NR
Ioffe et al. 1998 ⁵¹⁵	Consecutive core-needle biopsies between July 1995 and January 1997	NR
Lieberman et al. 1998 ⁵¹⁶	Patients with a solitary, nonpalpable mass who underwent US guided biopsy between May 1993 and June 1997	The parenchyma was too thin to support the excursion of the needle, a hemorrhagic diathesis, unable to cooperate, or the lesion was less than 5 mm
Schulz-Wendtland et al. 1998 ⁵¹⁷	Patients who underwent US guided biopsies between May 1992 and April 1993	NR
Vega-Bolivar et al. 1998 ⁵¹⁸	Patients seen between October 1993-October 1996 for nonpalpable breast lesions	NR
Whitman et al. 1998 ⁵¹⁹	Mammographically guided coaxial core needle biopsy procedures performed with a fenestrated alphanumeric compression device between 1995-1997	NR
Zannis and AliaNo 1998 ⁵²⁰	Consecutive records of patients undergoing a stereotactic procedure and biopsy by the same surgeon for a non-palpable, mammographically detected lesion between January 1993 and August 1997	NR
Bauer et al. 1997 ⁵²¹	Mammographically detected breast lesions considered worrisome enough to require biopsy, such as clustered microcalcifications, a spiculated mass, or an area of architectural distortion during the 30 months from July 1, 1993 to January 1, 1996.	NR
Britton et al. 1997 ⁵²²	All patients after April 1994 who were recalled for core-needle biopsy after routine mammographic screening	NR

Table 9. Patient inclusion/exclusion criteria for studies addressing key question 1 (continued)

Study	Patient Inclusion Criteria	Patient Exclusion Criteria
Helbich et al. 1997 ⁵²³	Consecutive patients with solid breast lesions over 20 months	NR
Khattar et al. 1997 ⁵²⁴	Between February 1993 and March 1995, patients over 18 years of age with a palpable mass scheduled for surgical excision	Lesion was revealed to be a simple cyst on US
Liberman et al. 1997 ⁵²⁵	Patients who underwent stereotactic core biopsy between August 7, 1992 and December 14, 1995	Thickness of compressed breast was inadequate to accommodate the needle; the lesion measured less than 5 mm in diameter; the lesion could not be targeted accurately; the patient had a bleeding diathesis; the patient was on anticoagulants; the patient was unable to cooperate with the procedure.
Pitre et al. 1997 ⁵²⁶	Patients who had stereotactic core needle biopsy for a nonpalpable unicentric mammographically detected breast lesion between January 1994 and February 1995	NR
Stolier et al. 1997 ⁵²⁷	All patients who underwent core-needle biopsy at the center by the study author from August 1993 through May 1996	NR
Sutton, et al. 1997 ⁵²⁸	Women who elected to have stereotactic-guided large-gauge core biopsy between July 1993 and June 1995 after detection of suspicious non-palpable abnormalities at a mammographic screening clinic	Initially, women with abnormalities considered to be obviously malignant were excluded from the series (from July to December 1993) but after the first 70 patients, these highly suspicious lesions were offered core biopsy
Walker et al. 1997 ⁵²⁹	All patients who had stereotactic core-needle for a nonpalpable lesion since 1993	NR
Frazer et al. 1996 ⁵³⁰	Patients with nonpalpable mammographic abnormality between July 1994 to June 1995	NR
Fuhrman et al. 1996 ⁵³¹	All non-palpable suspicious masses and calcifications noted on mammography from July 1993 - January 1995	Lesions not clearly visualized in the stereotactic unit, usually lesions deep within the breast along the chest wall, lesions found in small breasts which compress to less than 2cm in the stereotactic unit, asymmetric dense breast tissue, and patients unable to tolerate the prone position for 30 minutes
Head and Haynes 1996 ⁵³²	Patients with nonpalpable breast lesions discovered during routine mammography	NR
Mainiero et al. 1996 ⁵³³	Patients with microcalcifications were considered indeterminate or suspicious for malignancy	Lesions in which calcifications were within a mass or an area of architectural distortion

Table 9. Patient inclusion/exclusion criteria for studies addressing key question 1 (continued)

Study	Patient Inclusion Criteria	Patient Exclusion Criteria
Meyer et al. 1996 ⁵³⁴	Clinically occult suspicious mammographic abnormalities. The mass must be at least 6mm in diameter and be clearly visible on mammography	NR
Nguyen et al. 1996 ⁵³⁵	All core needle biopsies performed between December 1992 and June 1995	NR
Pettine et al. 1996 ⁵³⁶	Patients with nonpalable lesions discovered on mammogram followed immediately by wire localized biopsy	NR
Rosenblatt et al. 1996 ⁵³⁷	All patients who underwent biopsy of multiple unilateral lesions between January 1994 and September 1995	NR
Scopa et al. 1996 ⁵³⁸	Patients undergoing Tru-Cut biopsies who had not been previously investigated with fine-needle aspiration	NR
Cross et al. 1995 ⁵³⁹	Patients who were referred to the center for stereotactic biopsy of a nonpalpable mammographic abnormality	NR.
Doyle et al. 1995 ⁵⁴⁰	Mammographically detected impalpable breast lesions, completely well-circumscribed masses less than 8mm in diameter with smooth borders. Opacities containing fat or with concave margins, clusters or uniform tiny rounded calcifications, scattered calcifications, and scattered nodules. Lesions considered strongly suggestive of cancer included new spiculated masses, new clustered pleomorphic calcifications, or both.	Inability to provide informed consent and irreversible bleeding diathesis
Hamed et al. 1995 ⁵⁴¹	Female patients with clinically suspected breast carcinoma	Patients with locally advanced breast carcinoma
Burbank et al. 1994 ⁵⁴²	NR	Patients who underwent bone biopsies
Gisvold et al. 1994 ⁵⁴³	All patients referred for wire-localized open surgery between October 19, 1991 and January 15, 1993 were considered for the study. The inclusion criteria are: If it appeared the lesion and patient were suitable (patient could lie prone for an hour, no bleeding problems, and no allergy to local anesthesia; lesions thought to be visualizable and were not too superficial or close to the nipple).	Equipment or radiologist not available, lesion visualizable only on US
Parker et al. 1994 ⁵⁴⁴	Core-needle biopsies performed at sites at which the radiologists and assisting technologists had undergone dedicated training in larger core breast biopsy and had followed a standard protocol	NR
Smyth and Cederbom 1994 ⁵⁴⁵	Patients with mammographically suspicious non palpable lesions	NR

Table 9. Patient inclusion/exclusion criteria for studies addressing key question 1 (continued)

Study	Patient Inclusion Criteria	Patient Exclusion Criteria
Elvecrog et al. 1993 ⁵⁴⁶	Patients with single non-palpable mammographic lesion; study restricted to patients who would have undergone open biopsy if core biopsy wasn't available	Lesions less than 5 mm in diameter
Parker et al. 1993 ⁵⁴⁷	Consecutive patients with solid or indeterminate breast lesions visualized by US between August 1989 and July 1991	NR
McMahon et al. 1992 ⁵⁴⁸	Consecutive patients with palpable breast lumps between September 1989 and August 1991	NR
Hamed et al. 1991 ⁵⁴⁹	Symptomatic patients with palpable breast lumps suspected of having early breast cancer who were scheduled for open surgical excision	NR
Cusick et al. 1990 ⁵⁵⁰	Patients with suggestive mammary lumps seen at the surgery clinic of San Bernardino County Medical Center	NR
Parker et al. 1990 ⁵⁵¹	During a 13 month period, consecutive patients who underwent stereotactic needle core breast biopsies	NR

NR = Not Reported

Table 10. Characteristics of patients enrolled in studies addressing key question 1

Study	Number of Patients Recruited for Enrollment	Number of Patients Enrolled	Number of Lesions Enrolled	Age	Age Dispersion	Ethnicity
Peters et al. 2008 ⁴⁴⁸	955	948	948	NR	NR	NR
Tonegutti and Girardi 2008 ⁴⁴⁹	268	268	268	Mean: 52	Range: 22-79	NR
Youk et al. 2008 ⁶	4,359	4,359	4,359	Median: 45 Mean: 45.3	Range: 12 to 88	NR
Ciatto et al. 2007 ⁴⁵⁰	4,035	4,035	4,035	NR	NR	NR
de Lucena et al. 2007 ⁴⁵¹	NR	144	150	Mean: 50	Range: 15 to 89 Standard deviation: 16	NR
Uematsu et al. 2007 ⁴⁵²	NR	96	100	Mean: 49.4	Range: 28 to 85	NR
Vag et al. 2007 ⁴⁵³	NR	65	70	Median: 57	Range: 31 to 82	NR
Chapellier et al. 2006 ⁴⁵⁴	NR	301	318	Mean: 56	Range: 35 to 78, 64% postmenopausal	NR
Cipolla et al. 2006 ⁴⁵⁵	426	426	426	64% post-menopausal	NR	NR
Dhillon et al. 2006 ⁴⁵⁶	150	150	150	Median: 56	Range: 37 to 77	NR
Bolivar et al. 2005 ⁴⁵⁷	208	208	214	Mean: 55	Range: 32 to 87	NR
Crystal et al. 2005 ⁴⁵⁸	652	652	715	NR	NR	NR
Dillon et al. 2005 ⁴⁵⁹	2,427 (lesions)	NR	2,427	NR	NR	NR
Koskela et al. 2005 ⁴⁶⁰	212	205	213	Mean: 56	Range: 32 to 88	NR
Sauer et al. 2005 ⁴⁶¹	906	906	962	NR	NR	NR
Weber et al. 2005 ⁴⁶²	239	225	225	Median: 56.1	Range: 30 to 84	NR
Wu et al. 2005 ⁴⁶³	113	113	113	Median: 31	Range: 18 to 35	NR

Table 10. Characteristics of patients enrolled in studies addressing key question 1 (continued)

Study	Number of Patients Recruited for Enrollment	Number of Patients Enrolled	Number of Lesions Enrolled	Age	Age Dispersion	Ethnicity
Alonso-Bartolome et al. 2004 ⁴⁶⁴	97	97	102	Mean: 42	Range: 18 to 77	NR
Delle and Terinde 2004 ⁴⁶⁵	146	146	169	NR	NR	NR
Fajardo et al. 2004 ⁴⁶⁶	2,403	2,403	2,403	Mean: 54.6	Range: 25 to 89	% white european descent: 1,313 (78.1%) % black african descent: 265 (15.8%) % asian descent: 27 (1.6%) % hispanic descent: 62 (3.7%) % other, please specify: 6 Native American (0.4%), 8 another race (0.5%)
Kettritz et al. 2004 ⁴⁶⁷	2,939	NR	2,893	NR	NR	NR
Lomoschitz et al. 2004 ⁴⁶⁸	100	100	100	Median: 55	Range: 31 to 81	NR
Abdsaleh et al. 2003 ⁴⁶⁹	180	180	180	NR	Range: 35 to 93	NR
Ambrogetti et al. 2003 ⁴⁷⁰	364	364	364	Mean: 54.9	Range: 33 to 81	NR
Fishman et al. 2003 ⁴⁷¹	75	70	73	NR	NR	NR
Han et al. 2003 ⁴⁷²	284 (lesions)	267	271	Mean: 47 yrs	Range: 23 to 72	NR
Kirshenbaum et al. 2003 ⁴⁷³	492	492	506	Mean: 59.1	Range: 27 to 78	NR
March et al. 2003 ⁴⁷⁴	57	34	34	NR	NR	NR

Table 10. Characteristics of patients enrolled in studies addressing key question 1 (continued)

Study	Number of Patients Recruited for Enrollment	Number of Patients Enrolled	Number of Lesions Enrolled	Age	Age Dispersion	Ethnicity
Pfleiderer et al. 2003 ⁴⁷⁵	NR	14	14	Mean: 47.9	Standard deviation: 13.1	NR
Philpotts et al. 2003 ⁴⁷⁶	271	271	281	NR	NR	NR
Wong and Hisham 2003 ⁴⁷⁷	NR	145	150	NR	Range: 20 to 80	% asian descent: 80% % other, please specify: 18% Indian 2% "other"
Apesteguia et al. 2002 ⁴⁷⁸	126	126	132	Mean: 50.5	Range: 29 to 81 Standard deviation: 10.2	NR
Georgian-Smith et al. 2002 ⁴⁷⁹	179	179	185	Mean: 54.6	Range: 35 to 85	NR
Jackman and Lamm 2002 ⁴⁸⁰	25	25	31	Median: 58	Range: 35 to 75	NR
Johnson et al. 2002 ⁴⁸¹	81	81	101	Mean: 46.8	Range: 21 to 72	NR
Lieberman et al. 2002 ⁴⁸²	797	797	800	Median: 57	Range: 28 to 88	NR
Meloni et al. 2002 ⁴⁸³	138	129	129	NR	NR	NR
Morris et al. 2002 ⁴⁸⁴	NR	19	21	Mean: 57	Range: 36 to 75	NR
Pfarl et al. 2002 ⁴⁸⁵	332 (lesions)	325	332	Median: 56	Range: 28 to 83	NR
Verkooijen et al. COBRA 2002 ⁴⁸⁶	973	928	984	Mean: 58	Range: 29 to 85	NR
Becker et al. 2001 ⁴⁸⁷	218	218	232	Mean: 57.3	Range: 33 to 84	NR
Brenner et al. 2001 ⁴⁸⁸	NR	1003	1003	NR	NR	NR
Cangiarella et al. 2001 ⁴⁸⁹	142	142	160	Mean: 53.5	Range: 34 to 79	NR

Table 10. Characteristics of patients enrolled in studies addressing key question 1 (continued)

Study	Number of Patients Recruited for Enrollment	Number of Patients Enrolled	Number of Lesions Enrolled	Age	Age Dispersion	Ethnicity
Dahlstrom and Jain 2001 ⁴⁹⁰	266	discrepancy: study reports data for 301 core biopsies but states in methods that 266 women with 274 lesions were enrolled	310	NR	NR	NR
Lai et al. 2001 ⁴⁹¹	650	650	673	Mean: 54.7	Range: 22 to 89 Standard deviation: 11.6	NR
Levin et al. 2001 ⁴⁹²	NR	70	70	NR	Range: 39 to 80	NR
Margolin et al. 2001 ⁴⁹³	1,183	1,183	1,333	Mean: split into three groups 55, 52, 40	Range: 17 to 93	NR
Perez-Fuentes et al. 2001 ⁴⁹⁴	88 (lesions)	83	88	Median: 48	Range: 25 to 78	NR
Smith et al. 2001 ⁴⁹⁵	446	446	500	Median: 46 Mean: 47	Range: 18 to 89	NR
White et al. 2001 ⁴⁹⁶	939	939	1042	Median: 60	Range: 32 to 85	NR
Wunderbaldinger et al. 2001 ⁴⁹⁷	NR	45	45	Mean: 50	Range: 20 to 77	NR
Yeow et al. 2001 ⁴⁹⁸	104	98	98	Mean: 46.5	Range: 23 to 85 Standard deviation: 12.3	NR
Beck et al. 2000 ⁴⁹⁹	560	560	594	NR	NR	NR
Kirwan et al. 2000 ⁵⁰⁰	NR	72	72	NR	NR	NR
Latosinsky et al. 2000 ⁵⁰¹	607	607	692	NR	NR	NR

Table 10. Characteristics of patients enrolled in studies addressing key question 1 (continued)

Study	Number of Patients Recruited for Enrollment	Number of Patients Enrolled	Number of Lesions Enrolled	Age	Age Dispersion	Ethnicity
Lieberman et al. 2000 ⁵⁰²	155 (lesions)	NR	155	Median: 47	Range: 19 to 88	NR
Makoske et al. 2000 ⁵⁰³	817	817	887	NR	NR	NR
Ward et al. 2000 ⁵⁰⁴	161	NR	121	Mean: 58	Range: 33 to 83	NR
Welle et al. 2000 ⁵⁰⁵	NR	225	225	NR	NR	NR
Helbich et al. 1999 ⁵⁰⁶	NR	44	44	NR	Range: 20 to 77	NR
Jackman et al. 1999 ⁵⁰⁷	410	410	483	Median: 55	Range: 29 to 89	NR
Meyer et al. 1999 ⁵⁰⁸	NR	1,643	1,836	Mean: 50	Range: 20 to 85	NR
Puglisi et al. 1999 ⁵⁰⁹	NR	99	106	Median: 57	Range: 33 to 84	NR
Soo et al. 1999 ⁵¹⁰	110	110	116	NR	NR	NR
Caruso et al. 1998 ⁵¹¹	NR	91	92	Median: 65	Range: 29 to 81	NR
Doyle et al. 1998 ⁵¹²	151 (lesions)	NR	151	NR	NR	NR
Fuhrman et al. 1998 ⁵¹³	1,440	1,440	1,440	NR	NR	NR
Heywang-Kobrunner et al. 1998 ⁵¹⁴	238	238	261	NR	NR	NR
Ioffe et al. 1998 ⁵¹⁵	NR	198	224	Mean: 51	Range: 14 to 87	NR
Lieberman et al. 1998 ⁵¹⁶	179	151	151	Median: 50	Range: 23 to 80	NR
Schulz-Wendtland et al. 1998 ⁵¹⁷	307	307	2,307	NR	NR	NR
Vega-Bolivar et al. 1998 ⁵¹⁸	180	180	182	Mean: 55	Range: 30 to 79	NR

Table 10. Characteristics of patients enrolled in studies addressing key question 1 (continued)

Study	Number of Patients Recruited for Enrollment	Number of Patients Enrolled	Number of Lesions Enrolled	Age	Age Dispersion	Ethnicity
Whitman et al. 1998 ⁵¹⁹	11	11	12	Mean: 55	Range: 31 to 75, 8.3% older than age 65	NR
Zannis and AliaNo 1998 ⁵²⁰	372	372	424	Mean: 57.7	Range: 25 to 90	NR
Bauer et al. 1997 ⁵²¹	799 (lesions)	NR	799	Mean: 61	Range: 38 to 87	NR
Britton et al. 1997 ⁵²²	202	202	202	NR	NR	NR
Helbich et al. 1997 ⁵²³	205	205	210	Mean: 52.2	Range: 23 to 88	NR
Khattar et al. 1997 ⁵²⁴	117	106	106	Median: 52	Range: 19 to 85	NR
Liberman et al. 1997 ⁵²⁵	NR	NR	442	NR	NR	NR
Pitre et al. 1997 ⁵²⁶	128	128	128	Mean: 56.4	NR	NR
Stolier et al. 1997 ⁵²⁷	242	242	244	NR	NR	NR
Sutton, et al. 1997 ⁵²⁸	200	200	206	Mean: 59	Range: 41 to 85	NR
Walker et al. 1997 ⁵²⁹	200	200	200	NR	Range: 35 to 86	NR
Frazer et al. 1996 ⁵³⁰	103	103	103	Mean: 60	NR	NR
Fuhrman et al. 1996 ⁵³¹	451 (lesions)	NR	451	NR	NR	NR
Head and Haynes 1996 ⁵³²	115	115	115	NR	NR	NR
Mainiero et al. 1996 ⁵³³	128	124	138	Mean: 56.2	Range: 30 to 87	NR
Meyer et al. 1996 ⁵³⁴	545 (lesions)	369	388	Median: 49 yrs Mean: 51 yrs	Range: 24 to 81	NR
Nguyen et al. 1996 ⁵³⁵	NR	408	431	NR	NR	NR
Pettine et al. 1996 ⁵³⁶	25	25	25	NR	NR	NR

Table 10. Characteristics of patients enrolled in studies addressing key question 1 (continued)

Study	Number of Patients Recruited for Enrollment	Number of Patients Enrolled	Number of Lesions Enrolled	Age	Age Dispersion	Ethnicity
Rosenblatt et al. 1996 ⁵³⁷	156	25	58	NR	NR	NR
Scopa et al. 1996 ⁵³⁸	109	109	120	Mean: 51.2	Range: 21 to 85	NR
Cross et al. 1995 ⁵³⁹	NR	225	250	Mean: 54	Range: 26 to 89	NR
Doyle et al. 1995 ⁵⁴⁰	366	365	365	Mean: 57 years	NR	NR
Hamed et al. 1995 ⁵⁴¹	122	122	122	NR	NR	NR
Burbank et al. 1994 ⁵⁴²	105 (lesions)	NR	105	NR	NR	NR
Gisvold et al. 1994 ⁵⁴³	471	158	160	NR	NR	NR
Parker et al. 1994 ⁵⁴⁴	6,152 (lesions)	NR	6,152	NR	NR	NR
Smyth and Cederbom 1994 ⁵⁴⁵	52	52	58	Mean: 57	NR	NR
Elvecrog et al. 1993 ⁵⁴⁶	107	100	100	NR	NR	NR
Parker et al. 1993 ⁵⁴⁷	164	164	181	NR	NR	NR
McMahon et al. 1992 ⁵⁴⁸	151	152	151	Median: 57 Trucut 50 Bipopty 14G 56 Biopty 18G	Range: 24 to 87	NR
Hamed et al. 1991 ⁵⁴⁹	NR	107	107	Mean: 60.5 one group, 57.9 other group	SE 1.3 one group, 2.4 other group	NR
Cusick et al. 1990 ⁵⁵⁰	95	95	96	Mean: 52 years	Range: 24 to 78	NR
Parker et al. 1990 ⁵⁵¹	103	103	103	NR	NR	NR
	Sum		54,393			

NR = Not Reported

Table 11. Characteristics of the breast lesions in the studies addressing key question 1

Study	Number of Lesions Enrolled	% Non-palpable Lesions	Number of Non-palpable Lesions	Number of Microcalcifications	Number with Mammographic Masses	Number with Mammographic Distortions	Lesion Size	BIRADS 5	BIRADS 4	BIRADS 3
Peters et al. 2008 ⁴⁴⁸	948	100%	948	NR	NR	NR	NR	NR	NR	NR
Tonegutti and Girardi 2008 ⁴⁴⁹	268	100%	268	186	36	18	67% were 10 mm or less	7%	40%	19%
Youk et al. 2008 ⁶	4,359	NR	NR	NR	NR	NR	NR	NR	NR	NR
Ciatto et al. 2007 ⁴⁵⁰	4,035	67%	2,714	1,887	NR	NR	NR	NR	NR	NR
de Lucena et al. 2007 ⁴⁵¹	150	NR	NR	NR	NR	NR	44% were 2 cm or less 52% were 2 to 5 cm	NR	NR	NR
Uematsu et al. 2007 ⁴⁵²	100	NR	NR	100	NR	NR	NR	18%	27%	55%
Vag et al. 2007 ⁴⁵³	70	63%	44	NR	NR	NR	Median: 12 mm Range: 5 to 35 mm	15.70%	33%	51.40%
Chapellier et al. 2006 ⁴⁵⁴	318	NR	NR	288	30	NR	NR	11%	53.50%	34.90%
Cipolla et al. 2006 ⁴⁵⁵	426	71%	302	NR	NR	NR	NR	10.10%	10.60%	50.20%
Dhillon et al. 2006 ⁴⁵⁶	150	NR	NR	130	12	8	NR	NR	NR	NR

Table 11. Characteristics of the breast lesions in the studies addressing key question 1 (continued)

Study	Number of Lesions Enrolled	% Non-palpable Lesions	Number of Non-palpable Lesions	Number of Microcalcifications	Number with Mammo-graphic Masses	Number with Mammo-graphic Distortions	Lesion Size	BIRADS 5	BIRADS 4	BIRADS 3
Bolivar et al. 2005 ⁴⁵⁷	214	95%	204	9	152	34	53 lesions 1 to 10 mm 119 lesions 11 to 20 mm 32 lesions larger than 20 mm	NR	NR	NR
Crystal et al. 2005 ⁴⁵⁸	715	NR	NR	NR	NR	NR	NR	NR	NR	NR
Dillon et al. 2005 ⁴⁵⁹	2,427	NR	NR	NR	NR	NR	NR	NR	NR	NR
Koskela et al. 2005 ⁴⁶⁰	213	NR	NR	108	NR	NR	NR	22.10%	56.80%	16.40%
Sauer et al. 2005 ⁴⁶¹	962	75%	726	NR	NR	NR	Mean: 2.5 cm Range: 0.2 to 11 cm	NR	NR	NR
Weber et al. 2005 ⁴⁶²	225	100%	225	NR	NR	NR	NR	NR	NR	NR
Wu et al. 2005 ⁴⁶³	113	27%	30	NR	NR	NR	Median size: 1.4 cm Range: 0.5 to 2.0 cm	NR	NR	NR
Alonso-Bartolome et al. 2004 ⁴⁶⁴	102	61%	62	NR	NR	NR	Mean: 14.7 mm (Range: 6-30 mm)	NR	NR	100%
Delle and Terinde 2004 ⁴⁶⁵	169	NR	NR	NR	NR	NR	Mean 1.5 cm	NR	NR	NR

Table 11. Characteristics of the breast lesions in the studies addressing key question 1 (continued)

Study	Number of Lesions Enrolled	% Non-palpable Lesions	Number of Non-palpable Lesions	Number of Microcalcifications	Number with Mammo-graphic Masses	Number with Mammo-graphic Distortions	Lesion Size	BIRADS 5	BIRADS 4	BIRADS 3
Fajardo et al. 2004 ⁴⁶⁶	2,403	70%	1,681	NR	NR	NR	NR	NR	NR	NR
Ketritz et al. 2004 ⁴⁶⁷	2,893	NR	NR	2,013	NR	61	1,677 were less than 10 mm, 809 were 11 to 20 mm, and 388 were larger	5.90%	84.30%	9.80%
Lomoschitz et al. 2004 ⁴⁶⁸	100	100%	100	50	50	NR	NR	NR	NR	NR
Abdsaleh et al. 2003 ⁴⁶⁹	180	NR	NR	15	130	NR	6 to 80 mm	NR	NR	NR
Ambrogetti et al. 2003 ⁴⁷⁰	364	100%	364	326	NR	NR	NR	NR	NR	NR
Fishman et al. 2003 ⁴⁷¹	73	78%	57	NR	NR	NR	Mean: 1.7 cm Range: 0.6 to 6 cm	NR	NR	NR
Han et al. 2003 ⁴⁷²	271	100%	271	228	NR	NR	NR	NR	NR	NR
Kirshenbaum et al. 2003 ⁴⁷³	506	100%	506	228	212	75	Mean: 0.8 cm Range: 0.3 to 2.3 cm	NR	NR	NR
March et al. 2003 ⁴⁷⁴	34	71%	24	3	NR	NR	Mean: 0.7 cm Range: 0.4 to 1.2 cm	NR	NR	NR

Table 11. Characteristics of the breast lesions in the studies addressing key question 1 (continued)

Study	Number of Lesions Enrolled	% Non-palpable Lesions	Number of Non-palpable Lesions	Number of Microcalcifications	Number with Mammographic Masses	Number with Mammographic Distortions	Lesion Size	BIRADS 5	BIRADS 4	BIRADS 3
Pfleiderer et al. 2003 ⁴⁷⁵	14	NR	NR	NR	NR	NR	NR	28.60%	64.30%	NR
Philpotts et al. 2003 ⁴⁷⁶	281	NR	NR	NR	NR	NR	NR	NR	NR	NR
Wong and Hisham 2003 ⁴⁷⁷	150	0%	0	NR	NR	NR	NR	NR	NR	NR
Apesteguia et al. 2002 ⁴⁷⁸	132	100%	132	82	NR	24	NR	NR	NR	NR
Georgian-Smith et al. 2002 ⁴⁷⁹	185	NR	NR	159	16	5	NR	NR	NR	NR
Jackman and Lamm 2002 ⁴⁸⁰	31	97%	30	21	10	NR	NR	9.70%	90.30%	0%
Johnson et al. 2002 ⁴⁸¹	101	27%	27	NR	NR	NR	Mean: 1.15 cm	NR	NR	NR
Liberman et al. 2002 ⁴⁸²	800	100%	800	606	194		Median: 0.8 cm Range: 0.2 to 10 cm	NR	NR	NR
Meloni et al. 2002 ⁴⁸³	129	100%	129	NR	NR	NR	NR	NR	NR	NR
Morris et al. 2002 ⁴⁸⁴	21	100%	21	NR	21	NR	Mean: 1.8 cm Range: 0.8 to 5.5 cm	NR	NR	NR
Pfarl et al. 2002 ⁴⁸⁵	332	NR	NR	166	152	NR	NR	NR	NR	NR

Table 11. Characteristics of the breast lesions in the studies addressing key question 1 (continued)

Study	Number of Lesions Enrolled	% Non-palpable Lesions	Number of Non-palpable Lesions	Number of Microcalcifications	Number with Mammo-graphic Masses	Number with Mammo-graphic Distortions	Lesion Size	BIRADS 5	BIRADS 4	BIRADS 3
Verkooijen et al. COBRA 2002 ⁴⁸⁶	984	100%	984	533	310	26	NR	NR	NR	NR
Becker et al. 2001 ⁴⁸⁷	232	NR	NR	232	NR	NR	NR	NR	NR	NR
Brenner et al. 2001 ⁴⁸⁸	1,003	100%	1003	355	630	92	NR	11.10%	39.10%	35.70%
Cangiarella et al. 2001 ⁴⁸⁹	160	NR	NR	160	NR	NR	NR	NR	NR	NR
Dahlstrom and Jain 2001 ⁴⁹⁰	310	NR	NR	301	NR	NR	NR	NR	NR	NR
Lai et al. 2001 ⁴⁹¹	673	NR	NR	NR	NR	NR	NR	NR	NR	NR
Levin et al. 2001 ⁴⁹²	70	100%	70	27	NR	NR	NR	NR	NR	NR
Margolin et al. 2001 ⁴⁹³	1,333	NR	NR	NR	NR	NR	NR	NR	94%	NR
Perez-Fuentes et al. 2001 ⁴⁹⁴	88	73%	64	NR	NR	NR	NR	9.10%	81.80%	8.00%
Smith et al. 2001 ⁴⁹⁵	500	95%	475	0	NR	NR	Mean: 15 mm Range: 4 to 60 mm	NR	NR	NR
White et al. 2001 ⁴⁹⁶	1,042	NR	NR	NR	NR	NR	NR	NR	NR	NR

Table 11. Characteristics of the breast lesions in the studies addressing key question 1 (continued)

Study	Number of Lesions Enrolled	% Non-palpable Lesions	Number of Non-palpable Lesions	Number of Microcalcifications	Number with Mammographic Masses	Number with Mammographic Distortions	Lesion Size	BIRADS 5	BIRADS 4	BIRADS 3
Wunderbalinger et al. 2001 ⁴⁹⁷	45	100%	45	4	41	NR	Mean: 18 mm Range: 8 to 41	NR	NR	NR
Yeow et al. 2001 ⁴⁹⁸	98	0%	0	NR	NR	NR	Mean: 2.6 cm Range: 0.9 to 10 cm	NR	NR	NR
Beck et al. 2000 ⁴⁹⁹	594	NR	NR	NR	NR	NR	NR	16.50%	83.50%	NR
Kirwan et al. 2000 ⁵⁰⁰	72	NR	NR	NR	NR	NR	NR	NR	NR	NR
Latosinsky et al. 2000 ⁵⁰¹	692	NR	NR	313	426	4	NR	NR	NR	NR
Liberman et al. 2000 ⁵⁰²	155	0%	0	NR	NR	NR	Median: 1.7 cm Range: 0.5 to 15 cm	NR	NR	NR
Makoske et al. 2000 ⁵⁰³	887	100%	887	NR	NR	NR	NR	NR	NR	NR
Ward et al. 2000 ⁵⁰⁴	121	100%	121	121	NR	NR	NR	NR	NR	NR
Welle et al. 2000 ⁵⁰⁵	225	NR	NR	90	135	NR	NR	NR	NR	NR
Helbich et al. 1999 ⁵⁰⁶	44	NR	NR	24	5	5	Mean 12.9 mm Range: 8 to 27	NR	NR	NR

Table 11. Characteristics of the breast lesions in the studies addressing key question 1 (continued)

Study	Number of Lesions Enrolled	% Non-palpable Lesions	Number of Non-palpable Lesions	Number of Microcalcifications	Number with Mammo-graphic Masses	Number with Mammo-graphic Distortions	Lesion Size	BIRADS 5	BIRADS 4	BIRADS 3
Jackman et al. 1999 ⁵⁰⁷	483	100%	483	234	249	NR	NR	NR	NR	NR
Meyer et al. 1999 ⁵⁰⁸	1,836	100%	1,836	643	1,194	NR	NR	NR	NR	NR
Puglisi et al. 1999 ⁵⁰⁹	106	75%	79	66	59	NR	NR	NR	NR	NR
Soo et al. 1999 ⁵¹⁰	116	100%	116	0	NR	NR	NR	NR	NR	NR
Caruso et al. 1998 ⁵¹¹	92	0%	0	11	92	NR	NR	NR	NR	NR
Doyle et al. 1998 ⁵¹²	151	100%	151	88	71	5	NR	NR	NR	NR
Fuhrman et al. 1998 ⁵¹³	1,440	100%	1,440	749	691	NR	NR	NR	NR	NR
Heywang-Kobrunner et al. 1998 ⁵¹⁴	261	NR	NR	134	127	NR	NR	1.90%	10.00%	88.10%
Ioffe et al. 1998 ⁵¹⁵	224	NR	NR	51	173	NR	NR	NR	NR	NR
Liberman et al. 1998 ⁵¹⁶	151	100%	151	NR	NR	NR	NR	NR	NR	NR
Schulz-Wendtland et al. 1998 ⁵¹⁷	2,307	NR	NR	NR	NR	NR	NR	NR	NR	NR
Vega-Bolivar et al. 1998 ⁵¹⁸	182	100%	182	75	33	24	NR	NR	NR	NR
Whitman et al. 1998 ⁵¹⁹	12	NR	NR	NR	NR	NR	NR	NR	NR	NR

Table 11. Characteristics of the breast lesions in the studies addressing key question 1 (continued)

Study	Number of Lesions Enrolled	% Non-palpable Lesions	Number of Non-palpable Lesions	Number of Microcalcifications	Number with Mammo-graphic Masses	Number with Mammo-graphic Distortions	Lesion Size	BIRADS 5	BIRADS 4	BIRADS 3
Zannis and AliaNo 1998 ⁵²⁰	424	100%	424	NR	424	NR	NR	NR	NR	NR
Bauer et al. 1997 ⁵²¹	799	NR	NR	NR	NR	NR	NR	NR	NR	NR
Britton et al. 1997 ⁵²²	202	NR	NR	NR	NR	NR	NR	NR	NR	NR
Helbich et al. 1997 ⁵²³	210	NR	NR	NR	NR	NR	Mean: 14 mm Range: 7 to 30	NR	NR	NR
Khattar et al. 1997 ⁵²⁴	106	0%	0	NR	NR	NR	NR	NR	NR	NR
Liberman et al. 1997 ⁵²⁵	442	NR	NR	196	246	NR	NR	NR	NR	NR
Pitre et al. 1997 ⁵²⁶	128	100%	128	NR	NR	NR	NR	3.90%	NR	NR
Stolier et al. 1997 ⁵²⁷	244	NR	NR	65	173	4	NR	NR	NR	44.70%
Sutton, et al. 1997 ⁵²⁸	206	100%	206	81	125	NR	Mean: 14 mm Range: 2 mm to 30 mm	NR	NR	NR
Walker et al. 1997 ⁵²⁹	200	100%	200	136	28	36	NR	NR	NR	NR
Frazer et al. 1996 ⁵³⁰	103	100%	103	NR	NR	NR	NR	NR	NR	NR

Table 11. Characteristics of the breast lesions in the studies addressing key question 1 (continued)

Study	Number of Lesions Enrolled	% Non-palpable Lesions	Number of Non-palpable Lesions	Number of Microcalcifications	Number with Mammo-graphic Masses	Number with Mammo-graphic Distortions	Lesion Size	BIRADS 5	BIRADS 4	BIRADS 3
Fuhrman et al. 1996 ⁵³¹	451	NR	NR	NR	NR	NR	NR	NR	NR	NR
Head and Haynes 1996 ⁵³²	115	100%	115	22	85	NR	NR	NR	NR	NR
Mainiero et al. 1996 ⁵³³	138	NR	NR	138	NR	NR	NR	NR	NR	NR
Meyer et al. 1996 ⁵³⁴	388	100%	388	NR	NR	NR	NR	NR	NR	NR
Nguyen et al. 1996 ⁵³⁵	431	NR	NR	NR	NR	NR	NR	NR	NR	NR
Pettine et al. 1996 ⁵³⁶	25	100%	25	NR	NR	NR	NR	NR	NR	NR
Rosenblatt et al. 1996 ⁵³⁷	58	NR	NR	22	14	NR	Median: 1.5 cm Range: 0.8 to 3.0	NR	NR	NR
Scopa et al. 1996 ⁵³⁸	120	NR	NR	NR	NR	NR	Range: 0.7 to 5 cm	NR	NR	NR
Cross et al. 1995 ⁵³⁹	250	100%	250	NR	NR	NR	NR	NR	NR	NR
Doyle et al. 1995 ⁵⁴⁰	365	62%	225	59	225		Larger than 5 mm	NR	NR	NR
Hamed et al. 1995 ⁵⁴¹	122	NR	NR	NR	NR	NR	NR	NR	NR	NR
Burbank et al. 1994 ⁵⁴²	105	NR	NR	NR	NR	NR	NR	NR	NR	NR
Gisvold et al. 1994 ⁵⁴³	160	NR	NR	NR	NR	NR	Range: 3 to 70 mm	NR	NR	NR

Table 11. Characteristics of the breast lesions in the studies addressing key question 1 (continued)

Study	Number of Lesions Enrolled	% Non-palpable Lesions	Number of Non-palpable Lesions	Number of Microcalcifications	Number with Mammo-graphic Masses	Number with Mammo-graphic Distortions	Lesion Size	BIRADS 5	BIRADS 4	BIRADS 3
Parker et al. 1994 ⁵⁴⁴	6,152	93%	5,702	1,637	4515		NR	NR	NR	NR
Smyth and Cederbom 1994 ⁵⁴⁵	58	100%	58	NR	NR	NR	NR	NR	NR	NR
Elvecrog et al. 1993 ⁵⁴⁶	100	100%	100	26	100		NR	NR	NR	NR
Parker et al. 1993 ⁵⁴⁷	181	46%	84	NR	NR	NR	NR	NR	NR	NR
McMahon et al. 1992 ⁵⁴⁸	151	0%	0	NR	NR	NR	NR	NR	NR	NR
Hamed et al. 1991 ⁵⁴⁹	107	0%	0	NR	NR	NR	NR	NR	NR	NR
Cusick et al. 1990 ⁵⁵⁰	96	NR	NR	NR	NR	NR	NR	NR	NR	NR
Parker et al. 1990 ⁵⁵¹	103	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sum	54,393		25,760	13,198	11,186	421				

NR = Not Reported

Table 12. Studies of the dissemination of cancerous cells during biopsy procedures

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Michalopoulos et al. 2008 ⁸	Prospective study. Patients underwent core-needle biopsy followed by open surgery 6-8 days later. The needle track was excised and examined by a pathologist.	21 with DCIS and 10 with invasive ductal carcinoma	Vacuum-assisted 11G Mammotome device	No cases of dissemination of cancerous cells were observed. In two cases benign epithelial displacement was observed. The duration of the core-needle procedure was significantly longer in these two cases than for cases with no displacement observed.
Uematsu and Kasami 2007 ⁵⁹	The exterior of the core needles was washed immediately following withdrawal and the washings were examined for cells.	207	US-guided 18G automated Bard Magnum gun	65% of the washings were positive for cells. Lesions diagnosed as invasive lobular carcinoma were significantly less likely to have had cells in the washings than lesions diagnosed as DCIS or invasive ductal carcinoma. Biopsies that had been performed using multiple passes were slightly but not significantly more likely to yield cells in the washings than biopsies performed with a single pass.
Fitzal et al. 2006 ⁷³	Retrospective case-control study of patients treated with breast conserving surgery and radiotherapy, with or without chemotherapy/hormonal therapy.	189 with preoperative core-needle biopsy, 530 without preoperative core-needle biopsy	14G or 11G; stereotactic or US guidance; vacuum assisted or not.	In patients with preoperative core-needle biopsy the local recurrence rate was 1.1% with a median followup of 78 months (range 46 to 108 months); the mortality rate was 0%. In patients without preoperative core-needle biopsy the local recurrence rate was 2.1% with a median followup of 71 months (range 8 to 128 months); the mortality rate was 4.7%.
Newman et al. 2006 ⁹³	Retrospective chart review of women who underwent sentinel lymph node biopsy	279 with core-needle biopsy, 41 with fine-needle biopsy, and 217 with open excisional biopsy	Not described	The method of biopsy did not correlate with metastasis to the sentinel lymph node; however, patients who underwent excisional biopsy were more likely to have micrometastases to the sentinel lymph node than patients who underwent needle biopsies.
Uriburu et al. 2006 ¹⁰²	Case report	3	14G under stereotactic guidance	Three women treated with skin-sparing mastectomy are reported on. All three developed recurrences of their breast tumors at the core-needle biopsy scar. Two of the three had invasive ductal carcinomas and one had a mucinous carcinoma.

Table 12. Studies of the dissemination of cancerous cells during biopsy procedures (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Hansen et al. 2004 ¹⁵¹	Retrospective chart review of women who underwent sentinel lymph node biopsy	126 with fine-needle biopsy, 227 with core-needle biopsy and 323 with open excisional biopsy	11 or 14G, under stereotactic or US guidance	The incidence of metastases to the sentinel lymph node was significantly higher in women who underwent needle biopsies compared to women who had excisional biopsy.
Hoorntje et al. 2004 ¹⁵³	Prospective study. Patients underwent core-needle biopsy followed by open surgery a mean of 21 days later. The needle track was excised and examined by a pathologist.	13	14G automated device Bard under stereotactic guidance	Needle tracks were visible in 11 cases, and of these, 7 had displaced cells in the needle track.
Peters-Engl et al. 2004 ¹⁵⁸	Retrospective review of women who underwent sentinel lymph node biopsy	1048 with fine-needle or core-needle biopsy, 842 with open excisional biopsy	Not described	Patients who had undergone a needle biopsy had a 1.37 times increased risk of metastases to the lymph nodes, but after adjusting for known risk factors of axillary node metastases this result was overturned, 1.09 times increased risk (95% CI: 0.85% to 1.40%).
Chen et al. 2002 ²⁰⁷	Retrospective review of women treated with breast-conserving surgery and radiation therapy	86 with core-needle biopsy, 465 with open excisional biopsy	14G Bard device or 11G vacuum-assisted device Mammotome, all under stereotactic guidance	At a mean followup of 4.9 years (range 2.0 to 8.9 years), tumor recurrence rate was 2.3% in the core-needle group and 7.7% in the open biopsy group.
Knight et al. 2002 ²¹⁹	Retrospective review of women treated with breast-conserving surgery; 78.6% had radiation therapy as well	297 with core-needle biopsy, 101 with open excisional biopsy	14G Bard device under stereotactic or ultrasound guidance	At a mean followup of 29.7 months (Range: 2 to 90 months) 3.7% of the patients with core-needle biopsy had a tumor recurrence compared to 3.96% of patients with open biopsy who had a tumor recurrence.
Chao et al. 2001 ²⁴⁵	Case report	3	14G under stereotactic guidance	Two of the patients developed tumor recurrences at the site of the core-needle biopsy; the third patient had the needle track excised 1 month after biopsy and cancer cells were detected in the needle track. None of the patients received radiation therapy for the primary tumor.

Table 12. Studies of the dissemination of cancerous cells during biopsy procedures (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
King et al. 2001 ²⁵⁸	Retrospective review of women diagnosed with breast cancer by either core-needle biopsy or wire-localized open excisional biopsy and then treated with breast-conserving surgery; 91% had radiation therapy as well	132 with core-needle biopsy, 79 with open excisional biopsy	14G under US or stereotactic guidance	At a median followup of 44.4 months 3.0% of patients with core-needle biopsy had tumor recurrences; at a median followup of 50.1 months 2.5% of patients with open biopsy had tumor recurrences.
Stoller et al. 2000 ³⁰⁵	Prospective study. Patients underwent core-needle biopsy followed by open surgery a mean of 10.5 days later. The needle track was excised and examined by a pathologist.	89	14 or 11G, stereotactic or US guidance, multiple puncture or vacuum-assisted	2 patients had tumor cells in the needle tract. One of these patients had a local tumor recurrence 34 months after surgery at the biopsy site. Both of these patients had multiple puncture core-needle biopsies and no radiation treatment.

US = Ultrasound

Table 13. Surgical procedures avoided

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Altomare et al. 2005 ¹⁰⁸	Retrospective chart review of patients with nonpalpable breast lesions who underwent core-needle biopsy between January 2001-January 2004.	591	US or stereotactic guided vacuum-assisted biopsy (Mammotome) 11 gauge needle or ABBI	Core-needle biopsy spared a surgical procedure for 128 cancer patients and 134 non-cancer patients, but did not spare a procedure in 17 women
Bolivar et al. 2005 ⁴⁵⁷	Prospective case series of patients with non-palpable suspicious breast lesions who underwent core-needle biopsy from August 1997-August 2001.	198	US guided (7.5 MHz linear array transducer) using a freehand technique with patient in supine or supine oblique position.	Core-needle biopsy spared 155/198 (or 78%) women a surgical procedure.
Chapellier et al. 2005 ⁴⁵⁴	Prospective case series of the first 318 aspiration guided macrobiopsy procedures performed at one institution. The majority of patients had microcalcifications; approximately 50% were BIRADS 4 while 35% were BIRADS 3 but had risk factors.	301	Fischer stereotactic imaging table, vacuum-assisted biopsy (AND).	128 BIRADS 4 patients and six BIRADS 5 patients were spared an additional operation by use of core-needle biopsy.
Carmon et al. 2004 ¹³⁹	Retrospective chart review of patients with nonpalpable breast lesions who were ultimately operated on for primary breast carcinoma between 1997-mid-2001.	167	Percutaneous image guided core biopsy	From 1997 to 2001, the percent of patients requiring a second operation decreased from 56.2% to 11.1%, with increased availability of a preoperative diagnosis. 79.2% of subjects with a preoperative diagnosis of invasive duct carcinoma had axillary lymph node dissection vs. 37.7% of those without a preoperative CNB diagnosis.

Table 13. Surgical procedures avoided (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Apesteguia et al. 2002 ⁴⁷⁸	Prospective consecutive case series of patients with nonpalpable breast lesions non-visible or non-accessible by US.	126	Vacuum-assisted core biopsy on a digital stereotaxic table with an 11 gauge needle.	Second surgical procedures due to involved margins were required in 17.4% of cases and 5 additional lymphadenectomy procedures were needed based on core-needle biopsy's inability to predict invasion.
Liberman et al. 2002 ⁴⁸²	Retrospective study. Rate of spared surgical procedures was compared for those whose lesion was completely excised compared to those whose lesion was only sampled.	800 (565 calcifications, 194 mass, 41 both)	Vacuum-assisted core biopsy (Mammotome) with 11 gauge needle	466 lesions were totally removed by the core-needle procedure. Surgery was spared in 80.6% of lesions. There was not a significant difference between the excised versus sampled lesion groups in spared surgery rates (81.5% vs. 82%, p = 0.95).
Becker et al. 2001 ⁴⁸⁷	Retrospective chart review of lesions with indeterminate microcalcifications	218	DMR regular mammography machine plus either a Stereotix 2 conventional add-on unit or a SenoVision digital add-on unit. Core-needle biopsy was performed with a 14 gauge needle in all but 5 cases (in which a 16 gauge needle was used)	Open biopsy was avoided in 78 (69.6%) of patients in the conventional treatment group and in 78 (73.6%) of the digital treatment group.

Table 13. Surgical procedures avoided (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Liberman et al. 2001 ²⁶¹	Retrospective review of women with calcifications highly suggestive of malignancy who underwent a diagnostic biopsy procedure from 1993-2000.	139	Stereotactic vacuum-assisted biopsy with 11 or 14 gauge needle	The mean number of surgical procedures was 1.2 and 1.6 for core-needle biopsy vs. surgical biopsy. 62% of surgical biopsy patients overall and 83.8% of diagnostic surgical biopsy with cancer needed two procedures. The likelihood of requiring a single operation was greater for women who had core-needle biopsy. A surgical procedure was spared in 58.4% of this group.
Perez-Fuentes et al. 2001 ⁴⁹⁴	Prospective case series of patients seen between August 1998-December 2000 with palpable or nonpalpable breast masses	83	US-guided vacuum-assisted biopsy (Mammotome) with 11 gauge needle	Of the 83 patients studied, 79 were spared a surgical procedure (95.2%).
Verkooijen et al. 2001 ⁵⁵²	Prospective comparison of patients with nonpalpable breast lesions	164	Patient prone, 14 gauge needle	In 75% of core-needle cases, only a single surgical procedure was needed, while this was true in only 16% of open biopsy cases (p <0.001). Mean number of surgical procedures was 1.31 vs. 1.91 (p <0.001) in the core-needle and open biopsy groups, respectively.
Liberman et al. 2000 ⁵⁰²	Retrospective chart review of patients with breast masses that were palpable on physical examination from 1992 to 1998.	107	Stereotactic or US-guided core biopsy with a 14 gauge needle.	Core-needle biopsy spared 74% of subjects in this study an additional diagnostic tissue sampling

Table 13. Surgical procedures avoided (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Morrow et al. 2000 ²⁶⁸	Prospective nonrandomized comparative study of patients with nonpalpable mammographically detected abnormalities	1550	Core-needle or open biopsy	Among those with cancer, a single procedure was performed in 33% of the excisional biopsy subjects versus 84% of the core-needle group (p <0.001). The core-needle group consistently had a larger proportion of subjects treated with a single procedure, regardless of lesion type: for architectural distortions 71% vs. 46% and for highly suspicious lesions 83% vs. 45%.
Al-Sobhi et al. 1999 ³⁰⁹	Retrospective review of patients found to have cancer	67	Vacuum-assisted with an 11 or 14 gauge needle	The number of surgical procedures performed in an operating room differed significantly for the two groups overall (CNB mean 1.1 ±0.3 and wire localization mean 1.8 ±0.4). For the subset who underwent breast conserving treatment a significant difference between groups was also evident, mean surgical procedures were 1.2 ±0.4 and 2.1 ±0.2, respectively.
Williams et al. 1999 ³⁴⁷	Prospective case series of patients with impalpable breast lesions diagnosed by stereotactic CNB on a prone table vs. a historical cohort of patients with similar lesions diagnosed prior to the use of prone stereotactic CNB.	222	Stereotactic prone core-needle with Mammotest and 14 gauge needle.	More patients in the prone group required only a single operation (p <0.03). The average number of operations was 1.33 (SE 0.053) vs.1.47 (SE 0.054) in the prone and control groups, respectively.

Table 13. Surgical procedures avoided (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Johnson et al. 1998 ³⁵⁸	Retrospective review of patients with malignant appearing microcalcifications without an associated parenchymal abnormality on mammography.	167	Stereotactic biopsy was performed using Lorad Stereotactic prone biopsy table with 14 gauge needle. Digital mammography was used to localize the lesions. US biopsies were performed using a 7.5 MHz probe with real time imaging using the same CNB device.	The mean number of procedures required until definitive treatment was 2.4 and 1.7 for the initial IGBB and initial NLOB, respectively ($p = 0.0002$)
Kaufman et al. 1998 ³⁵⁹	Retrospective review of consecutive mammographically detected nonpalpable breast lesions ultimately diagnosed as in situ or invasive carcinoma.	113	Core-needle or open biopsy	Negative margins were achieved twice as often in the core-needle group as in the open biopsy group after the first surgical procedure (77% vs. 38%, $p < 0.001$). A one stage surgical procedure was possible in many more of the core-needle patients than in the open biopsy group (79% vs. 21%, $p < 0.001$). On average, 2.2 procedures (surgery and biopsy) were needed in the core-needle group vs. 1.8 among the open biopsy patients. However, the average number of surgeries was 50% higher in the open biopsy group (1.8 vs. 1.2).
Liberman et al. 1998 ⁵¹⁶	Retrospective review of patients with nonpalpable breast masses.	151	US guided biopsy was performed in the supine or supine oblique position using high resolution (7.5 MHz linear array transducer) equipment with a 14 gauge cutting needle.	85% of patients in this study were spared a surgical procedure by use of core-needle biopsy.

Table 13. Surgical procedures avoided (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Lind et al. 1998 ³⁶⁵	Retrospective review of patients with mammographically detected breast cancer that underwent breast conserving surgery	117	Biopsies were performed on a dedicated prone table with 14 gauge needle	Only 6% of patients in the core-needle group had positive margins vs. 55% of the open biopsy patients (p <0.01). One patient with positive margins in the core-needle group was re-excised vs. 34/38 of those with positive margins in the open group (p <0.01).
Fenoglio et al. 1997 ³⁸²	Retrospective chart review of patients with mammographically detected breast cancer	40	14 gauge long throw Biopsy gun plus MammoTest Stereotactic System	All 20 patients diagnosed with core-needle biopsy required one surgical procedure only whereas among the 20 initially diagnosed with open biopsy a total of 41 procedures were required to diagnose and treat their cancers
Lieberman et al. 1997 ³⁹¹	Retrospective chart review of nonpalpable breast cancers	197	Stereotactic CNB were done with patient in prone position using StereoGuide; sonographically guided CNB were done with patients in supine or supine oblique using a 7.5 MHz linear array transducer and high resolution sonographic equipment; all CNB used a 14 gauge needle or an ultra-core biopsy needle.	84% of patients in the CNB group underwent a single surgical procedure vs. 29% of those diagnosed by surgical biopsy (p <0.00001). 16% of the CNB patients required two surgical procedures while 66% of the open-biopsy patients needed two surgeries and 5% underwent three surgical procedures.
Smith et al. 1997 ³⁹⁶	Retrospective review.	677	US-guided MammoTest (67) or wire localized excisional biopsy (610)	On average 1.25 surgical procedures were required by the core-needle group versus 2.01 in the surgical biopsy group (p <0.001).

Table 13. Surgical procedures avoided (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Sutton et al. 1997 ⁵²⁸	Retrospective review of patients with nonpalpable mammographic abnormalities detected at routine screening in a community based clinic.	200	Biopsies were performed on a dedicated prone stereotactic table (Mammotest) with an autoguide attachment and 14 gauge 22 mm-throw Bard Biopty-cut needles held in a Bard Biopty gun.	The authors estimated that open biopsy was avoided in 82% of cases by using core-needle biopsy for diagnosis.
Whitten et al. 1997 ³⁹⁸	Retrospective review	171	Stereotactic or US guided biopsy with a 14 gauge needle	Among the 86 subjects diagnosed by image guided core needle biopsy, 98 surgical procedures were completed (1.1 surgeries per patient) compared with 1.9 operations on average for the 85 patients undergoing a diagnostic needle localized biopsy (157 surgeries total in 85 subjects).
Yim et al. 1996 ⁴¹⁷	Retrospective review	52	Stereotactic biopsy with a 14 gauge needle was performed on a dedicated prone table	At the time of excision, surgical margins were more frequently positive in the open biopsy group (55%) vs. the CNB group (0%); the distance of the tumor from the surgical margin was greater for the CNB vs. open biopsy patients among the negative margins; and, among those having breast conservation surgery, the rate of re-excision was higher for the open biopsy group (74%) vs. no patients in the CNB treatment group.

Table 13. Surgical procedures avoided (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Liberman et al. 1995 ⁴²¹	Retrospective chart review of patients with impalpable speculated masses.	43	Biopsies were performed with patients prone on a dedicated table using either a 14 gauge Bard Biopty needle or a 14 gauge Manan needle and either a Bard Biopty gun with 23 mm throw or Manan ProMag 2.2 gun with a 22 mm throw.	The use of core-needle biopsy in the diagnosis of breast cancer reduced the number of procedures required in 33 (77%) patients.
Strong et al. 1995 ⁴²⁶	Prospective study of patients with mammographically detected, asymptomatic, nonpalpable breast lesions	97	Mammotest stereotactic device using 14 gauge Manan needle.	In eight benign cases, open biopsy was performed, adding an extra procedure to the diagnostic protocol for these patients. However, 74 women (76%) were spared an open biopsy by core-needle biopsy. As the 15 women with carcinoma went directly to mastectomy without an open biopsy, core-needle biopsy did not add a diagnostic procedure in these cases.
Elliott et al. 1992 ⁴⁴²	Retrospective review of 12 month period of patients with nonpalpable breast lesions.	115	Mammotest II with 18 gauge Bard biopsy needle using Bard Biopty gun	Core-needle biopsy spared 97 patients an open surgical biopsy.

Table 14. Patient procedure preference

Reference	Design of study	Number of patients	Biopsy methods	Conclusion
Duschesne et al. 2007 ²⁴	Prospective trial of new device	113	US guided radiofrequency tipped vacuum-assisted with 9 gauge needle (SenoCor 360 Biopsy System).	They rated patient comfort as equivalent with other types of biopsies.
Krainick-Strobel et al. 2007 ³⁶	Prospective case series of patients with benign lesions undergoing biopsy for the purpose of complete extirpation.	45	Hand-held US guided vacuum-assisted biopsy (Mammotome) using either an 8- or 11-gauge needle.	Ninety-five percent of respondents said they would prefer core-needle to open excisional biopsy if they needed a future procedure. A minimum of 7 days post-procedure, patients were given a questionnaire about their experience. The mean level of satisfaction with the procedure, on a scale of 0-10, was 9.2 (range 3-10).
Killebrew et al. 2006 ⁸³	Retrospective comparison study of patients with BIRADS 4 or 5 and mammographic lesions presenting as microcalcifications.	1600	Vacuum-assisted procedure (Mammotome) with 11 gauge needle vs. vacuum assisted intact specimen biopsy with 10 or 15 mm probe.	Self-reports by patients showed that those undergoing both treatments tolerated their respective procedures equally. Patients were asked to rate the biopsy procedure for comfort and to rate comfort of lying on stereotactic table, as a comparison. In the vacuum-assisted arm, ratings of 5.8 and 2.0 (with 10 = extreme pain) were given for lying on table and actual biopsy procedure, respectively. In the other group, the ratings were 4.1 and 1.9 respectively.

Table14. Patient procedure preference (continued)

Reference	Design of study	Number of patients	Biopsy methods	Conclusion
Chapellier et al. 2005 ⁴⁵⁴	Prospective case series of the first 318 aspiration guided macrobiopsy procedures performed at one institution. The majority of patients had microcalcifications; approximately 50% were BIRADS 4 while 35% were BIRADS 3 but had risk factors.	301	Fischer stereotactic imaging table, vacuum-assisted	Patient tolerance of procedure was excellent, as measured by a self-administered patient questionnaire. The authors also found that the post-procedure psychological state was associated with the procedure outcome, the information given to patients and the attitudes of medical staff members.
Weber et al. 2005 ⁴⁶²	Retrospective comparison study of patients with nonpalpable breast lesions	387	Stereotactically guided vacuum-assisted (Mammotome) technique with 11 gauge needle or ABBI	Three patients in this series underwent both procedures but they did not indicate a preference for one over the other.
Wong et al. 2005 ¹³⁴	Prospective trial of Asian patients with nonpalpable mammographic abnormalities	114	Vacuum-assisted (Mammotome) on a prone biopsy table with 8 to 11 gauge needle	Bruising (one week post-procedure) occurred in 79 patients (46 minimal, 25 mild, 5 moderate and 3 severe. All patients were able to be discharged after 2-3 hours following the procedure and all reported the procedure was acceptable without undo discomfort.
Alonso-Bartolome et al. 2004 ⁴⁶⁴	Prospective study of women with probably benign breast lesions who refused radiologic follow-up and, instead, insisted on removal. Complete lesion removal was the intended goal for all lesions.	97	US-guided vacuum-assisted biopsy (Mammotome) with 11 gauge needle	Patients estimated that the time lost to core-needle biopsy is less than 20% of the time required for a surgical biopsy.

Table14. Patient procedure preference (continued)

Reference	Design of study	Number of patients	Biopsy methods	Conclusion
Geller et al. 2004 ¹⁴⁶	Survey of women with nonpalpable breast lesions	315	US guided core-needle biopsy or open excisional biopsy	Survey results 1-3 months post procedure measured convenience of the procedure (distance travelled, procedure time, and number of days of work missed post procedure). No difference was found between two groups in terms of miles travelled for procedure, but the excisional biopsy group missed more work.
March et al. 2003 ⁴⁷⁴	Prospective study of women with breast masses who underwent biopsy in which complete removal of the lesion was attempted.	34	US guided vacuum-assisted biopsy with an 11 gauge biopsy device	Radiologists examined the biopsy site 2-5 days post-procedure and found 24 subjects (71%) had ecchymosis, nine (26%) had no visible abnormality aside from the skin incision and one (3%) had slight skin convexity without ecchymosis at the biopsy site. Twenty-one subjects who did not undergo an open procedure were examined at 6 months post core-needle biopsy. All 21 said they would recommend the procedure to others.
Mariotti et al. 2003 ¹⁹¹	Retrospective study of patients with suspicious non palpable mammographic lesions not confirmed by ultrasonography.	360	Vacuum-assisted (Mammotome) with an 11 gauge needle or ABBI	Patient acceptance of the biopsy procedure was high

Table14. Patient procedure preference (continued)

Reference	Design of study	Number of patients	Biopsy methods	Conclusion
Fine et al. 2003 ¹⁸⁰	Women with low risk palpable masses were assessed prospectively.	216	Vacuum assisted (Mammotome) with US guidance with either an 8 or 11 gauge probe	A majority of patients stated that they would recommend the procedure to others in a survey conducted 10 days post-procedure (82% and 92%; respectively).By the 6 month follow-up visit, 100% stated they would recommend the procedure to others, while 97% stated they themselves would have the procedure again, if needed.
Chun et al. 2002 ²⁰⁸	Retrospective review and survey of patients who had undergone a Mammotome, ABBI or wire localized biopsy more than 2 years ago for benign disease.	59	Stereotactic vacuum-assisted 11 gauge (Mammotome) or stereotactic excisional biopsy with ABBI (15 or 20 mm cannula) or wire localized open biopsy	The biopsy experience was rated as satisfactory by 90%, 75% and 80% of patients in the open, ABBI, and Mammotome groups, respectively. Complaints about the procedures included uncomfortable (2 Mammotome, 4 ABBI), pain (2 each open and Mammotome), painful breast compression (3 ABBI), delay in getting results (1 each Mammotome and ABBI), rude doctors (2 Mammotome) and length of procedure (1 open).
Hui et al. 2002 ²¹⁵	Prospective case series of patients with nonpalpable breast lesions requiring a biopsy procedure.	79	Stereotactic guided breast biopsy (StereoGuide with Digital Spot Mammography): Trucut with a 14 gauge needle, vacuum-assisted (Mammotome) with 11 gauge probe	31.6% of patients were very satisfied with the procedure; 73.7% felt the level of pain associated with the biopsy was less severe than erect mammography; 34.2% felt the pain experienced was less severe than needle pricking; and 14.5% felt it was less severe than previous free-hand or ultrasound guided breast biopsy.

Table14. Patient procedure preference (continued)

Reference	Design of study	Number of patients	Biopsy methods	Conclusion
Beck et al. 2000 ⁴⁹⁹	Retrospective review of first experience using vacuum-assisted core-needle biopsy.	560	Digital stereotaxic biopsy table, vacuum-assisted (Mammotome) with 11 gauge needle.	A majority of patients tolerated the procedure well.
Gukas et al. 2000 ²⁸⁹	Prospective study of 112 consecutive patients with palpable breast lesions	108	Tru-Cut and excisional biopsies.	A majority of patients, 90.7%, accepted the procedure. The authors note that patients experienced more apprehension about the procedure than actual discomfort.
Welle et al. 2000 ⁵⁰⁵	Retrospective review of patients who underwent a stereotactic CNB in a decubitus or recumbent position from September 1995-March 1999.	225	Stereotactic guided core-needle biopsy in a decubitus or recumbent position.	Two patients out of the 225 had experienced a traditional prone position CNB and both stated they preferred the decubitus position, preferring to lie on their sides. Overall, 29% of patients reported mild discomfort or numbness in the dependent arm with the decubitus or recumbent position.
Doyle et al. 1999 ⁵¹²	Retrospective study of patients with mammographically detected lesions	151	Senographe 600T was used for 136 biopsies; 15 using Mammomat 3000; all in decubitus position unless the patient couldn't tolerate that positioning and with a 14 gauge needle.	90% of subjects were able to tolerate the decubitus position although some developed discomfort in the dependent arm and required supporting the arm away from the body on a chair or small trolley.
Helbich et al. 1998 ³⁵⁶	Prospective randomized study of consecutive patients with indeterminate or suggestive lesions on mammography	64	Mammotest stereotactic system with 13 gauge coaxial needle.	Author reports that all patients tolerated the procedure well.

Table14. Patient procedure preference (continued)

Reference	Design of study	Number of patients	Biopsy methods	Conclusion
Handy et al. 1996 ⁴⁰⁸	Prospective survey of patients Patients completed a pre-procedure survey, one immediately after the procedure, one 24 hours post-procedure and 5 days later.	58	StereoGuide SM Breast Biopsy System with 14 gauge needle. The majority of patients were in a prone position.	67% of patients reported that they understood the procedure they were about to undergo. Immediately after the procedure, 78% said they understood the procedure but the remainder still felt they did not understand it. Five of those who initially thought they understood decided they really had not after experiencing it. 38% said the clinic nurse/technologist was the best source of information about the procedure, 26% said it was the physician, 15% said there was no good source of information available to them and 21 said other (books, friends, popular media). Pre-procedure, 79% were most concerned about the results of the biopsy while 10% were most concerned about the procedure itself. 31% reported none or slight anxiety about the impending procedure, 60% said they were mild to moderately anxious and 9% were extremely anxious. Five days post procedure, 97% said they would have the procedure again in the future, if needed.
Elliott et al. 1992 ⁴⁴²	Retrospective review of 12 month period	115	Mammotest II with 18 gauge Bard biopsy needle using Bard Biopty gun	The authors explain that patients are very accepting of the CNB procedure and found the test easy to perform in the office.

US = Ultrasound

Table 15. Cosmetic outcome

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Krainick-Strobel et al. 2007 ³⁶	Prospective case series of patients with benign lesions undergoing vacuum-assisted biopsy for the purpose complete lesion removal	45	Hand-held ultrasound-guided vacuum-assisted CNB biopsy (Mammotome) using either an 8- or 11-gauge needle.	Ninety-five percent of respondents said they would prefer CNB to open excisional biopsy if they needed a future procedure. A minimum of seven days post-procedure, patients were given a questionnaire about their experience. All patients said that the scar from the needle was cosmetically unimportant to them and, on a scale of 0-10, their mean level of satisfaction with CNB was 9.2 (range 3-10).
Weber et al. 2005 ⁴⁶²	Retrospective comparison study of patients with impalpable breast lesions undergoing either Mammotome or ABBI	387	Stereotactically guided vacuum-assisted CNB biopsy (Mammotome) technique with 11 gauge needle or ABBI	Incomplete satisfaction with the cosmetic result occurred at a higher rate in the ABBI group (6.7% vs. 1.3%, $p = 0.03$).
Wong et al. 2005 ¹³⁴	Prospective trial of Asian patients with nonpalpable mammographic abnormalities underwent either ABBI (N = 7) or Mammotome (N = 107).	114	CNB was performed on a prone biopsy table with Vacuum-assisted CNB (Mammotome) with 8-11 gauge needle or ABBI.	Bruising (one week post-procedure) occurred in 79 patients (46 minimal, 25 mild, 5 moderate and 3 severe) and at one-month follow up a scar was visible in 79 patients (40 minimal, 32 mild, 7 moderate, 0 severe).

Table 15. Cosmetic outcome (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Mariotti et al. 2003 ¹⁹¹	Retrospective study of patients undergoing either ABBI or Mammotome from June 1999-December 2001 for suspicious non palpable mammographic lesions not confirmed by ultrasonography	360	Vacuum-assisted CNB (Mammotome) with 11 gauge needle or ABBI	Both surgeons and patients were pleased with the cosmetic outcome.
March et al. 2003 ⁴⁷⁴	Prospective study of women with breast masses who underwent CNB in which complete removal of the lesion was attempted.	34	Ultrasound guided vacuum-assisted CNB with an 11 gauge biopsy device	The twenty-one subjects who did not undergo an open procedure following CNB were examined at 6 months post CNB. Nineteen (90%) were very satisfied with appearance of biopsy area, 2 were satisfied and none were dissatisfied. Sixteen were very satisfied with how the biopsy area felt, 5 satisfied, none dissatisfied. At 6 month follow-up examination, four (19%) had no visible scar, 17 (81%) minimal scarring = 2-9 mm, none had skin retraction concavity, convexity, or other changes in breast contour.

Table 15. Cosmetic outcome (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Fine et al. 2003 ¹⁸⁰	Women who underwent CNB for low risk palpable masses were assessed prospectively.	216	Ultrasound guided vacuum assisted handheld biopsy device (Mammotome) with either an 8 or 11 gauge needle	A majority of patients were both satisfied with the appearance of their incisions and stated that they would recommend the procedure to others in a survey conducted 10 days post-procedure (82% and 92%; respectively).By the 6 month follow-up visit, 100% were happy with the incision's appearance and would recommend the procedure to others, while 97% stated they themselves would have the procedure again, if needed.
Kettritz et al. 2003 ⁵⁵³	Retrospective analysis of patients who underwent a CNB between January 1996-June 2000for indeterminate lesions and microcalcifications.	2874	Vacuum-assisted CNB on a digital prone table (Mammotest) with an 11gauge needle.	Scarring at the latest postbiopsy visit was graded as not relevant (86%), slight (14%) or relevant (0.3%).

Table 15. Cosmetic outcome (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Chun et al. 2002 ²⁰⁸	Retrospective review and survey of patients who had undergone a Mammotome, ABBI or wire localized biopsy more than 2 years ago for benign disease, 20 patients per group.	59	Stereotactic vacuum-assisted CNB biopsy (Mammotome) with 11 gauge needle or stereotactic excisional biopsy with ABBI (15 or 20 mm cannula) or wire localized open biopsy	Patients were asked to rate the appearance of their scar, if they were satisfied with the biopsy procedure, and which mattered most to them, complete lesion removal or scar appearance. Ninety-five percent of the core-needle biopsy group and only 25% of the open biopsy group were very satisfied with the appearance of their breast. None of the core-needle biopsy group said the cosmetic results were unacceptable compared to 20% of the open biopsy group who found the results unacceptable. Overall, eighty percent of subjects were more concerned with complete lesion removal than scar appearance.
Perez-Fuentes et al. 2001 ⁴⁹⁴	Prospective case series of patients seen between August 1998-December 2000 with palpable or nonpalpable breast masses diagnosed with CNB.	83	Ultrasound guided vacuum-assisted CNB (Mammotome) with 11 gauge needle	No scarring was evident at follow-up.
Beck et al. 2000 ⁴⁹⁹	Retrospective review of first experience using vacuum-assisted CNB	560	Digital stereotaxic biopsy table and vacuum-assisted CNB (Mammotome) 11 gauge needle.	In 90% no scar was visible at final follow-up.

CNB = Core-needle Biopsy

Table 16. Physician experience

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Duschesne et al. 2007 ²⁴	Prospective trial of new device used on patients already scheduled for CNB between December 2002-April 2003.	113	US guided radiofrequency tipped vacuum-assisted CNB with 9 gauge needle (SenoCor 360 Biopsy System).	Operators of the new device rated it in terms of ease of penetration, positioning and holding the device, acquiring a satisfactory specimen, positioning accuracy, safety, and patient comfort and compared it to existing spring and vacuum devices based on their past experiences with these. All operators of the study device were experienced in US breast biopsy techniques. Operators found the new device to be equivalent to 14 gauge biopsy devices but superior to other vacuum-assisted devices in terms of penetration of the lesion and positioning of the device at the desired location. They rated patient comfort as equivalent with other types of biopsies.
Holloway et al. 2007 ³⁰	Retrospective review of patients with breast abnormality seen between April 2002-December 31, 2002 who were diagnosed by CNB or fine-needle aspiration and/or surgery as the initial procedure in Ontario Canada.	17,068	Fine-needle aspiration or CNB or mastectomy	Differences in the availability of the CNB (specialized expertise) may account for some of the geographic variation in how often women received a needle-biopsy procedure rather than proceeding immediately to open surgery.
Liberman et al. 2007 ⁴³	Retrospective chart review of patients who had lesions detected with MRI and then had an MRI guided CNB	237 lesions	MRI guided vacuum-assisted CNB with a 9 gauge needle	The median number of previous MRI-guided CNB performed by the radiologists was 21 (Range: 1-55).

Table 16. Physician experience (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Hoffman 2005 ⁷⁸	To compare the quality of service at a clinic only partially staffed with breast specialists in 1998 to the same clinic in 2003 after it had become fully specialized. Technologically, the only change in diagnostic equipment in that time period was more sophisticated US scanners, which were used in a majority of 2003 procedures but only a small percent of 1998 procedures.	5451	CNB vs. excisional biopsy	Over time, excisional biopsy was used less, more women had breast conserving surgery and complication rates decreased. It is the author's conclusion that a dedicated, specialized breast care center improved the quality of care.
Lehman et al. 2004 ¹²³	Retrospective review of consecutive patients with nonpalpable lesions not clearly visible on mammography or targeted sonography, many of whom had recently been diagnosed with breast cancer.	28	MRI-guided vacuum-assisted CNB with the ETEC Breast Biopsy and Excision System.	The experience level of those performing the procedures was low, with half having no prior experience and the other half having one month of experience performing the procedure only (although they had one year of experience with MRI guided CNB).
Popiela et al. 2002 ²²⁶	Retrospective review of asymptomatic women without pathological resistance on physical examination but with breast pathologies below 0.5 cm confirmed by complementary examination.	122	Vacuum assisted CNB (Mammotome) biopsy with either ultrasonography or digital mammography guidance	The authors contend that a lack of experience, rather than a problem with the equipment, explains problems encountered early on in precise targeting and complete removal of the lesion.
Schneider et al. 2001 ²⁷⁵	Prospective case series of patients undergoing a new unilateral MR guided breast lesion localization and core biopsy system.	14	MR image guidance CNB using a mechanical needle guide and trajectory planning software with 14 gauge needle.	The authors report that the new device is intuitive and easy to use as well.
Wunderbaldinger et al. 2001 ⁴⁹⁷	Prospective nonconsecutive first-experience case series of patients with nonpalpable breast lesions diagnosed by CNB followed by surgical excision.	45	New dedicated US system for computer guided CNB (Sonopsy) with a 14 gauge needle.	The authors also comment that this new device may hold promise for non-skilled physicians.

Table 16. Physician experience (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
McMahon et al. 1992 ⁵⁴⁸	Prospective randomized trial of consecutive patients with palpable breast lumps. Patients were randomized to percutaneous biopsy using Tru-Cut 14 gauge needle, Biopty-cut 14 gauge needle or a Biopty-cut 18 gauge needle.	151	Biopty-cut needles were used with the Biopty gun. A standard technique was used for the Tru Cut.	Tru Cut's poor performance (sensitivity 68%) may be related to the fact that eight different surgeons performed the 49 Tru Cut biopsies included in this study whereas the Biopty gun, with an absolute diagnostic sensitivity of 92%, may be less dependent on operator experience.
Parker et al. 1990 ⁵⁵¹	Prospective case series of consecutive patients referred for biopsy of nonpalpable mammographically suggestive lesions. Subjects underwent CNB followed by wire localization and excisional surgery.	103	14-, 16-, or 18-gauge Biopty-cut needles were used in conjunction with a Biopty gun. The first 30 patients were treated with Senographe Mammographic System 600T coupled with Stereotix computerized stereotactic needle localization device. Logistical problems caused investigators to switch to the Mammostest Stereotactic System for remaining patients.	Increased operator experience brought about a reduction in procedure time.

CNB = Core-needle Biopsy

Table 17. Procedure duration time

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Duschesne et al. 2007 ²⁴	Prospective trial of new device used on patients already scheduled for CNB between December 2002-April 2003.	113	US guided radiofrequency tipped vacuum-assisted (SenoCor 360 Biopsy System) with 9 gauge needle	Procedure time is decreased for this device as the breast tissue offers no resistance to penetration, but the authors do not report a time estimate.
Liberman et al. 2007 ⁴³	Retrospective chart review of patients who had lesions detected with MRI and then had a MRI guided CNB	237 lesions	MRI guided vacuum-assisted (Mammotome) with 9 gauge needle	Median procedure time was 31 minutes, with procedures ranging from 17-57 minutes in total
Michalopoulos et al. 2007 ⁸	Prospective review of nonpalpable mammographic lesions diagnosed by CNB as either DCIS or IDC then surgically excised.	31	Vacuum-assisted CNB (Mammotome) with 11 gauge needle	Two cases of benign epithelial cell displacement occurred. The duration of the procedure was significantly longer in the two cases with displacement (52.5 ±3.5 minutes) vs. in cases without any displacement (42.0 ±4.4 min., p = 0.018).
Uematsu et al. 2007 ⁶⁰	Retrospective study of all patients who had had an 18 gauge CNB performed from July 2003-June 2004 followed by a surgical excision.	235 lesions	US guided 18 gauge CNB	Average procedure time was 10 minutes.
Viehweg et al. 2006 ¹⁰⁵	Retrospective review of consecutive patients with a family history, but no personal history, of breast cancer.	63	Either MR guided preoperative wire localization or vacuum-assisted CNB.	Examination time was approximately 40 minutes per wire localization and 20-30 minutes for the vacuum-assisted CNB procedure, including pre- and post-interventional imaging.
Bolivar et al. 2005 ⁴⁵⁷	Prospective case series of patients with non-palpable suspicious breast lesions who underwent 14 gauge US guided CNB from August 1997-August 2001.	198	US guided (7.5 MHz linear array transducer) CNB using a freehand technique with patient in supine or supine oblique position.	Examination time did not exceed 20 minutes in any cases.
Chapellier et al. 2005 ⁴⁵⁴	Prospective case series of the first 318 aspiration guided macrobiopsies procedures performed at one institution.	301	Fischer stereotactic imaging table system, AND vacuum-assisted CNB	The procedure, including manual pressure application, took less than one hour in 79% of cases, 90 minutes in 16% of cases, and two hours in about 5% of cases.

Table 17. Procedure duration time (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Diebold et al. 2005 ¹¹⁵	Prospective consecutive case series of patients with mammographic BI-RADS IV microcalcifications who underwent stereostatic vacuum-assisted CNB.	58	Vacuum-assisted CNB (Mammotome) with 8-gauge needle with the ST driver (Holster) on a Mammotest plus S biopsy table.	Mean biopsy time was 28.2 minutes (Range: 10-120 minutes). Removing 5 highly complicated cases from this analysis reduced the average procedure time to 16.1 minutes.
Orel et al. 2005 ⁹⁴	Retrospective review of patients with suspicious lesions identified at MR imaging who either underwent surgery or had six month follow-up imaging.	75	MR guided vacuum-assisted CNB with a 9-gauge needle	Total MRI guided procedure time (including pre-biopsy imaging examination, biopsy and postbiopsy care) ranged from 30-60 minutes.
Perlet et al. 2005 ⁹⁵	Prospective study of MR guided vacuum-assisted CNB visible by CE-MRI alone or localized in 3 dimensions by MRI alone	538	Impact, Expert or Vision MR scanner guidance, vacuum-assisted CNB (Mammotome) with an 11 gauge needle	On average, MR guided CNB lasted 70 minutes if the patient was having one lesion biopsied and 90 minutes for patients with two lesions.
Weber et al. 2005 ⁴⁶²	Retrospective comparison study of patients with impalpable breast lesions undergoing either Mammotome or ABBI.	387	Stereotactically guided vacuum assisted CNB (Mammotome) with 11 gauge needle or ABBI	Median duration of the Mammotome procedure was shorter than the ABBI procedure (p <0.0001).
Wong et al. 2005 ¹³⁴	Prospective trial of Asian patients with nonpalpable mammographic abnormalities underwent either ABBI (N = 7) or vacuum-assisted CNB (N = 107).	114	Vacuum-assisted CNB (Mammotome) with an 8-11 gauge needle prone or ABBI.	Procedures lasted from 30-128 minutes (Median: 68.5).
Alonso-Bartolome et al. 2004 ⁴⁶⁴	Prospective study of women with probably benign breast lesions who refused radiologic follow-up and, instead, insisted on removal. Complete lesion removal was the intended goal for all lesions.	97	US guided vacuum assisted CNB (Mammotome) with 11 gauge needle	Mean procedure time was one hour (Range: 40-75 minutes). Based on a cost to patient estimate in terms of hours lost, investigators report that the time lost to CNB is less than 20% of the time required for a surgical biopsy.

Table 17. Procedure duration time (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Geller et al. 2004 ¹⁴⁶	Survey of women with nonpalpable breast lesions who had an US guided CNB or excisional biopsy between 1997-1999.	315	US guided CNB vs. excisional biopsy.	Survey results 1-3 months post procedure measured convenience of the procedure (distance travelled, procedure time, and number of days of work missed post procedure). No difference was found between two groups in terms of miles travelled for procedure, but the excisional biopsy group missed more work.
Lehman et al. 2004 ¹²³	Retrospective review of consecutive patients with nonpalpable lesions not clearly visible on mammography or targeted sonography, many of whom had recently been diagnosed with breast cancer.	28	MRI-guided vacuum-assisted CNB with the ETEC Breast Biopsy and Excision System.	Time to perform procedure was defined as the start of the first MRI sequence (localizing) to the last scan sequence (clip deployment). The average time for single biopsy procedures was 38 minutes (range: 23-57 minutes). Average time for multiple biopsy procedures in a single breast was 59 minutes (51-68 minutes) and for bilateral procedures 64 (46-80 minutes).
Rotenberg et al. 2004 ¹⁶³	Prospective case series of patients with palpable tumors and patients with tumors which were visible on ultrasound imaging or radiology.	30	Spirotome System with 8-10 gauge needle. No stereotactic tables were used in the study.	Biopsies took a maximum of 20 minutes to complete, with 80% of the biopsies being completed in only 10 minutes.
Chen et al. 2003 ¹⁷³	Retrospective study of patients with nonpalpable breast lesions from January 1998-2001 undergoing either a CNB or open biopsy.	232	Comparison of vacuum-assisted CNB (Mammotome) with 11 gauge needle vs. ultrasound guided excisional biopsy	Procedure times were measured from initial skin incision to wound closure or needle withdrawal. Procedure times were as follows: for benign tumor cases 44.3 and 21.5 minutes (p <0.001); for malignant cases 44.0 and 27.0 (P = 0.036); for tumors <1 cm in diameter, 43.5 and 20.6 (p <0.001) and for tumors 1-2 cm, 44.2 and 23.6 minutes (p <0.001) for open and CNB, respectively. Procedure time for the older model Mammotome device (used in first year of study) vs. newer handheld variant, which was used in the second year, was 24 and 18 minutes on average respectively (p <0.001).

Table 17. Procedure duration time (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Liberman et al. 2003 ¹⁹⁰	Prospective case series of women with one of the following: a nonpalpable mammographically occult lesion at high risk for breast cancer or for extent of disease assessment.	20	MRI guided 9 gauge vacuum assisted breast biopsy.	Imaging time was 20 minutes, on average, including three contrast enhanced acquisitions. Median MRI guided CNB time, from localizing image to imaging after clip deployment was 35 minutes (Mean: 35, Range: 24-48 for a single lesion and 65 minutes (Mean: 69, Range: 62-86) for patients with two lesions. Median tissue acquisition time was 38 seconds (Mean: 41, Range: 29-87).
Mariotti et al. 2003 ¹⁹¹	Retrospective study of patients undergoing either ABBI or CNB from June 1999-December 2001 for suspicious non palpable mammographic lesions not confirmed by ultrasonography.	360	Vacuum-assisted CNB (Mammotome) with 11 gauge needle vs. ABBI	ABBI and Mammotome procedure times were 20 and 10 minutes, on average, respectively, for the operative portion of the procedure only.
Pleiderer et al. 2003 ⁴⁷⁵	Prospective nonconsecutive case series of patients with suspicious breast lesions who had a diagnostic CNB with a new device.	14	Remote controlled MRI compatible prototype manipulator system (ROBITOM) using 14 gauge large core breast biopsy.	Total procedure time was between 50-70 minutes.
Apesteguia et al. 2002 ⁴⁷⁸	Prospective consecutive case series of patients with nonpalpable breast lesions non-visible or non-accessible by US.	126	Vacuum-assisted CNB on a digital stereotaxic table with an 11 gauge needle.	Mean procedure time was 29.6 ±14 minutes (Range: 15-90 minutes).
Hui et al. 2002 ²¹⁵	Prospective case series of patients with nonpapable breast lesions requiring a biopsy procedure.	79	Stereotactic guided breast biopsy (StereoGuide with Digital Spot Mammography): Trucut with a 14 gauge needle, Mammotome with 11 gauge probe, or FNA with a 22 gauge needle, depending on the characteristics of the lesion.	Mean duration of the biopsy procedure was 49 minutes (range: 30-90).

Table 17. Procedure duration time (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Mainiero et al. 2002 ²²²	Prospective nonrandomized comparison study of patients with suspicious breast lesions undergoing a CNB between 1997-1999.	193	Either freehand high resolution sonographically guided large core biopsy with 14 gauge needle vs. stereotactic vacuum-assisted CNB (Mammotest with 11 gauge needle).	The authors examined how much room time and physician time was expended for each type of procedure. They found stereotactic VABB took more room and physician time when all biopsies were examined together. When only room and physician time for patients with masses was examined, only room time significantly differed in the same direction by procedure type. The authors conclude that sonographically guided breast biopsies reduce procedure time compared with stereotactic biopsy.
Becker et al. 2001 ⁴⁸⁷	Retrospective chart review of 232 lesions with indeterminate microcalcifications in 218 women.	218	DMR regular mammography machine plus either a Stereotix 2 conventional add-on unit or a SenoVision digital add-on unit. CNB was performed with a 14 gauge needle in all but 5 cases (in which a 16 gauge needle was used)	Changing from a conventional to a digital add-on unit cut the procedure time by half (from 50 to 20 minutes). Most of this time savings is related to the speed of displaying digital images, 15 seconds per image, versus 3 minutes to develop radiographs.
Perez-Fuentes et al. 2001 ⁴⁹⁴	Prospective case series of patients seen between August 1998-December 2000 with palpable or nonpalpable breast masses diagnosed with CNB.	83	Sonographically guided vacuum-assisted CNB (Mammotome) with 11 gauge needle	Median procedure time (acquisition of prebiopsy sonogram to positioning of sterile bandage on skin) was 17 minutes (Range: 10-40)
Schneider et al. 2001 ²⁷⁵	Prospective case series of patients undergoing a new unilateral MR guided breast lesion localization and core biopsy system.	14	MR image guidance AND CNB using a mechanical needle guide and trajectory planning software with 14 gauge needle.	Mean procedure time was 15 ±5 minutes (Range: 5-24), including 3D acquisition scan, completion of the verification scan, placement of single and multiple stylettes for multiple localization wire placements, and multiple tissue sampling by CNB.

Table 17. Procedure duration time (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Wunderbaldinger et al. 2001 ⁴⁹⁷	Prospective nonconsecutive first-experience case series of patients with nonpalpable breast lesions diagnosed by CNB followed by surgical excision.	45	New dedicated US system for computer guided CNB (Sonopsy) with a 14 gauge needle.	Average procedure time (including patient positioning, biopsy, localization but not post procedural handling) was 30 ±2.7 minutes.
Beck et al. 2000 ⁴⁹⁹	Retrospective review of first experience using vacuum-assisted CNB	560	Digital stereotaxic biopsy table and vacuum-assisted CNB (Mammotom) with 11 gauge needle.	The authors report that patient positioning took approximately 15 minutes; 30 minutes for the actual procedure; 15 minutes for compression; 10 minutes for a final mammogram; and another 30-45 for observation.
Welle et al. 2000 ⁵⁰⁵	Retrospective review of patients who underwent a stereotactic CNB in a decubitus or recumbent position from September 1995-March 1999.	225	Stereotactic CNB in a decubitus or recumbent position.	Procedure time was recorded as minutes in compression (mean 25, range: 20-50). Procedures done with digital mammographic equipment and the Mammotome were approximately 10 minutes shorter
Bloomston et al. 1999 ³¹¹	Prospective consecutive case series of women with nonpalpable breast abnormalities who had an ABBI.	100	Stereotactic ABBI.	Average procedure time was 20 ±8 minutes.
Doyle et al. 1999 ⁵¹²	Retrospective study of patients with mammographically detected lesions on CNB from 1994-1998.	151	Senographe 600T was used for 136 biopsies; 15 using Mammomat 3000; all in decubitus position unless the patient couldn't tolerate that positioning and with a 14 gauge needle.	Mean procedure time was 20 minutes

Table 17. Procedure duration time (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Bolivar et al. 1998 ⁵¹⁸	Patients seen between October 1993-October 1996 having a CNB for nonpalpable breast lesions.	180	Stereotactic CNB (Stereotix localization stereotaxic device attached to Senix 500T screen film mammographic unit) with the Menghini nonautomatic 15 gauge needle with multiple pass technique (Surecut).	THE CNB procedure averaged between 45-55 minutes.
Whitman et al. 1998 ⁵¹⁹	Retrospective chart review of 12 CNB in 11 women.	11	Mammographically guided coaxial CNB procedure performed with a fenestrated alphanumeric compression device with a 15 gauge Tru Guide outer cannula and a 16 gauge Monopty biopsy instrument	The CNB procedure ranged in time from 30-80 minutes.
Burbank 1997 ³⁷⁶	Retrospective study comparing the accuracy of directional, vacuum assisted stereotactic CNB with stereotactic automated gun CNB	101	Prone position under stereotactic guidance on the Mammotest with 14 gauge needles	Directional, vacuum assisted biopsy tissue harvest time was 18.6 ±15.8 minutes per lesion, on average, meaning 26.5 specimens can be obtained in that amount of time, at a tissue harvest rate of 1.4 specimens per minute. No information is given for automated procedure.
Florentine et al. 1997 ³⁸⁴	Retrospective review of patients with palpable breast lesions who underwent a combined FNA/CNB procedure.	12	CNB using an 18 gauge Temno needle	The CNB procedure took approximately 20 minutes, on average.

Table 17. Procedure duration time (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Helbich et al. 1997 ⁵²³	Prospective randomized trial of patients with mammographically suspicious solid lesions. Patients were randomized to stereotactic CNB in a sitting position; stereotactic CNB in the prone position; or CNB with US guidance. CNB was followed by surgical excision.	210	CNB with either stereotactic or US guidance using a 14 gauge needle.	Acquisition of the CNB specimen took an average of 19±3 minutes with stereotactic guidance vs. 13±4 minutes with US guidance.
Howisey et al. 1997 ³⁸⁷	Retrospective review of Medicare patients with mammographic abnormalities who went on to have ultrasound guided CNB, stereotactic-guided CNB or wire localization with surgical excision between July 1994-December 1995.	139	Ultrasound or stereotactic guided CNB	US guided CNB had a shorter procedure time (<20 minutes per case) than stereotactic guided CNB. No time given for stereotactic procedure.
Yim et al. 1996 ⁴¹⁷	Retrospective chart review of subjects with invasive breast cancer diagnosed by either CNB or needle localization surgical biopsy.	52	Stereotactic CNB with a 14 gauge needle was performed on a dedicated prone table (Lorad, Danbury, CT) vs. needle localized open biopsy	Average total procedure time for the CNB was 40-50 minutes, but the biopsy time itself was shorter than for open biopsy.
Janes et al. 1994 ⁴³²	Prospective case series of initial 300 CNBs performed by a group of five surgeons.	288	CNB using Fischer Imaging Mammotest with Auto-Guide and the Mammoscan System, 14 gauge needle Biopsy-Cut Biopsy Needle.	By the 100 th procedure, total procedure time, from initial image taking to completion of the acquisition, rarely exceeded 30 minutes. Acquisition times for lesions centered on the initial image were 15-20 minutes.
Elvecrog et al. 1993 ⁵⁴⁶	Prospective study of women with a single nonpalpable breast lesion imaged by mammography who underwent CNB followed by hook-wire localization and open surgical biopsy.	100	Mammothest stereotactic system and 14 gauge needle.	Average per case procedure time, including obtaining preliminary views, was 50-60 minutes. The CNB alone took between 30-40 minutes, on average. No data on average time for the open biopsy procedure was presented.

Table 17. Procedure duration time (continued)

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Parker et al. 1990 ⁵⁵¹	Prospective case series of consecutive patients referred for biopsy of nonpalpable mammographically suggestive lesions. Subjects underwent CNB followed by wire localization and excisional surgery.	103	14-, 16-, or 18-gauge Biopsy-cut needles were used in conjunction with a Biopsy gun. The first 30 patients were treated with Senographe Mammographic System 600T coupled with Stereotix computerized stereotactic needle localization device. Logistical problems caused investigators to switch to the MammoTest Stereotactic System for remaining patients.	Average procedure time by end of the study was 20-30 minutes without localization wire placement. No data on procedure time for early cases was provided.

CNB = Core-needle Biopsy

Table 18. Wait time for test results

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Verkooijen et al. 2001 ⁵⁵²	Prospective comparison of patients with nonpalpable breast lesions	164	Stereotactic guidance on a prone table with a 14 gauge needle.	Median wait time was 9 days for core-needle biopsies and 19 days for wire-localized open biopsies.
Gukas et al. 2000 ²⁸⁹	Prospective study of patients with palpable lesions	108	Tru-Cut	Reduced wait time to get back a test result was, on average, 7.3 days less for Tru-Cut than excisional biopsy.

Table 19. Availability of a qualified pathologist

Reference	Design of study	Number of patients	Biopsy methods	Conclusion
Collins et al. 2004 ¹⁴²	Retrospective chart review of patients with nonpalpable lesions	2004	CNB using either stereotactic mammography or ultrasound. In some cases a 14 gauge needle was used, in others a vacuum-assisted procedure was done with either a 14 or 11 gauge needle.	Local pathology diagnoses were compared to those made by a central pathologist. In 96% of CNB cases the two pathologists were in agreement. Agreement rates were as follows for the subcategories of benign lesions, invasive cancers, DCIS cases, ADH, and lobular neoplasia: 99%, 97%, 83%, 63%, and 53%, respectively. Agreement rates remained stable regardless of biopsy guidance system and biopsy device used.
Gukas et al. 2000 ²⁸⁹	Prospective study of 112 consecutive patients with palpable breast lesions.	108	Tru-Cut and excisional biopsies.	The pathologist in this study was not highly experienced with Tru-Cut, which the authors believe explains its poor diagnosis rate in this study.

Table 20. Availability of equipment

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Deurloo et al. 2001 ²⁴⁸	Retrospective review of patients with nonpalpable breast lesions.	84	StereoGuide with 14 gauge needle	Vacuum-assisted biopsy is increasingly being used in the United States. But, in Europe, acceptance of vacuum-assisted biopsy is considerably less whereas core biopsy devices are used much more.
Verkooijen et al. 2001 ⁵⁵²	Prospective comparison of patients with nonpalpable breast lesions	164	Stereotactic guidance, on a prone table with a 14 gauge needle.	Median wait times for access to core-needle biopsy equipment were only 4 days while access to open surgical biopsy had a median wait time of 13 days.
Williams et al. 1999 ³⁴⁷	Prospective case series of patients with impalpable breast lesions diagnosed by stereotactic core-needle biopsy on a prone table vs. a historical cohort of patients with similar lesions diagnosed prior to the availability of a prone table.	222	Stereotactic prone CNB with Mammotest and 14 gauge needle.	There was no significant difference in lag time between screening and definitive diagnosis for the two groups. However, there was a delay in having the prone procedure due to the longer waiting list.

Table 21. Resource usage

Reference	Design of Study	Number of Patients	Biopsy Methods	Conclusion
Mainiero et al. 2002 ²²²	Prospective nonrandomized comparison study of patients with suspicious breast lesions	193	Either freehand high resolution US- guided large core biopsy with 14 gauge needle or a stereotactic guided vacuum-assisted biopsy (Mammotest) with 11 gauge needle	The authors examined how much room time and physician time was expended for each type of procedure. They found vacuum-assisted procedures took more room and physician time when all biopsies were examined together. When only room and physician time for patients with masses was examined, only room time significantly differed in the same direction by procedure type.
Wunderbaldinger et al. 2002 ²⁴⁰	Prospective randomized study	200	Stereotactic guided biopsies in either sitting or prone position with a 14 gauge needle.	In the conclusion the authors report that prone systems require four times the amount of space as a regular unit and are often underused as their only function is breast biopsy. In addition, there is a weight limit to prone machines.

Appendix F. Data analysis

Table 22. Accuracy data freehand biopsies

Study	Type Core Biopsy	TP	FP	FN	TN	N atypia	N Atypia Underestimates	N DCIS	N DCIS Underestimates
Wong and Hisham 2003 ⁴⁷⁷	Freehand automated gun 14G	42	1	3	50	NR	NR	NR	NR
Wong and Hisham 2003 ⁴⁷⁷	Freehand automated gun 16G	23	0	1	30	NR	NR	NR	NR
Scopa et al. 1996 ⁵³⁸	Freehand TruCut	83	1	10	14	6	5	NR	NR
McMahon et al. 1992 ⁵⁴⁸	Freehand Biopcut 14G	21	0	3	27	NR	NR	NR	NR
McMahon et al. 1992 ⁵⁴⁸	Freehand Biopcut 18G	23	0	1	27	NR	NR	NR	NR
McMahon et al. 1992 ⁵⁴⁸	Freehand Trucut 14G	17	0	8	24	NR	NR	NR	NR
Hamed et al. 1991 ⁵⁴⁹	Freehand automated gun 18G	62	0	34	11	NR	NR	NR	NR
Cusick et al. 1990 ⁵⁵⁰	Freehand	78	0	10	6	NR	NR	NR	NR

Table 23. Accuracy data for US guided automated gun biopsies

Study	Type of core biopsy	TP	FP	FN	TN	N atypia	N atypia underestimated	N DCIS	N DCIS underestimated
Youk et al. 2008 ⁶	US guidance automated gun 14G	1,281	68	31	1,040	93	25	126	36
de Lucena et al. 2007 ⁴⁵¹	US guidance automated gun 14G	95	0	6	49	0	0	0	0
Bolivar et al. 2005 ⁴⁵⁷	US guidance automated gun 14G	118	2	4	79	2	0	NR	NR
Crystal et al. 2005 ⁴⁵⁸	US guidance automated gun 14G	313	3	10	389	5	2	6	4
Sauer et al. 2005 ⁴⁶¹	US guidance automated gun 14G	604	0	11	44	2	2	18	11
Delle and Terinde 2004 ⁴⁶⁵	US guidance automated gun 14G	124	0	4	39	NR	NR	NR	NR
Fishman et al. 2003 ⁴⁷¹	US guidance automated gun 14G	14	0	0	38	NR	NR	2	0
Philpotts et al. 2003 ⁴⁷⁶	US guidance automated gun 14G	35	4	1	81	4	0	2	0
Smith et al. 2001 ⁴⁹⁵	US guidance automated gun 14G	118	2	0	275	4	2	5	1
Wunderbaldinger et al. 2001 ⁴⁹⁷	US guidance automated gun 14G	21	3	0	20	3	0	2	0
Yeow et al. 2001 ⁴⁹⁸	US guidance automated gun 14 or 16G	66	2	0	30	2	0	2	0
Liberman et al. 1998 ⁵¹⁶	US guidance automated gun 14G	51	1	3	64	1	0	4	2
Schulz-Wendtland et al. 1998 ⁵¹⁷	US guidance automated gun 14G	155	0	3	147	1	1	8	2
Khattar et al. 1997 ⁵²⁴	US guidance automated gun	41	0	3	13	NR	NR	NR	NR
Parker et al. 1993 ⁵⁴⁷	US guidance automated gun 14G	34	4	0	143	4	0	NR	NR

Table 24. Accuracy data stereotactic guidance automated gun core-needle biopsies

Study	Type of Core Biopsy	TP	FP	FN	TN	N Atypia	N Atypia Underestimated	N DCIS	N DCIS Underestimated
Peters et al. 2008 ⁴⁴⁸	Stereotactic guidance automated gun 14G	483	16	0	312	22	6	196	55
Koskela et al. 2005 ⁴⁶⁰	Stereotactic guidance automated gun 14G	82	2	1	117	4	3	33	7
Han et al. 2003 ⁴⁷²	Stereotactic guidance automated gun 14G	44	8	11	33	8	0	39	4
Verkooijen et al. COBRA 2002 ⁴⁸⁶	Stereotactic guidance automated gun 14G	480	20	15	307	26	6	190	32
Becker et al. 2001 ⁴⁸⁷	Stereotactic guidance automated gun 14G	43	6	2	101	14	8	36	NR
Brenner et al. 2001 ⁴⁸⁸	Stereotactic guidance automated gun 14G	230	0	24	234	NR	NR	NR	NR
Dahlstrom and Jain 2001 ⁴⁹⁰	Stereotactic guidance automated gun 14G	56	4	11	219	15	11	NR	NR
Levin et al. 2001 ⁴⁹²	Stereotactic guidance automated gun 14G	22	0	2	46	NR	NR	NR	NR
Kirwan et al. 2000 ⁵⁰⁰	Stereotactic guidance automated gun 14G	23	6	0	34	11	5	3	0
Ward et al. 2000 ⁵⁰⁴	Stereotactic guidance automated gun 14G	26	3	1	73	6	3	NR	NR
Jackman et al. 1999 ⁵⁰⁷	Stereotactic guidance automated gun 14G	159	13	2	305	29	16	56	8
Soo et al. 1999 ⁵¹⁰	Stereotactic guidance automated gun 14G	12	0	0	48	1	1	0	0
Doyle et al. 1998 ⁵¹²	Stereotactic guidance automated gun 14G	51	4	0	77	4	4	21	NR
Vega-Bolivar et al. 1998 ⁵¹⁸	Stereotactic guidance Surecut 15G	74	5	0	44	11	6	18	6

Table24. Accuracy data stereotactic guidance automated gun core-needle biopsies (continued)

Study	Type of Core Biopsy	TP	FP	FN	TN	N Atypia	N Atypia Underestimated	N DCIS	N DCIS Underestimated
Whitman et al. 1998 ⁵¹⁹	Stereotactic guidance automated gun 16G	6	2	0	3	2	0	4	3
Zannis and AliaNo 1998 ⁵²⁰	Stereotactic guidance automated gun 14G	31	6	0	77	7	1	3	2
Bauer et al. 1997 ⁵²¹	Stereotactic guidance automated gun 14G	85	12	1	697	20	8	32	8
Liberman et al. 1997 ⁵²⁵	Stereotactic guidance automated gun 14G	144	34	7	162	55	21	NR	NR
Pitre et al. 1997 ⁵²⁶	Stereotactic guidance automated gun	10	2	1	100	3	1	NR	NR
Sutton, et al. 1997 ⁵²⁸	Stereotactic guidance automated gun 14G	58	1	1	80	8	7	NR	NR
Walker et al. 1997 ⁵²⁹	Stereotactic guidance automated gun 14G	95	9	14	60	14	5	43	6
Frazer et al. 1996 ⁵³⁰	Stereotactic guidance automated gun	6	0	0	45	0	0	2	0
Fuhrman et al. 1996 ⁵³¹	Stereotactic guidance automated gun 14G	48	12	1	268	21	9	NR	NR
Head and Haynes 1996 ⁵³²	Stereotactic guidance automated gun 18G	12	6	0	84	12	6	NR	NR
Mainiero et al. 1996 ⁵³³	Stereotactic guidance automated gun 14G	23	10	3	79	14	4	13	6
Meyer et al. 1996 ⁵³⁴	Stereotactic guidance automated gun 14G	60	1	0	210	2	1	2	2
Pettine et al. 1996 ⁵³⁶	Stereotactic guidance automated gun 14G	6	0	1	17	NR	NR	1	0
Rosenblatt et al. 1996 ⁵³⁷	Stereotactic guidance automated gun 14G	15	0	0	6	NR	NR	2	2
Cross et al. 1995 ⁵³⁹	Stereotactic guidance automated gun 14G	44	0	0	172	NR	NR	NR	NR

Table24. Accuracy data stereotactic guidance automated gun core-needle biopsies (continued)

Study	Type of Core Biopsy	TP	FP	FN	TN	N Atypia	N Atypia Underestimated	N DCIS	N DCIS Underestimated
Gisvold et al. 1994 ⁵⁴³	Stereotactic guidance automated gun 14G	60	1	6	93	4	3	NR	NR
Smyth and Cederbom 1994 ⁵⁴⁵	Stereotactic guidance automated gun 14G	14	0	0	44	NR	NR	NR	NR
Elvecrog et al. 1993 ⁵⁴⁶	Stereotactic guidance automated gun 14G	31	8	0	64	8	0	NR	NR
Parker et al. 1990 ⁵⁵¹	Stereotactic guidance automated gun	15	0	1	80	NR	NR	NR	NR

Table 25. Accuracy data ultrasound guided vacuum-assisted core-needle biopsies

Study	Type of Core Biopsy	TP	FP	FN	TN	N Atypia	N atypia Underestimated	N DCIS	N DCIS Underestimated
Vag et al. 2007 ⁴⁵³	US guidance vacuum-assisted 10G	28	0	1	41	NR	NR	NR	NR
Wu et al. 2005 ⁴⁶³	US guidance vacuum-assisted 11G	0	0	1	112	0	0	0	0
Alonso-Bartolome et al. 2004 ⁴⁶⁴	US guidance vacuum-assisted 11G	1	1	0	100	1	0	NR	NR
March et al. 2003 ⁴⁷⁴	US guidance vacuum-assisted 11G	8	2	0	21	2	0	1	0
Philpotts et al. 2003 ⁴⁷⁶	US guidance vacuum-assisted 11G	19	2	1	37	2	0	1	1
Johnson et al. 2002 ⁴⁸¹	US guidance vacuum-assisted 11 or 8G	3	2	0	70	2	0	0	0
Perez-Fuentes et al. 2001 ⁴⁹⁴	US guidance vacuum-assisted 11G	14	1	0	42	1	0	NR	NR

Table 26. Accuracy data stereotactic guidance vacuum-assisted core-needle biopsy

Study	Type of Core Biopsy	TP	FP	FN	TN	N Atypia	N atypia Underestimated	N DCIS	N DCIS Underestimated
Tonegutti and Girardi 2008 ⁴⁴⁹	Stereotactic guidance vacuum-assisted 11G	56	22	0	140	27	5	35	3
Uematsu et al. 2007 ⁴⁵²	Stereotactic guidance vacuum-assisted 11G	34	7	0	59	8	1	31	4
Chapellier et al. 2006 ⁴⁵⁴	Stereotactic guidance vacuum-assisted 11G	85	17	0	209	19	2	51	11
Dhillon et al. 2006 ⁴⁵⁶	Stereotactic guidance vacuum-assisted 11G	46	16	0	88	18	2	34	4
Weber et al. 2005 ⁴⁶²	Stereotactic guidance vacuum-assisted 11G	62	8	2	118	9	1	40	6
Kettritz et al. 2004 ⁴⁶⁷	Stereotactic guidance vacuum-assisted 11G	669	103	1	1461	135	32	434	49
Lomoschitz et al. 2004 ⁴⁶⁸	Stereotactic guidance vacuum-assisted 11G	45	2	2	22	4	2	12	2
Ambrogetti et al. 2003 ⁴⁷⁰	Stereotactic guidance vacuum-assisted 11G	144	12	15	66	17	5	115	20
Apesteguia et al. 2002 ⁴⁷⁸	Stereotactic guidance vacuum-assisted 11G	47	13	0	70	14	1	32	5
Georgian-Smith et al. 2002 ⁴⁷⁹	Stereotactic guidance vacuum-assisted 11G	29	7	1	106	9	2	17	2
Liberman et al. 2002 ⁴⁸²	Stereotactic guidance vacuum-assisted 11G	213	38	3	321	49	11	120	17
Meloni et al. 2002 ⁴⁸³	Stereotactic guidance vacuum-assisted	40	1	0	64	2	1	22	1
Morris et al. 2002 ⁴⁸⁴	Stereotactic guidance vacuum-assisted 14G	4	1	0	12	1	0	0	0
Pfarl et al. 2002 ⁴⁸⁵	Stereotactic guidance vacuum-assisted 11G	207	11	7	93	17	6	91	11
Cangiarella et al. 2001 ⁴⁸⁹	Stereotactic guidance vacuum-assisted 11G	15	8	0	92	10	2	12	1

Table 26. Accuracy data stereotactic guidance vacuum-assisted core-needle biopsy (continued)

Study	Type of Core Biopsy	TP	FP	FN	TN	N Atypia	N atypia Underestimated	N DCIS	N DCIS Underestimated
Lai et al. 2001 ⁴⁹¹	Stereotactic guidance vacuum-assisted 11G	148	8	2	321	10	2	48	6
Beck et al. 2000 ⁴⁹⁹	Stereotactic guidance vacuum-assisted 11G	105	13	0	477	13	0	74	0
Soo et al. 1999 ⁵¹⁰	Stereotactic guidance vacuum-assisted 14G	10	1	0	22	1	0	2	0
Heywang-Kobrunner et al. 1998 ⁵¹⁴	Stereotactic guidance vacuum-assisted 11 or 14G	45	6	0	129	6	0	30	0
Zannis and AliaNo 1998 ⁵²⁰	Stereotactic guidance vacuum-assisted 11G	17	4	0	33	4	0	9	0

Table 27. Accuracy data miscellaneous methods of biopsy

Study	Type Core Biopsy	TP	FP	FN	TN	N Atypia	N Atypia Underestimates	N DCIS	N DCIS Underestimates
Pfleiderer et al. 2003 ⁴⁷⁵	MRI guidance automated gun 14G	5	0	1	8	1	1	NR	NR
Puglisi et al. 1999 ⁵⁰⁹	Perforated compression grid automated gun 14G	32	2	3	63	4	1	7	2

Table 28. Accuracy data mixed methods of biopsy not reported separately

Study	Type Core Biopsy	TP	FP	FN	TN	N Atypia	N Atypia Underestimated	N DCIS	N DCIS Underestimated
Ciatto et al. 2007 ⁴⁵⁰	Multiple methods	1,158	207	71	1,532	NR	NR	NR	NR
Cipolla et al. 2006 ⁴⁵⁵	Multiple methods	182	11	1	232	16	6	8	3
Dillon et al. 2005 ⁴⁵⁹	Multiple methods	1,299	120	85	461	181	71	NR	NR
Fajardo et al. 2004 ⁴⁶⁶	Multiple methods	358	31	17	1,025	54	23	NR	NR
Abdsaleh et al. 2003 ⁴⁶⁹	Multiple methods	104	1	16	18	NR	NR	7	2
Kirshenbaum et al. 2003 ⁴⁷³	Multiple methods	117	20	2	253	24	6	NR	NR
Jackman and Lamm 2002 ⁴⁸⁰	Multiple methods	11	3	0	17	3	0	5	0
Margolin et al. 2001 ⁴⁹³	Multiple methods	158	14	0	1,120	26	12	NR	NR
White et al. 2001 ⁴⁹⁶	Multiple methods	231	31	7	464	39	10	65	18
Latosinsky et al. 2000 ⁵⁰¹	Multiple methods	85	13	6	246	21	8	30	8
Lieberman et al. 2000 ⁵⁰²	Multiple methods	62	4	1	36	4	2	4	2
Makoske et al. 2000 ⁵⁰³	Multiple methods	139	28	0	377	38	10	39	19
Welle et al. 2000 ⁵⁰⁵	Multiple methods	36	15	0	122	13	4	7	3
Meyer et al. 1999 ⁵⁰⁸	Multiple methods	493	63	0	855	88	25	133	20
Caruso et al. 1998 ⁵¹¹	Multiple methods	67	0	0	7	NR	NR	2	2
Fuhrman et al. 1998 ⁵¹³	Multiple methods	295	31	3	852	67	36	84	30
Loffe et al. 1998 ⁵¹⁵	Multiple methods	50	7	0	125	10	3	NR	NR
Britton et al. 1997 ⁵²²	Multiple methods	94	2	7	95	NR	NR	NR	NR
Helbich et al. 1997 ⁵²³	Multiple methods	100	2	3	105	4	2	12	0
Stolier et al. 1997 ⁵²⁷	Multiple methods	30	6	2	170	12	3	10	0
Nguyen et al. 1996 ⁵³⁵	Multiple methods	183	9	4	217	NR	NR	NR	NR
Doyle et al. 1995 ⁵⁴⁰	Multiple methods	23	2	0	119	6	4	NR	NR
Burbank et al. 1994 ⁵⁴²	Multiple methods	14	3	0	88	3	1	6	0
Parker et al. 1994 ⁵⁴⁴	Multiple methods	967	129	15	2,654	186	57	148	18

Table 29. Miscellaneous accuracy data

Study	Accuracy by Breast Lesion Factors	Accuracy by Patient Characteristics	Accuracy by Biopsy Methods	Accuracy by Clinician and Facility Factors
Ciatto et al. 2007 ⁴⁵⁰	<p>Palpable lesions: 400 true positives, 63 false positives, 27 false negatives, 493 true negatives</p> <p>Non-palpable lesions: 758 true positives, 144 false positives, 44 false negatives, 1038 true negative</p> <p>Masses on mammography: 540 true positives, 103 false positives, 36 false negatives, 839 true negatives</p> <p>Distortions on mammography: 17 true positives, 27 false positives, 1 false negative, 29 true negatives</p> <p>Microcalcifications: 601 true positives, 77 false positives, 34 false negatives, 663 true negatives</p>	NR	NR	Overall sensitivity improved over the course of the study, 88% first year, 96% final year.
de Lucena et al. 2007 ⁴⁵¹	NR	NR	The rate of false negatives decreased from 9.9% with only one core to 5.9% with two cores. Adding additional cores beyond 2 didn't improve the accuracy of the biopsy.	NR
Cipolla et al. 2006 ⁴⁵⁵	Correspondence between the core-biopsy and surgical specimen was 100% in palpable lesions but only 88.6% in non-palpable lesions	NR	NR	NR
Koskela et al. 2005 ⁴⁶⁰	<p>Masses on mammography: 40 true positives, 1 false-negative, 55 true negatives</p> <p>Microcalcifications: 43 true positives, 0 false-negatives, 66 true negatives</p>	NR	More than three samples are needed for a diagnosis of a mass lesion	NR

Table29. Miscellaneous accuracy data (continued)

Study	Accuracy by Breast Lesion Factors	Accuracy by Patient Characteristics	Accuracy by Biopsy Methods	Accuracy by Clinician and Facility Factors
Fajardo et al. 2004 ⁴⁶⁶	Nonpalpable lesions: Sensitivity 90.7% Masses on mammography: Sensitivity 97.4% Microcalcifications: 90.7%	NR	NR	NR
Lomoschitz et al. 2004 ⁴⁶⁸	Masses on mammography: 25 true positives, 1 false-negative, 23 true negatives Microcalcifications: 18 true positives, 1 false-negative, 28 true negatives	NR	12 specimens were necessary to yield correct diagnoses in 96% of patients with masses and 92% of patients with microcalcifications, and addition of further cores did not improve accuracy.	NR
Abdsaleh et al. 2003 ⁴⁶⁹	NR	34 of the 35 technical failures occurred in dense breasts	For one core there were 12 false-negatives out of 107 biopsies; for two cores there were 3 false-negatives out of 34 biopsies.	NR
Fishman et al. 2003 ⁴⁷¹	NR	NR	Cells indicating the final diagnosis were present in the first core in 51 cases, in the second core in 67 cases, in the third core in 70 cases, and in the fourth core in all 73 cases.	
Pfarl et al. 2002 ⁴⁸⁵	Masses on mammography: 96 true positives, 3 false negatives, 52 true negatives Microcalcifications: 111 true positives, 4 false negatives, 42 true negatives	NR	NR	In six of the seven false-negative cases the biopsy was performed by an operator who had previously performed 15 or fewer stereotactic vacuum-assisted biopsies.

Table 29. Miscellaneous accuracy data (continued)

Study	Accuracy by Breast Lesion Factors	Accuracy by Patient Characteristics	Accuracy by Biopsy Methods	Accuracy by Clinician and Facility Factors
Doyle et al. 1998 ⁵¹²	NR	NR	Of 14 biopsies performed in the seated position there were no technical failures and no false negatives Of 137 biopsies performed in the decubitus position there were 2 technical failures and no false negatives	NR
Helbich et al. 1997 ⁵²³	NR	NR	Patients were randomly assigned to supine, prone, sitting; authors comment they did not find patient position to impact the biopsy procedure.	NR
Walker et al. 1997 ⁵²⁹	Masses on mammography: Sensitivity 93% Distortions on mammography: Sensitivity 89% Microcalcifications: Sensitivity 85%	NR	NR	NR
Hamed et al. 1991 ⁵⁴⁹	Tumor size did not affect accuracy; however, patients with the lesion located in the right breast had a higher rate of false-negatives (right side, 45% were false negative, left side, 27% were false negative).	Age of patients did not affect accuracy	NR	Accuracy improved over time- first 25% of biopsies performed there were 50% true positives; second and third 25% of biopsies performed there were 63% true positives; last 25% of biopsies performed there were 83% true positives.
Cusick et al. 1990 ⁵⁵⁰	24% of lesions smaller than 2 cm had false-negative findings compared to only 7% of larger lesions having false-negative findings	NR	NR	NR

Table 30. Harms data

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Peters et al. 2008 ⁴⁴⁸	948	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Tonegutti and Girardi 2008 ⁴⁴⁹	268	Stereotactic guidance vacuum-assisted 11G	3 had large hematomas that did not require treatment	2 but did not require treatment	1	NR	3 had acute localized inflammation, and one large abscess that required surgery	NR	NR	NR	NR
Youk et al. 2008 ⁶	4,359	US guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Ciatto et al. 2007 ⁴⁵⁰	4,035	Multiple methods	NR	NR	NR	NR	NR	NR	NR	NR	NR
de Lucena et al. 2007 ⁴⁵¹	150	US guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Uematsu et al. 2007 ⁴⁵²	100	Stereotactic guidance vacuum-assisted 11G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Vag et al. 2007 ⁴⁵³	70	US guidance vacuum-assisted 10G	NR	No severe bleeding occurred	1	No severe infections occurred	NR	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Chapellier et al. 2006 ⁴⁵⁴	318	Stereotactic guidance vacuum-assisted 11G	123 subclinical	NR	NR	NR	No abscesses occurred	NR	NR	269 found procedure had good tolerability and 49 reported it was acceptable or poor. Of these 49, 17 complained of intense pain, 23 of pain that didn't respond to the local anesthetic, and 12 reported the procedure was stressful	NR
Cipolla et al. 2006 ⁴⁵⁵	426	Multiple methods	NR	NR	NR	NR	NR	NR	NR	NR	NR
Dhillon et al. 2006 ⁴⁵⁶	150	Stereotactic guidance vacuum-assisted 11G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Bolivar et al. 2005 ⁴⁵⁷	214	US guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Crystal et al. 2005 ⁴⁵⁸	715	US guidance automated gun 14G	NR	NR	NR	NR	No major complications occurred	NR	NR	NR	NR
Dillon et al. 2005 ⁴⁵⁹	2,427	Multiple methods	NR	NR	NR	NR	NR	NR	NR	NR	NR
Koskela et al. 2005 ⁴⁶⁰	213	Stereotactic guidance automated gun 14G	No hematomas that required treatment occurred	NR	2	No infections that required treatment occurred	NR	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Sauer et al. 2005 ⁴⁶¹	962	US guidance automated gun 14G	NR	Some cases of minor bleeding that did not require treatment	NR	1 that required surgery and antibiotics	NR	NR	NR	NR	NR
Weber et al. 2005 ⁴⁶²	225	Stereotactic guidance vacuum-assisted 11G	NR	NR	NR	2	1 biopsy was terminated after complaints of severe pain by the patient, 5 patients had severe bruising and 2 complained of persistent pain	NR	NR	2 patients were not satisfied with the cosmetic result	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Wu et al. 2005 ⁴⁶³	113	US guidance vacuum-assisted 11G	NR	NR	NR	NR	2 cases pneumothorax that resolved without treatment, 13 cases of severe ecchymosis that also resolved without treatment; All complications occurred during the first year of the study, no complications occurred during the second and third years	NR	NR	NR	NR
Alonso-Bartolome et al. 2004 ⁴⁶⁴	102	US guidance vacuum-assisted 11G	37 that did not require treatment	3, only one required treatment	NR	NR	1 patient complained of paine	NR	NR	NR	NR
Delle and Terinde 2004 ⁴⁶⁵	169	US guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Fajardo et al. 2004 ⁴⁶⁶	2,403	Multiple methods	NR	NR	NR	NR	NR	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Kettritz et al. 2004 ⁴⁶⁷	2,893	Stereotactic guidance vacuum-assisted 11G	25 hematomas of which 3 were hospitalized overnight and 1 required surgery	4 patients were hospitalized for persistent bleeding, of which 3 needed surgery	5	5 that required antibiotics	1 seizure	NR	NR	NR	In 196 patients a slight mammographic density was observed. In 4 patients a scar that might cause diagnostic difficulty was observed.
Lomoschitz et al. 2004 ⁴⁶⁸	100	Stereotactic guidance vacuum-assisted 11G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Abdsaleh et al. 2003 ⁴⁶⁹	180	Multiple methods	NR	Mild bleeding occurred in all cases	NR	NR	No significant complications occurred	NR	NR	NR	NR
Ambrogetti et al. 2003 ⁴⁷⁰	364	Stereotactic guidance vacuum-assisted 11G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Fishman et al. 2003 ⁴⁷¹	73	US guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Han et al. 2003 ⁴⁷²	271	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Kirshenbaum et al. 2003 ⁴⁷³	506	Multiple methods	NR	Three cases of minor bleeding and one case of major bleeding that required surgery.	5 vasovagal reactions; the most experienced radiologist had 3 reactions in 409 procedures while the two more inexperienced radiologists had 1 reaction out of 47 procedures and 1 reaction out of 53 procedures.	NR	NR	NR	NR	NR	NR
March et al. 2003 ⁴⁷⁴	34	US guidance vacuum-assisted 11G	9 hematomas that did not require treatment	NR	NR	NR	19 reported no pain, 13 reported mild pain, 2 reported moderate pain. 24 patients had ecchymosis 2-4 days after the procedure	16 reported the procedure had not interfered with usual activity at all, 14 a little, 4 somewhat.	20 took acetaminophen	NR	NR
Pfleiderer et al. 2003 ⁴⁷⁵	14	MRI guidance automated gun 14G	NR	NR	NR	NR	no severe side effects were observed.	NR	None used	NR	NR
Philpotts et al. 2003 ⁴⁷⁶	281	Multiple methods	3 hematomas in 11G no surgery required	3 cases of bleeding with 14G	NR	NR	NR	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Wong and Hisham 2003 ⁴⁷⁷	150	Freehand automated gun 14G/16G	NR	1 patient in 14G group experienced troublesome bleeding.	NR	3 patients from 14G group developed infections	There was no difference in the amount of pain experienced between 14G and 16G as measured on a VAS, p >0.05	NR	NR	NR	NR
Apestequia et al. 2002 ⁴⁷⁸	132	Stereotactic guidance vacuum-assisted 11G	Some hematomas that did not require treatment	8 cases of bleeding which caused premature termination of the procedure in 3 of the 8 cases	NR	NR	2 cases of severe pain	NR	NR	NR	NR
Georgian-Smith et al. 2002 ⁴⁷⁹	185	Stereotactic guidance vacuum-assisted 11G	3, one case of which it became infected and required antibiotics to treat	5, 2 of which were severe enough to require termination of the biopsy	10, 2 of which were severe enough to require termination of the biopsy procedure	NR	1 patient vomited	NR	NR	NR	NR
Jackman and Lamm 2002 ⁴⁸⁰	31	Multiple methods	NR	2 serious bleeding	NR	NR	NR	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Johnson et al. 2002 ⁴⁸¹	101	US guidance vacuum-assisted 11 or 8G	1 large hematoma requiring narcotics	1 significant bleeding requiring surgery; less than 5% of cases had bleeding requiring treatment	NR	2 infections requiring antibiotics and surgical drainage	NR	NR	1 case required narcotics	NR	NR
Liberman et al. 2002 ⁴⁸²	800	Stereotactic guidance vacuum-assisted 11G	2 that required treatment	12	2	NR	1 patient was in such severe pain that the procedure was terminated	NR	NR	NR	NR
Meloni et al. 2002 ⁴⁸³	129	Stereotactic guidance vacuum-assisted	2 that did not require treatment	1	5	NR	NR	NR	NR	NR	NR
Morris et al. 2002 ⁴⁸⁴	21	Stereotactic guidance vacuum-assisted 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Pfarl et al. 2002 ⁴⁸⁵	332	Stereotactic guidance vacuum-assisted 11G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Verkooijen et al. COBRA 2002 ⁴⁸⁶	984	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Becker et al. 2001 ⁴⁸⁷	232	Stereotactic guidance automated gun 14G	NR	3 minor	2	NR	NR	NR	NR	NR	NR
Brenner et al. 2001 ⁴⁸⁸	1,003	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Cangiarella et al. 2001 ⁴⁸⁹	160	Stereotactic guidance vacuum-assisted 11G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Dahlstrom and Jain 2001 ⁴⁹⁰	310	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Lai et al. 2001 ⁴⁹¹	673	Stereotactic guidance vacuum-assisted 11G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Levin et al. 2001 ⁴⁹²	70	Stereotactic guidance automated gun 14G	NR	NR	3	NR	NR	NR	NR	NR	NR
Margolin et al. 2001 ⁴⁹³	1,333	Multiple methods	NR	NR	NR	2 that required antibiotics	NR	NR	NR	NR	NR
Perez-Fuentes et al. 2001 ⁴⁹⁴	88	US guidance vacuum-assisted 11G	NR	1 patient with implants experienced severe bleeding that required surgical treatment	NR	NR	NR	NR	NR	NR	NR
Smith et al. 2001 ⁴⁹⁵	500	US guidance automated gun 14G	0	NR	NR	0	26 had large areas of ecchymosis; one patient had a small pneumothorax that resolved without treatment	NR	NR	NR	NR
White et al. 2001 ⁴⁹⁶	1,042	Multiple methods	NR	NR	NR	NR	NR	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Wunderbaldinger et al. 2001 ⁴⁹⁷	45	US guidance automated gun 14G	NR	NR	4	NR	NR	NR	NR	NR	NR
Yeow et al. 2001 ⁴⁹⁸	98	US guidance automated gun 14 or 16G	0	NR	NR	0	1 patient had a puncture site ecchymosis	NR	NR	NR	NR
Beck et al. 2000 ⁴⁹⁹	594	Stereotactic guidance vacuum-assisted 11G	1 that required surgical treatment	NR	NR	NR	1 patient had a seizure	NR	NR	NR	In 90% of patients no scarring was seen on subsequent mammography; in 10% a faint density could be seen at the biopsy site; 1 patient had a diagnostically confusing scar that was evidently benign on MRI
Kirwan et al. 2000 ⁵⁰⁰	72	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Latosinsky et al. 2000 ⁵⁰¹	692	Multiple methods	NR	NR	NR	NR	There were no significant complications of bleeding or infection	NR	NR	NR	NR
Liberman et al. 2000 ⁵⁰²	155	Multiple methods	NR	NR	NR	NR	NR	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Makoske et al. 2000 ⁵⁰³	887	Multiple methods	NR	NR	NR	NR	NR	NR	NR	NR	NR
Ward et al. 2000 ⁵⁰⁴	121	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Welle et al. 2000 ⁵⁰⁵	225	Multiple methods	1 did not require treatment	1 did not require treatment	4 (in seated patients)	NR	NR	NR	NR	NR	NR
Helbich et al. 1999 ⁵⁰⁶	44	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Jackman et al. 1999 ⁵⁰⁷	483	Multiple methods	NR	NR	NR	NR	NR	NR	NR	NR	NR
Meyer et al. 1999 ⁵⁰⁸	1,836	Perforated compression grid automated gun 14G	0 that required treatment	NR	NR	1 that required antibiotics	Complications were minor and infrequent. 1 pneumothorax requiring no treatment occurred	NR	NR	NR	NR
Puglisi et al. 1999 ⁵⁰⁹	106	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	No complications resulted from this technique	NR	NR	NR	NR
Soo et al. 1999 ⁵¹⁰	116	Stereotactic guidance vacuum-assisted 14G	NR	NR	NR	NR	One patient was in such severe pain that the procedure was terminated	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Caruso et al. 1998 ⁵¹¹	92	Multiple methods	NR	NR	NR	NR	NR	NR	NR	NR	NR
Doyle et al. 1998 ⁵¹²	151	Stereotactic guidance automated gun 14G	NR	NR	4 (in seated patients)	1 minor	No serious complications occurred	NR	NR	Most of our patients found that decubitus position was reasonably comfortable and that discomfort was mostly related to prolonged breast compression.	NR
Fuhrman et al. 1998 ⁵¹³	1,440	Multiple methods	NR	NR	NR	NR	Hospitalization was not required for any subjects. The only complication encountered was minor breast ecchymosis, which resolved uneventfully in all cases.	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Heywang-Kobrunner et al. 1998 ⁵¹⁴	261	Stereotactic guidance vacuum-assisted 11 or 14G	NR	1	NR	NR	No side effects occurred. No patients complained about pain.	NR	NR	NR	117 of 129 patients had no scarring visible at 6-month mammography. Very slight scarring occurred in ten patients, and mammographically visible scarring in 2 patients, one of whom was sent for MRI to verify it was a scar and not a tumor.
Ioffe et al. 1998 ⁵¹⁵	224	US guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Liberman et al. 1998 ⁵¹⁶	151	Multiple methods	NR	NR	NR	NR	NR	NR	NR	NR	NR
Schulz-Wendtland et al. 1998 ⁵¹⁷	2,307	US guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Vega-Bolivar et al. 1998 ⁵¹⁸	182	Stereotactic guidance Surecut 15G	NR	NR	12	NR	NR	NR	NR	NR	NR
Whitman et al. 1998 ⁵¹⁹	12	Stereotactic guidance automated gun 16G	NR	NR	1	NR	NR	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Zannis and AliaNo 1998 ⁵²⁰	424	Multiple methods	NR	Bleeding requiring operative intervention was not required in any group	NR	NR	Open biopsy: 12 cases cellulitis and 4 abscesses out of 190 procedures; zero cases of cellulitis and abscesses out of 234 core-needle biopsy procedures.	NR	Open biopsy: all 190 were sent home with oral narcotic analgesia; zero patients out of 157 SCNB and 77 VAB procedures required oral narcotic analgesia.	NR	NR
Bauer et al. 1997 ⁵²¹	799	Stereotactic guidance automated gun 14G	10 that did not require treatment	NR	NR	0	NR	NR	NR	NR	NR
Britton et al. 1997 ⁵²²	202	Multiple methods	0	NR	7		No complications that required treatment occurred	NR	NR	NR	NR
Helbich et al. 1997 ⁵²³	210	Multiple methods	NR	NR	4 (in seated patients)	NR	No serious complications, patients tolerated it well	NR	NR	NR	NR
Khattar et al. 1997 ⁵²⁴	106	US guidance automated gun	NR	NR	NR	NR	NR	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Liberman et al. 1997 ⁵²⁵	442	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Pitre et al. 1997 ⁵²⁶	128	Stereotactic guidance automated gun	NR	NR	NR	NR	NR	NR	NR	NR	NR
Stolier et al. 1997 ⁵²⁷	244	Multiple methods	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sutton, et al. 1997 ⁵²⁸	206	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	There were no cases of long-term morbidity and only 3 patients (1.5%) had a biopsy-related problem 3 days after their core-needle biopsy	NR	NR	Pain: 36% none, 27.6% uncomfortable, 12.3% slight, 7% quite, 0% very Discomfort: 50% none, 40% uncomfortable, 6% slight, 4% quite, 0% very	NR
Walker et al. 1997 ⁵²⁹	200	Stereotactic guidance automated gun 14G	NR	0	1	0	A few patients complained of pain; bruising was not infrequent	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Frazee et al. 1996 ⁵³⁰	103	Stereotactic guidance automated gun	NR	NR	NR	NR	Patients rating of post-operative pain was evaluated using a Pain Analog Scale. The mean score for open biopsy was 2.5 and for stereotactic biopsy was 2.8 (P = NS)	The interval of returning to normal activities was measured. This averaged 3.8 days for open biopsy and 1.5 days for stereotactic biopsy (P = NS).	NR	Overall patient satisfaction was evaluated. No significant differences were seen in overall patient satisfaction between the two biopsy techniques.	NR
Fuhrman et al. 1996 ⁵³¹	451	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Head and Haynes 1996 ⁵³²	115	Stereotactic guidance automated gun 18G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Mainiero et al. 1996 ⁵³³	138	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Meyer et al. 1996 ⁵³⁴	388	Stereotactic guidance automated gun 14G	3	NR	NR	NR	Ecchymosis at the biopsy site occurred in 48% of patients.	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Nguyen et al. 1996 ⁵³⁵	431	Multiple methods	A few small superficial ones that required no treatment	NR	NR	NR	There were no serious complications. Several patients complained of pain related to lying on the biopsy table for a prolonged period of time.	NR	NR	NR	NR
Pettine et al. 1996 ⁵³⁶	25	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Rosenblatt et al. 1996 ⁵³⁷	58	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Scopa et al. 1996 ⁵³⁸	120	Freehand TruCut	NR	NR	NR	NR	NR	NR	NR	NR	NR
Cross et al. 1995 ⁵³⁹	250	Stereotactic guidance automated gun 14G	NR	NR	NR	0	Pain was reported to be minimal	NR	NR	NR	NR
Doyle et al. 1995 ⁵⁴⁰	365	Multiple methods	NR	NR	NR	NR	NR	NR	NR	NR	NR
Burbank et al. 1994 ⁵⁴²	105	Multiple methods	NR	NR	NR	NR	NR	NR	NR	NR	NR
Gisvold et al. 1994 ⁵⁴³	160	Stereotactic guidance automated gun 14G	Hemotoma formation was infrequent	NR	0	1 serious systemic infection	Two patients had significant pain.	NR	NR	NR	NR
Parker et al. 1994 ⁵⁴⁴	6,152	Multiple methods	3 that required surgery	NR	NR	3 that required antibiotics	NR	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
Smyth and Cederbom 1994 ⁵⁴⁵	58	Stereotactic guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Elvecrog et al. 1993 ⁵⁴⁶	100	Stereotactic guidance automated gun 14G	1 that required surgical treatment	NR	NR	NR	NR	NR	NR	Some patients complained of pain from biopsy, but usually with only 1 or 2 needle passes. In a few cases, deep anesthesia was administered with the biopsy needle still in the lesion. There were frequent complaints of neck, shoulder, and arm discomfort from patients lying in the same position for an extended period of time	NR
Parker et al. 1993 ⁵⁴⁷	181	US guidance automated gun 14G	NR	NR	NR	NR	NR	NR	NR	NR	NR

Table 30. Harms data (continued)

Study	Number of Lesions Enrolled	Type of Biopsy	Hematomas	Bleeding	Vasovagal Reactions	Infections	Other	Time to Recovery or Time to Return to Work	Use of Pain Medications	Patient Satisfaction, Quality of Life Data	Impact of Biopsy Procedure on Accuracy of Subsequent Mammography Procedures
McMahon et al. 1992 ⁵⁴⁸	151	Freehand 14/1618G	NR	Troublesome bleeding occurred in 3 patients in Bioptycut 14G, 2 patients in Bioptycut 18G, and 1 in trucut.	NR	NR	There were no major complications. Minor bruising was common. No patients developed pneumothorax .	NR	NR	Pain scores on a 0 to 3 scale were recorded after the procedure: Trucut 40% had a 0, 40% a 1, 15% a 2, 5% a 3. Biopty 14G 70% had a 0, 12% a 1, 15% a 2, 3% a 3. Biopty 18G 60% had a 0, 30% a 1, 10% a 2, 0% a 3. B18 was reported to have significantly p = 0.01 less pain than trucut.	NR
Hamed et al. 1991 ⁵⁴⁹	107	Freehand automated gun 18G	NR	NR	NR	NR	NR	NR	NR	NR	NR
Cusick et al. 1990 ⁵⁵⁰	96	Freehand	NR	NR	NR	NR	NR	NR	NR	NR	NR
Parker et al. 1990 ⁵⁵¹	103	Stereotactic guidance automated gun	NR	No significant bleeding occurred, even with use of the 14 gauge needle.	2 (in seated patients)	Three that required treatment with antibiotics	None of the patients suffered immediate significant complications.	NR	NR	NR	NR

NR = Not Reported

META-ANALYTIC INTEGRATION OF DIAGNOSTIC TEST ACCURACY STUDIES

All biopsies

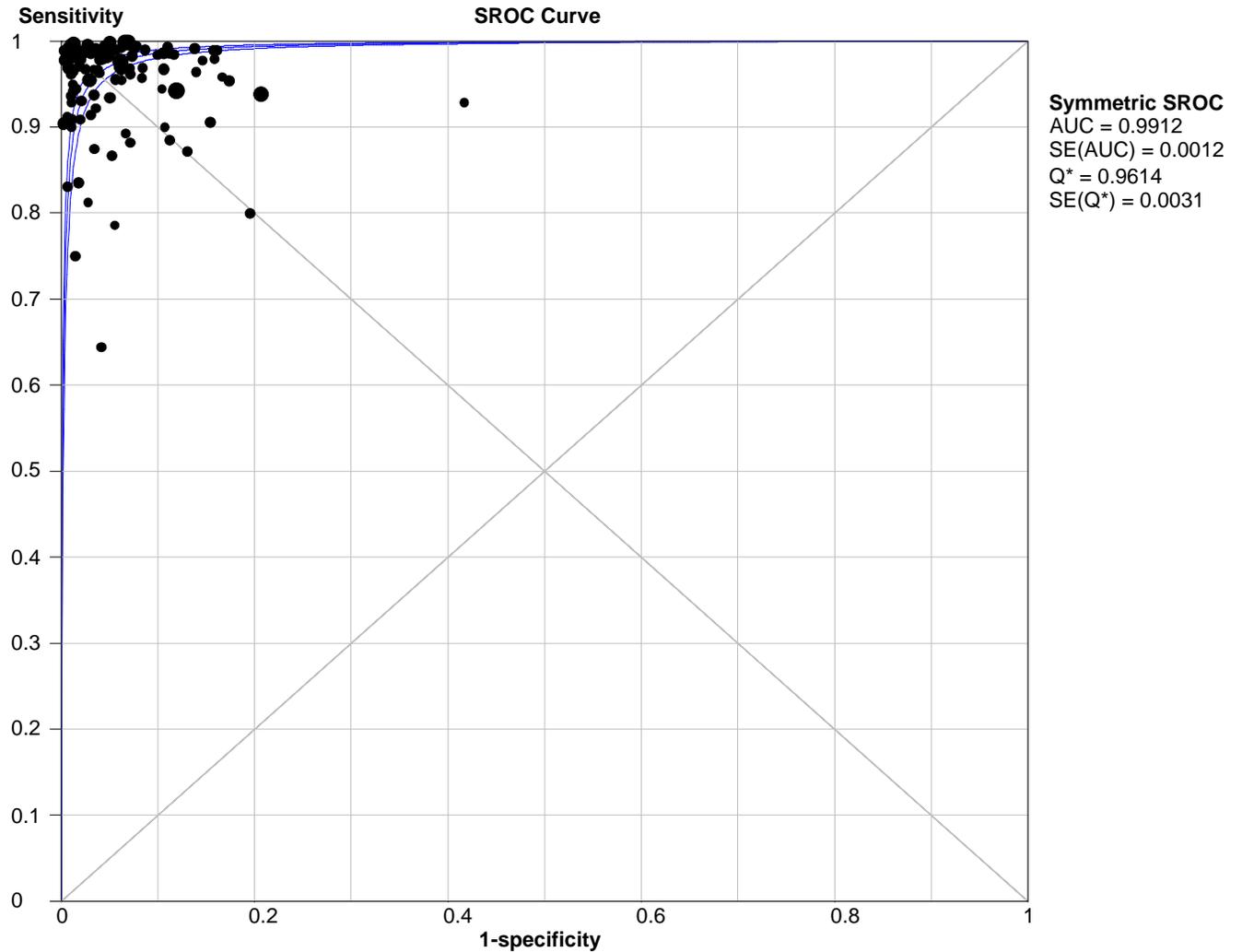
Could not fit a bivariate binomial model

Random-effects model:

Summary sensitivity: 96.4% (96.1% to 96.7%), $I^2 = 83.2\%$

Summary negative likelihood ratio: 0.038 (0.030 to 0.050), $I^2 = 86.6\%$

Figure 1. Summary ROC of all core-needle biopsy studies



META-ANALYTIC INTEGRATION OF DIAGNOSTIC TEST ACCURACY STUDIES

Freehand biopsies

SUMMARY DATA AND PERFORMANCE ESTIMATES

Bivariate Binomial Mixed Model

Number of studies = 5

Reference-positive Subjects = 419

Reference-negative Subjects = 191

Pretest Prob of Disease = 0.687

Between-study variance (varlogitSEN) = 0.438, 95% CI = [0.096-1.994]

Between-study variance (varlogitSPE) = 0.562, 95% CI = [0.001-309.743]

Correlation (Mixed Model) = -1.000

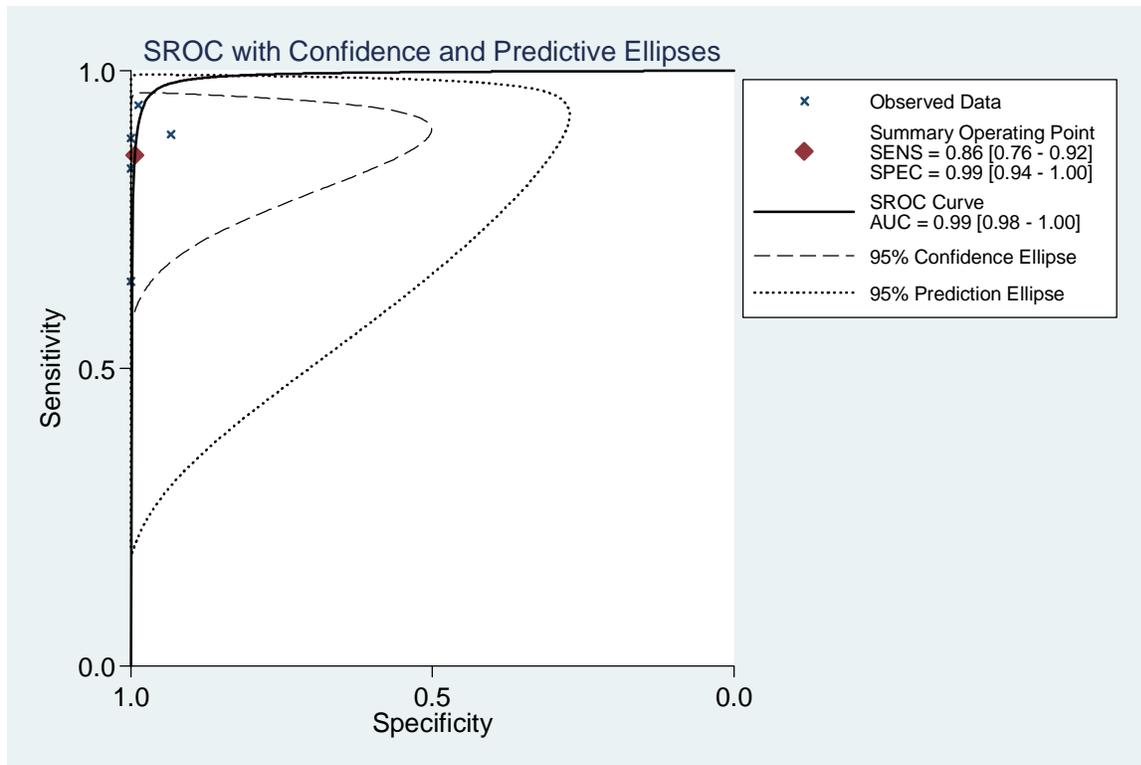
ROC Area, AUROC = 0.99 [0.98 - 1.00]

Heterogeneity (Chi-square): LRT_Q = 2.149, df = 2.00, LRT_p = 0.171

Inconsistency (I-square): LRT_I2 = 6.95, 95% CI = [0.00-100.00]

<u>Parameter</u>	<u>Estimate</u>	<u>95% CI</u>
Sensitivity	0.858	[0.758, 0.921]
Specificity	0.993	[0.939, 0.999]
Positive Likelihood Ratio	121.004	[13.764, 1063.749]
Negative Likelihood Ratio	0.143	[0.082, 0.250]
Diagnostic Score	6.738	[4.613, 8.863]
Diagnostic Odds Ratio	844.025	[100.826, 7065.427]

Figure 2. Summary ROC of freehand core-needle biopsies



META-ANALYTIC INTEGRATION OF DIAGNOSTIC TEST ACCURACY STUDIES

Ultrasound guided automated gun biopsies

Could not fit a bivariate binomial model

Random-effects model:

Summary sensitivity: 97.6% (97.0 to 98.1%) $I^2 = 38.6\%$

Summary negative likelihood ratio: 0.031 (0.024 to 0.040) $I^2 = 16.7\%$

Summary atypia underestimation rate: 0.276 (0.202 to 0.364) $I^2 = 0.0\%$

Summary DCIS underestimation rate: 0.360 (0.245 to 0.493) $I^2 = 24.6\%$

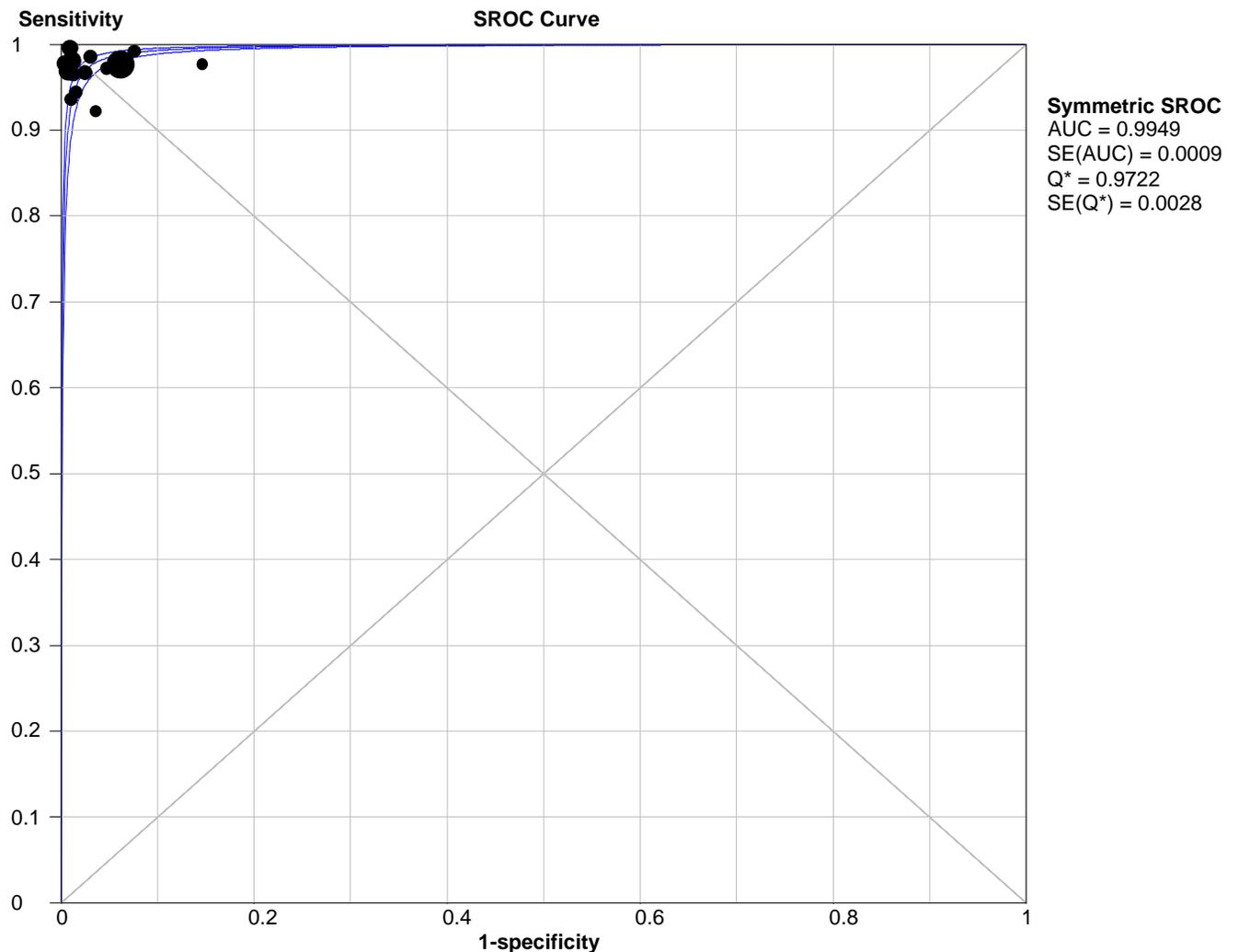
Meta-regression results:

Country study conducted in $p = 0.25$

Open surgery to verify all results vs. surgery + patient followup $p = 0.7919$

Open surgery + at least 2 years followup to verify results vs. open surgery + some patients had less than 2 years followup $p = 0.341$

Figure 3. Summary ROC of ultrasound-guided automated gun core-needle biopsies



META-ANALYTIC INTEGRATION OF DIAGNOSTIC TEST ACCURACY STUDIES

Stereotactic guided automated gun biopsies

SUMMARY DATA AND PERFORMANCE ESTIMATES

Bivariate Binomial Mixed Model

Number of studies = 33

Reference-positive Subjects = 2,653

Reference-negative Subjects = 4,482

Pretest Prob of Disease = 0.372

Between-study variance (varlogitSEN) = 1.836, 95% CI = [0.777-4.339]

Between-study variance (varlogitSPE) = 1.592, 95% CI = [0.724-3.501]

Correlation (Mixed Model) = 0.062

ROC Area, AUROC = 1.00 [0.98 - 1.00]

Heterogeneity (Chi-square): LRT_Q = 76.751, df = 2.00, LRT_p = 0.000

Inconsistency (I-square): LRT_I2 = 97.39, 95% CI = [95.65-99.14]

<u>Parameter</u>	<u>Estimate</u>	<u>95% CI</u>
Sensitivity	0.978	[0.958, 0.989]
Specificity	0.970	[0.950, 0.982]
Positive Likelihood Ratio	32.208	[19.313, 53.711]
Negative Likelihood Ratio	0.022	[0.012, 0.043]
Diagnostic Score	7.269	[6.398, 8.140]
Diagnostic Odds Ratio	1435.328	[600.670, 3429.782]
Atypia underestimation rate	0.435	(0.357 to 0.517) $I^2 = 35.7\%$
DCIS underestimation rate	0.244	(0.18 to 0.321) $I^2 = 57.0\%$

Meta-regression results:

Gauge of needle p = 0.423

Number of centers p = 0.235

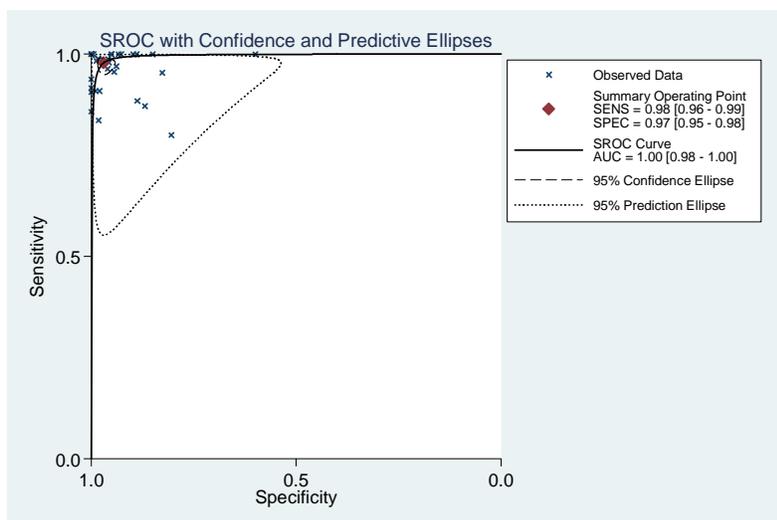
Type of facility p = 0.685

Country conducted in p = 0.543

Open surgery to verify all results vs. surgery + patient followup p = 0.459

Open surgery + at least 2 years followup to verify results vs. open surgery + some patients had less than 2 years followup p = 0.681

Figure 4. Summary ROC of stereotactic guided automated gun core-needle biopsies



META-ANALYTIC INTEGRATION OF DIAGNOSTIC TEST ACCURACY STUDIES

Ultrasound guided vacuum-assisted biopsies

SUMMARY DATA AND PERFORMANCE ESTIMATES

Bivariate Binomial Mixed Model

Number of studies = 7

Reference-positive Subjects = 76

Reference-negative Subjects = 431

Pretest Prob of Disease = 0.150

Between-study variance (varlogitSEN) = 1.928, 95% CI = [0.014-270.021]

Between-study variance (varlogitSPE) = 0.574, 95% CI = [0.031-10.757]

Correlation (Mixed Model) = -1.000

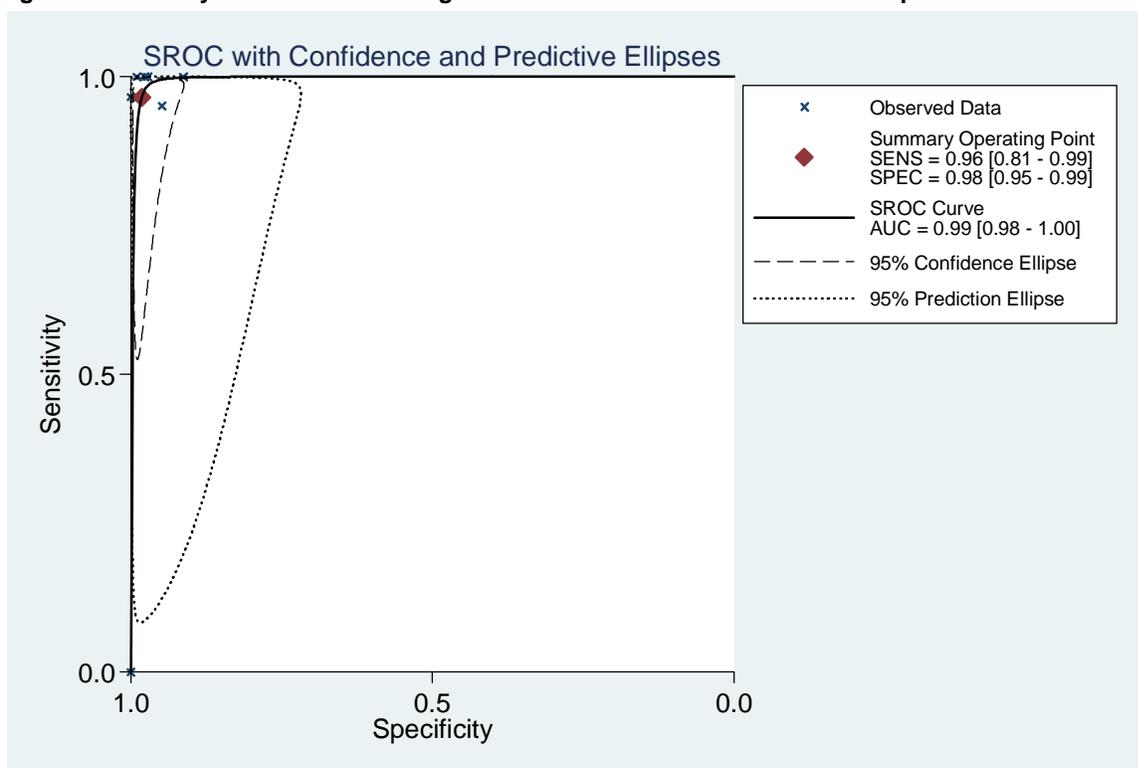
ROC Area, AUROC = 0.99 [0.98 - 1.00]

Heterogeneity (Chi-square): LRT_Q = 1.085, df = 2.00, LRT_p = 0.291

Inconsistency (I-square): LRT_I2 = 0.00, 95% CI = [0.00-100.00]

<u>Parameter</u>	<u>Estimate</u>	<u>95% CI</u>
Sensitivity	0.965	[0.812, 0.994]
Specificity	0.982	[0.954, 0.993]
Positive Likelihood Ratio	53.843	[21.308, 136.059]
Negative Likelihood Ratio	0.036	[0.006, 0.212]
Diagnostic Score	7.319	[5.502, 9.136]
Diagnostic Odds Ratio	1509.018	[245.261, 9284.523]

Figure 5. Summary ROC of ultrasound guided vacuum-assisted core-needle biopsies



META-ANALYTIC INTEGRATION OF DIAGNOSTIC TEST ACCURACY STUDIES

Stereotactic guided vacuum-assisted biopsies

SUMMARY DATA AND PERFORMANCE ESTIMATES

Bivariate Binomial Mixed Model

Number of studies = 20

Reference-positive Subjects = 2,054

Reference-negative Subjects = 4,201

Pretest Prob of Disease = 0.328

Between-study variance (varlogitSEN) = 1.467, 95% CI = [0.417-5.162]

Between-study variance (varlogitSPE) = 0.289, 95% CI = [0.118-0.708]

Correlation (Mixed Model) = 0.435

ROC Area, AUROC = 0.99 [0.97 - 0.99]

Heterogeneity (Chi-square): LRT_Q = 13.346, df = 2.00, LRT_p = 0.001

Inconsistency (I-square): LRT_I2 = 85.01, 95% CI = [68.78-100.00]

Parameter	Estimate	95% CI
Sensitivity	0.992	[0.979, 0.997]
Specificity	0.925	[0.902, 0.943]
Positive Likelihood Ratio	13.170	[10.029, 17.294]
Negative Likelihood Ratio	0.009	[0.003, 0.023]
Diagnostic Score	7.304	[6.243, 8.366]
Diagnostic Odds Ratio	1486.976	[514.651, 4296.303]
Atypia underestimation rate	0.219	(0.178 to 0.266) I ² = 0.0%
DCIS underestimation rate	0.130	(0.111 to 0.151) I ² = 0.0%

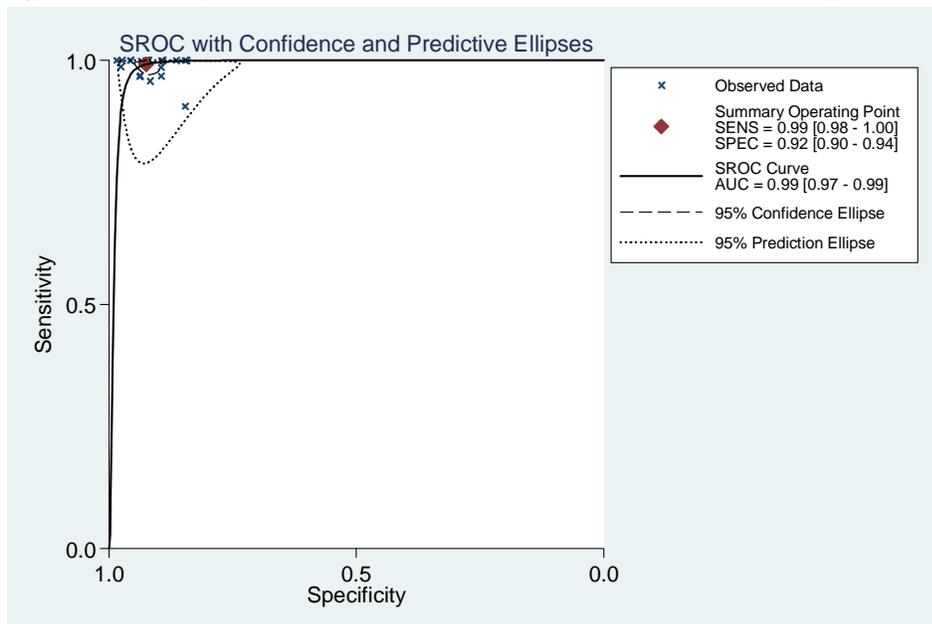
Meta-regression results:

Type of facility study conducted in p = 0.787

Country study was conducted in p = 0.1034

Open surgery + at least 2 years followup to verify results vs. open surgery + some patients had less than 2 years followup p = 0.456

Figure 6. Summary ROC of stereotactic vacuum-assisted core-needle biopsies



References

1. Brem RF, Lechner MC, Jackman RJ, Rapelyea JA, Evans WP, Philpotts LE, Hargreaves J, Wasden S. Lobular neoplasia at percutaneous breast biopsy: variables associated with carcinoma at surgical excision. *AJR Am J Roentgenol* 2008 Mar;190(3):637-41.
2. Eun YK, Bae YA, Kim MJ, Kwan SL, Lee Y, Lee SK. Factors affecting the efficacy of ultrasound-guided vacuum-assisted percutaneous excision for removal of benign breast lesions. *J Ultrasound Med* 2008 Jan;27(1):65-73.
3. Hauth EA, Jaeger HJ, Lubnau J, Maderwald S, Otterbach F, Kimmig R, Forsting M. MR-guided vacuum-assisted breast biopsy with a handheld biopsy system: Clinical experience and results in postinterventional MR mammography after 24 h. *Eur Radiol* 2008 Jan;18(1):168-76.
4. Hemmer JM, Kelder JC, van Heesewijk HP. Stereotactic large-core needle breast biopsy: Analysis of pain and discomfort related to the biopsy procedure. *Eur Radiol* 2008 Feb;18(2):351-4.
5. Ji HY, Kim EK, Min JK, Ki KO. Sonographically guided 14-gauge core needle biopsy of breast masses: A review of 2,420 cases with long-term follow-up. *AJR Am J Roentgenol* 2008 Jan;190(1):202-7.
6. Youk JH, Kim EK, Kim MJ, Oh KK. Sonographically guided 14-gauge core needle biopsy of breast masses: a review of 2,420 cases with long-term follow-up. *AJR Am J Roentgenol* 2008 Jan;190(1):202-7.
7. Kim MJ, Kim E-K, Park SY, Jung HK, Park B-W, Kim H, Oh KK. Imaging-histologic discordance at sonographically guided percutaneous biopsy of breast lesions. *Eur J Radiol* 2008 Jan;65(1):163-9.
8. Michalopoulos NV, Zagouri F, Sergentanis TN, Pararas N, Koulocheri D, Nonni A, Filippakis GM, Chatzipantelis P, Bramis J, Zografos GC. Needle tract seeding after vacuum-assisted breast biopsy. *Acta Radiol* 2008 Apr;49(3):267-70.
9. Peter D, Grunhagen J, Wenke R, Schafer FK, Schreer I. False-negative results after stereotactically guided vacuum biopsy. *Eur Radiol* 2008 Jan;18(1):177-82.
10. Rizzo M, Lund MJ, Oprea G, Schniederjan M, Wood WC, Mosunjac M. Surgical follow-up and clinical presentation of 142 breast papillary lesions diagnosed by ultrasound-guided core-needle biopsy. *Ann Surg Oncol* 2008 Apr;15(4):1040-7.
11. Shin HJ, Kim HH, Kim SM, Yang HR, Sohn JH, Kwon GY, Gong G. Papillary lesions of the breast diagnosed at percutaneous sonographically guided biopsy: comparison of sonographic features and biopsy methods. *AJR Am J Roentgenol* 2008 Mar;190(3):630-6.
12. Sigal-Zafrani B, Muller K, El Khoury C, Varoutas PC, Buron C, Vincent-Salomon A, Alran S, Livartowski A, Neuenschwander S, Salmon RJ. Vacuum-assisted large-core needle biopsy (VLNB) improves the management of patients with breast microcalcifications - Analysis of 1009 cases. *Eur J Surg Oncol* 2008 Apr;34(4):377-81.
13. Sohn VY, Arthurs ZM, Kim FS, Brown TA. Lobular neoplasia: Is surgical excision warranted? *Am Surg* 2008 Feb;74(2):172-7.
14. Tagaya N, Nakagawa A, Ishikawa Y, Oyama T, Kubota K. Experience with ultrasonographically guided vacuum-assisted resection of benign breast tumors. *Clin Radiol* 2008 Apr ;63(4):396-400.
15. Zagouri F, Sergentanis TN, Gounaris A, Koulocheri D, Nonni A, Domeyer P, Fotiadis C, Bramis J, Zografos GC. Pain in different methods of breast biopsy: Emphasis on vacuum-assisted breast biopsy. *Breast* 2008 Feb;17(1):71-5.
16. Andreu FJ, Saez A, Sentis M, Rey M, Fernandez S, Dinares C, Tortajada L, Ganau S, Palomar G. Breast core biopsy reporting categories--An internal validation in a series of 3054 consecutive lesions. *Breast* 2007 Feb;16(1):94-101.
17. Arora N, Hill C, Hoda SA, Rosenblatt R, Pigalarga R, Tousimis EA. Clinicopathologic features of papillary lesions on core needle biopsy of the breast predictive of malignancy. *Am J Surg* 2007 Oct;194(4):444-9.
18. Ashkenazi I, Ferrer K, Sekosan M, Marcus E, Bork J, Aiti T, Lavy R, Zaren HA. Papillary lesions of the breast discovered on percutaneous large core and vacuum-assisted biopsies: reliability of clinical and pathological parameters in identifying benign lesions. *Am J Surg* 2007 Aug;194(2):183-8.
19. Bode MK, Rissanen T, Apaja-Sarkkinen M. Ultrasonography and core needle biopsy in the differential diagnosis of fibroadenoma and tumor phyllodes. *Acta Radiol* 2007 Sep;48(7):708-13.
20. Cassano E, Urban LA, Pizzamiglio M, Abbate F, Maisonneuve P, Renne G, Viale G, Bellomi M. Ultrasound-guided vacuum-assisted core breast biopsy: experience with 406 cases. *Breast Cancer Res Treat* 2007 Mar;102(1):103-10.
21. Ciatto S, Houssami N. Breast imaging and needle biopsy in women with clinically evident breast cancer: does combined imaging change overall diagnostic sensitivity? *Breast* 2007 Aug;16(4):382-6.

22. Dillon MF, McDermott EW, Hill AD, O'Doherty A, O'Higgins N, Quinn CM. Predictive value of breast lesions of "uncertain malignant potential" and "suspicious for malignancy" determined by needle core biopsy. *Ann Surg Oncol* 2007 Feb;14(2):704-11.
23. Douglas-Jones AG, Denson JL, Cox AC, Harries IB, Stevens G. Radial scar lesions of the breast diagnosed by needle core biopsy: analysis of cases containing occult malignancy. *J Clin Pathol* 2007 Mar;60(3):295-8.
24. Duchesne N, Parker SH, Lechner MC, Gittleman MA, Kusnick CA, Elvecrog EE, Kaske TI, Gizienski TA. Multicenter evaluation of a new ultrasound-guided biopsy device: Improved ergonomics, sampling and rebiopsy rates. *Breast J* 2007 Jan-Feb;13(1):36-43.
25. Duijm LEM, Groenewoud JH, Roumen RMH, De Koning HJ, Plaisier ML, Fracheboud J. A decade of breast cancer screening in the Netherlands: Trends in the preoperative diagnosis of breast cancer. *Breast Cancer Res Treat* 2007 Nov;106(1):113-9.
26. Easley S, Abdul-Karim FW, Klein N, Wang N. Segregation of radiographic calcifications in stereotactic core biopsies of breast: Is it necessary? *Breast J* 2007 Sep;13(5):486-9.
27. Esserman LE, Lamea L, Tanev S, Poppiti R. Should the extent of lobular neoplasia on core biopsy influence the decision for excision? *Breast J* 2007 Jan;13(1):55-61.
28. Foxcroft LM, Evans EB, Porter AJ. Difficulties in the pre-operative diagnosis of phyllodes tumours of the breast: a study of 84 cases. *Breast* 2007 Feb;16(1):27-37.
29. Garg S, Mohan H, Bal A, Attri AK, Kochhar S. A comparative analysis of core needle biopsy and fine-needle aspiration cytology in the evaluation of palpable and mammographically detected suspicious breast lesions. *Diagn Cytopathol* 2007 Nov;35(11):681-9.
30. Holloway CMB, Saskin R, Brackstone M, Paszat L. Variation in the use of percutaneous biopsy for diagnosis of breast abnormalities in Ontario. *Ann Surg Oncol* 2007 Oct;14(10):2932-9.
31. Houssami N, Ciatto S, Bilous M, Vezzosi V, Bianchi S. Borderline breast core needle histology: Predictive values for malignancy in lesions of uncertain malignant potential (B3). *Br J Cancer* 2007 Apr 23;96(8):1253-7.
32. Karabakhtsian RG, Johnson R, Sumkin J, Dabbs DJ. The clinical significance of lobular neoplasia on breast core biopsy. *Am J Surg Pathol* 2007 May;31(5):717-23.
33. Kikuchi M, Tsunoda-Shimizu H, Kawasaki T, Suzuki K, Nakamura S, Yagata H, Tsugawa K, Takahashi O. Indications for stereotactically-guided vacuum-assisted breast biopsy for patients with category 3 microcalcifications. *Breast Cancer* 2007;14(3):285-91.
34. Kim MJ, Kim EK, Lee JY, Youk JH, Park BW, Kim SI, Kim H, Oh KK. Breast lesions with imaging-histologic discordance during US-guided 14G automated core biopsy: can the directional vacuum-assisted removal replace the surgical excision? Initial findings. *Eur Radiol* 2007 Sep;17(9):2376-83.
35. Ko ES, Cho N, Cha JH, Park JS, Kim SM, Moon WK. Sonographically-guided 14-gauge core needle biopsy for papillary lesions of the breast. *Korean J Radiol* 2007 May-Jun;8(3):206-11.
36. Krainick-Strobel U, Huber B, Majer I, Bergmann A, Gall C, Gruber I, Hoffmann J, Paepke S, Peisker U, Walz-Attmüller R, Siegmann K, Wallwiener D, Hahn M. Complete extirpation of benign breast lesions with an ultrasound-guided vacuum biopsy system. *Ultrasound Obstet Gynecol* 2007 Mar;29(3):342-6.
37. Kumaraswamy V, Carder PJ. Examination of breast needle core biopsy specimens performed for screen-detected microcalcification. *J Clin Pathol* 2007 Jun;60(6):681-4.
38. Kunju LP, Kleer CG. Significance of flat epithelial atypia on mammotome core needle biopsy: should it be excised? *Hum Pathol* 2007 Jan;38(1):35-41.
39. Lavoue V, Graesslin O, Classe JM, Fondrinier E, Angibeau H, Leveque J. Management of lobular neoplasia diagnosed by core needle biopsy: study of 52 biopsies with follow-up surgical excision. *Breast* 2007 Oct;16(5):533-9.
40. Lee JM, Kaplan JB, Murray MP, Mazur-Grbec M, Tadic T, Stimac D, Liberman L. Underestimation of DCIS at MRI-guided vacuum-assisted breast biopsy. *AJR Am J Roentgenol* 2007 Aug;189(2):468-74.
41. Lee J-M, Kaplan JB, Murray MP, Bartella L, Morris EA, Joo S, Dershaw DD, Liberman L. Imaging-histologic discordance at MRI-guided 9-gauge vacuum-assisted breast biopsy. *AJR Am J Roentgenol* 2007 Oct;189(4):852-9.
42. Leikola J, Heikkilä P, Pamilo M, Salmenkivi K, Von Smitten K, Leidenius M. Predicting invasion in patients with DCIS in the preoperative percutaneous biopsy. *Acta Oncol* 2007;46(6):798-802.
43. Liberman L, Holland AE, Marjan D, Murray MP, Bartella L, Morris EA, Dershaw DD, Wynn RT. Underestimation of atypical ductal hyperplasia at MRI-guided 9-gauge vacuum-assisted breast biopsy. *AJR Am J Roentgenol* 2007 Mar;188(3):684-90.

44. Londero V, Zuiani C, Furlan A, Nori J, Bazzocchi M. Role of ultrasound and sonographically guided core biopsy in the diagnostic evaluation of ductal carcinoma in situ (DCIS) of the breast. *Radiol Med (Torino)* 2007 Sep;112(6):863-76.
45. Lourenco AP, Mainiero MB, Lazarus E, Giri D, Schepps B. Stereotactic breast biopsy: Comparison of histologic underestimation rates with 11- and 9-gauge vacuum-assisted breast biopsy. *AJR Am J Roentgenol* 2007 Nov;189(5):W275-9.
46. Luczynska E, Skotnicki P, Kocurek A, Pawlik T, Aniol J, Herman K. Vacuum mammotomy under ultrasound guidance. *Pol Przegl Radiol* 2007 Jul;72(3):15-8.
47. Martel M, Barron-Rodriguez P, Tolgay Ocal I, Dotto J, Tavassoli FA. Flat DIN 1 (flat epithelial atypia) on core needle biopsy: 63 Cases identified retrospectively among 1,751 core biopsies performed over an 8-year period (1992-1999). *Virchows Arch* 2007 Nov;451(5):883-91.
48. Mathew J, Crawford DJ, Lwin M, Barwick C, Gash A. Ultrasound-guided, vacuum-assisted excision in the diagnosis and treatment of clinically benign breast lesions. *Ann R Coll Surg Engl* 2007 Jul;89(5):494-6.
49. Mendel JB, Long M, Slanetz PJ. CT-guided core needle biopsy of breast lesions visible only on MRI. *AJR Am J Roentgenol* 2007 Jul;189(1):152-4.
50. Murta De Lucena CE, Dos Santos Jr JL, De Lima Resende CA, Do Amaral VF, De Almeida Barra A, Reis JHP. Ultrasound-guided core needle biopsy of breast masses: How many cores are necessary to diagnose cancer? *J Clin Ultrasound* 2007 Sep;35(7):363-6.
51. Nakano S, Sakamoto H, Ohtsuka M, Mibu A, Sakata H, Yamamoto M. Evaluation and indications of ultrasound-guided vacuum-assisted core needle breast biopsy. *Breast Cancer* 2007;14(3):292-6.
52. Popiela TJ, Herman-Sucharska I, Kleinrok K, Urbanik A, Podsiadlo-Kleinrok B, Tabor J. Core breast biopsy under MR control - Preliminary results. *Pol Przegl Radiol* 2007 Apr;72(2):15-24.
53. Pivoski SP, Jimenez RE. A comprehensive evaluation of the 8-gauge vacuum-assisted Mammotome system for ultrasound-guided diagnostic biopsy and selective excision of breast lesions. *World J Surg Oncol* 2007;5:Article 83.
54. Rutstein LA, Johnson RR, Poller WR, Dabbs D, Groblewski J, Rakitt T, Tsung A, Kirchner T, Sumkin J, Keenan D, Soran A, Ahrendt G, Falk JS. Predictors of residual invasive disease after core needle biopsy diagnosis of ductal carcinoma in situ. *Breast J* 2007 May-Jun;13(3):251-7.
55. Schaefer FK, Eden I, Schaefer PJ, Peter D, Jonat W, Heller M, Schreer I. Factors associated with one step surgery in case of non-palpable breast cancer. *Eur J Radiol* 2007 Dec;64(3):426-31.
56. Smitt MC, Horst K. Association of clinical and pathologic variables with lumpectomy surgical margin status after preoperative diagnosis or excisional biopsy of invasive breast cancer. *Ann Surg Oncol* 2007 Mar;14(3):1040-4.
57. Sohn V, Arthurs Z, Herbert G, Keylock J, Perry J, Eckert M, Fellabaum D, Smith D, Brown T. Atypical ductal hyperplasia: Improved accuracy with the 11-gauge vacuum-assisted versus the 14-gauge core biopsy needle. *Ann Surg Oncol* 2007 Sep;14(9):2497-501.
58. Sydnor MK, Wilson JD, Hijaz TA, Massey HD, Shaw de Paredes ES. Underestimation of the presence of breast carcinoma in papillary lesions initially diagnosed at core-needle biopsy. *Radiology* 2007 Jan;242(1):58-62.
59. Uematsu T, Kasami M. Risk of needle tract seeding of breast cancer: cytological results derived from core wash material. *Breast Cancer Res Treat* 2008 Jul;110(1):51-5. Epub 2007 Aug 3.
60. Uematsu T, Kasami M, Uchida Y, Yuen S, Sanuki J, Kimura K, Tanaka K. Ultrasonographically guided 18-gauge automated core needle breast biopsy with post-fire needle position verification (PNPV). *Breast Cancer* 2007;14(2):219-28.
61. Usami S, Moriya T, Amari M, Suzuki A, Ishida T, Sasano H, Ohuchi N. Reliability of prognostic factors in breast carcinoma determined by core needle biopsy. *Jpn J Clin Oncol* 2007 Apr;37(4):250-5.
62. Zagouri F, Sergentanis TN, Nonni A, Koulocheri D, Fotou M, Panopoulou E, Panou M, Fotiadis C, Bramis J, Zografos GC. Vacuum-assisted breast biopsy: The value and limitations of cores with microcalcifications. *Pathol Res Pract* 2007 Aug 30;203(8):563-6.
63. Zografos GC, Zagouri F, Sergentanis TN, Koulocheri D, Nonni A, Oikonomou V, Domeyer P, Kotsani M, Fotiadis C, Bramis J. Is zero underestimation feasible? Extended Vacuum-assisted breast biopsy in solid lesions - A blind study. *World J Surg Oncol* 2007 May 14;5:Article Number: 53.
64. Zuiani C, Mazzarella F, Londero V, Linda A, Puglisi F, Bazzocchi M. Stereotactic vacuum-assisted breast biopsy: results, follow-up and correlation with radiological suspicion. *Radiol Med (Torino)* 2007 Mar;112(2):304-17.
65. Al-Attar MA, Michell MJ, Ralleigh G, Evans D, Wasan R, Bose S, Akbar N. The impact of image guided needle biopsy on the outcome of mammographically detected indeterminate microcalcification. *Breast* 2006 Oct;15(5):635-9.

66. Becker L, Trop I, David J, Latour M, Ouimet-Oliva D, Gaboury L, Lalonde L. Management of radial scars found at percutaneous breast biopsy. *Can Assoc Radiol J* 2006 Apr;57(2):72-8.
67. Bedei L, Falcini F, Sanna PA, Casadei Giunchi D, Innocenti MP, Vignutelli P, Saragoni L, Folli S, Amadori D. Atypical ductal hyperplasia of the breast: The controversial management of a borderline lesion: Experience of 47 cases diagnosed at vacuum-assisted biopsy. *Breast* 2006 Apr;15(2):196-202.
68. Chrzan R, Rudnicka L, Popiela Jr T, Nowak W, Podsiadlo-Kleinrok B. The problems with histopathological verification of breast microcalcification clusters in the stereotactic mammotome biopsy specimens. *Pol J Pathol* 2006;57(3):133-5.
69. Cox D, Bradley S, England D. The significance of mammotome core biopsy specimens without radiographically identifiable microcalcification and their influence on surgical management- A retrospective review with histological correlation. *Breast* 2006 Apr;15(2):210-8.
70. Dillon MF, McDermott EW, Quinn CM, O'Doherty A, O'Higgins N, Hill ADK. Predictors of invasive disease in breast cancer when core biopsy demonstrates DCIS only. *J Surg Oncol* 2006 Jun 1;93(7):559-63.
71. Dillon MF, Quinn CM, McDermott EW, O'Doherty A, O'Higgins N, Hill AD. Needle core biopsy in the diagnosis of phyllodes neoplasm. *Surgery* 2006 Nov;140(5):779-84.
72. Fine RE, Staren ED. Percutaneous radiofrequency-assisted excision of fibroadenomas. *Am J Surg* 2006;192(4):545-7.
73. Fitzal F, Sporn EP, Draxler W, Mittlbock M, Taucher S, Rudas M, Riedl O, Helbich TH, Jakesz R, Gnant M. Preoperative core needle biopsy does not increase local recurrence rate in breast cancer patients. *Breast Cancer Res Treat* 2006 May;97(1):9-15.
74. Gebauer B, Bostanjoglo M, Moesta KT, Schneider W, Schlag PM, Felix R. Magnetic resonance-guided biopsy of suspicious breast lesions with a handheld vacuum biopsy device. *Acta Radiol* 2006 Nov;47(9):907-13.
75. Ghate SV, Rosen EL, Soo MS, Baker JA. MRI-guided vacuum-assisted breast biopsy with a handheld portable biopsy system. *AJR Am J Roentgenol* 2006 Jun;186(6):1733-6.
76. Govindarajulu S, Narreddy S, Shere MH, Ibrahim NB, Sahu AK, Cawthorn SJ. Preoperative mammotome biopsy of ducts beneath the nipple areola complex. *Eur J Surg Oncol* 2006 May;32(4):410-2.
77. Hanley C, Kessaram R. Quality of diagnosis and surgical management of breast lesions in a community hospital: room for improvement? *Can J Surg* 2006 Jun;49(3):185-92.
78. Hoffmann J. Analysis of surgical and diagnostic quality at a specialist breast unit. *Breast* 2006 Aug;15(4):490-7.
79. Huo L, Sneige N, Hunt KK, Albarracin CT, Lopez A, Resetskova E. Predictors of invasion in patients with core-needle biopsy-diagnosed ductal carcinoma in situ and recommendations for a selective approach to sentinel lymph node biopsy in ductal carcinoma in situ. *Cancer* 2006 Oct 15;107(8):1760-8.
80. Jackman RJ, Rodriguez-Soto J. Breast microcalcifications: retrieval failure at prone stereotactic core and vacuum breast biopsy-- frequency, causes, and outcome. *Radiology* 2006 Apr;239(1):61-70.
81. Jensen A, Rank F, Dyreborg U, Severinsen N, Nielsen S, Lyng E, Vejborg I. Performance of combined clinical mammography and needle biopsy: a nationwide study from Denmark. *APMIS* 2006 Dec;114(12):884-92.
82. Kamer E, Unalp HR, Akguner T, Yigit S, Peskersoy M, Onal MA. Thick-needle vacuum-assisted biopsy technique for inflammatory breast carcinoma diagnosis. *Acta Cir Bras* 2006 Nov;21(6):422-4.
83. Killebrew LK, Oneson RH. Comparison of the diagnostic accuracy of a vacuum-assisted percutaneous intact specimen sampling device to a vacuum-assisted core needle sampling device for breast biopsy: Initial experience. *Breast J* 2006 Jul;12(4):302-8.
84. Koskela A, Berg M, Sudah M, Malinen A, Karja V, Mustonen P, Kataja V, Soimakallio S, Vanninen R. Learning curve for add-on stereotactic core needle breast biopsy. *Acta Radiol* 2006 Jun;47(5):454-60.
85. Lam WW, Chu WC, Tse GM, Ma TK, Tang AP. Role of fine needle aspiration and tru cut biopsy in diagnosis of mucinous carcinoma of breast--from a radiologist's perspective. *Clin Imaging* 2006 Jan-Feb;30(1):6-10.
86. Lannin DR, Ponn T, Andrejeva L, Philpotts L. Should all breast cancers be diagnosed by needle biopsy? *Am J Surg* 2006 Oct;192(4):450-4.
87. Liberman L, Tornos C, Huzjan R, Bartella L, Morris EA, Dershaw DD. Is surgical excision warranted after benign, concordant diagnosis of papilloma at percutaneous breast biopsy? *AJR Am J Roentgenol* 2006 May;186(5):1328-34.
88. Lieske B, Ravichandran D, Wright D. Role of fine-needle aspiration cytology and core biopsy in the preoperative diagnosis of screen-detected breast carcinoma. *Br J Cancer* 2006 Jul 3;95(1):62-6.

89. Lim CN, Ho BC, Bay BH, Yip G, Tan PH. Nuclear morphometry in columnar cell lesions of the breast: is it useful? *J Clin Pathol* 2006 Dec;59(12):1283-6.
90. Lopez-Medina A, Cintora E, Mugica B, Opere E, Vela AC, Ibanez T. Radial scars diagnosed at stereotactic core-needle biopsy: Surgical biopsy findings. *Eur Radiol* 2006 Aug;16(8):1803-10.
91. Margenthaler JA, Duke D, Monsees BS, Barton PT, Clark C, Dietz JR. Correlation between core biopsy and excisional biopsy in breast high-risk lesions. *Am J Surg* 2006 Oct;192(4):534-7.
92. Mercado CL, Hamele-Bena D, Oken SM, Singer CI, Cangiarella J. Papillary lesions of the breast at percutaneous core-needle biopsy. *Radiology* 2006 Mar;238(3):801-8.
93. Newman EL, Kahn A, Diehl KM, Cimmino VM, Kleer CA, Chang AE, Newman LA, Sabel MS. Does the method of biopsy affect the incidence of sentinel lymph node metastases? *Breast J* 2006 Jan;12(1):53-7.
94. Orel SG, Rosen M, Mies C, Schnall MD. MR imaging-guided 9-gauge vacuum-assisted core-needle breast biopsy: Initial experience. *Radiology* 2006 Jan;238(1):54-61.
95. Perlet C, Heywang-Kobrunner SH, Heinig A, Sittek H, Casselman J, Anderson I, Taourel P. Magnetic resonance-guided, vacuum-assisted breast biopsy: Results from a European multicenter study of 538 lesions. *Cancer* 2006 Mar 1;106(5):982-90.
96. Popiela TJ, Tabor J, Chrzan R, Posiadlo-Kleinrok B, Urbanik A. Mammotome biopsy in the diagnostic management of non-palpable breast pathologies. *Pol Przegl Radiol* 2006 Jul;71(3):48-56.
97. Renshaw AA, Gould EW. Comparison of disagreement and amendment rates by tissue type and diagnosis: identifying cases for directed blinded review. *Am J Clin Pathol* 2006 Nov;126(5):736-9.
98. Renshaw AA, Derhagopian RP, Martinez P, Gould EW. Lobular neoplasia in breast core needle biopsy specimens is associated with a low risk of ductal carcinoma in situ or invasive carcinoma on subsequent excision. *Am J Clin Pathol* 2006 Aug;126(2):310-3.
99. Senn Bahls E, Dupont Lampert V, Oelschlegel C, Senn H-J. Multitarget stereotactic core-needle breast biopsy (MSBB)-an effective and safe diagnostic intervention for non-palpable breast lesions: A large prospective single institution study. *Breast* 2006 Jun;15(3):339-46.
100. Shin S, Schneider HB, Cole Jr FJ, Laronga C. Follow-up recommendations for benign breast biopsies. *Breast J* 2006 Sep;12(5):413-7.
101. Sie A, Bryan DC, Gaines V, Killebrew LK, Kim CH, Morrison CC, Poller WR, Romilly AP, Schilling K, Sung JH. Multicenter evaluation of the breast lesion excision system, a percutaneous, vacuum-assisted, intact-specimen breast biopsy device. *Cancer* 2006 Sep 1;107(5):945-9.
102. Uriburu JL, Vuoto HD, Cogorno L, Isetta JA, Candas G, Imach GC, Bernabo OL. Local recurrence of breast cancer after skin-sparing mastectomy following core needle biopsy: Case reports and review of the literature. *Breast J* 2006 May;12(3):194-8.
103. Valdes EK, Tartter PI, Genelus-Dominique E, Guilbaud D-A, Rosenbaum-Smith S, Estabrook A. Significance of papillary lesions at percutaneous breast biopsy. *Ann Surg Oncol* 2006 Apr;13(4):480-2.
104. Vargas HI, Vargas MP, Gonzalez K, Burla M, Khalkhali I. Percutaneous excisional biopsy of palpable breast masses under ultrasound visualization. *Breast J* 2006 Sep;12(SUPPL. 2):S218-S222.
105. Viehweg P, Bernerth T, Kiechle M, Buchmann J, Heinig A, Koelbl H, Laniado M, Heywang-Kobrunner SH. MR-guided intervention in women with a family history of breast cancer. *Eur J Radiol* 2006 Jan;57(1):81-9.
106. Wu YC, Chen DR, Kuo SJ. Personal experience of ultrasound-guided 14-gauge core biopsy of breast tumor. *Eur J Surg Oncol* 2006 Sep;32(7):715-8.
107. Yazici B, Sever AR, Mills P, Fish D, Jones SE, Jones PA. Scar formation after stereotactic vacuum-assisted core biopsy of benign breast lesions. *Clin Radiol* 2006 Jul;61(7):619-24.
108. Altomare V, Guerriero G, Giacomelli L, Battista C, Carino R, Montesano M, Vaccaro D, Rabitti C. Management of nonpalpable breast lesions in a modern functional breast unit. *Breast Cancer Res Treat* 2005 Sep;93(1):85-9.
109. Badoual C, Maruani A, Ghorra C, Lebas P, Avigdor S, Michenet P. Pathological prognostic factors of invasive breast carcinoma in ultrasound-guided large core biopsies - Correlation with subsequent surgical excisions. *Breast* 2005 Feb;14(1):22-7.
110. Bonifacino A, Petrocelli V, Pisani T, Giannerini S, Giovagnoli A, Vecchione A, Mingazzini PL, Giovagnoli MR. Accuracy rates of US-guided vacuum-assisted breast biopsy. *Anticancer Res* 2005 May;25(3 C):2465-70.
111. Brem RF, Tran K, Rapelyea J, Michener KH, Zisman G, Mohtashemi K, Berezowski K. Percutaneous biopsy of papillary lesions of the breast: Accuracy of pathologic diagnosis. *J Womens Imaging* 2005 Dec;7(4):157-62.

112. Caines JS, Schaller GH, Iles SE, Woods ER, Barnes PJ, Johnson AJ, Jones GRM, Borgaonkar JN, Rowe JA, Topp TJ, Porter GA. Ten years of breast screening in the Nova Scotia Breast Screening Program, 1991-2001. Experience: Use of an adaptable stereotactic device in the diagnosis of screening-detected abnormalities. *Can Assoc Radiol J* 2005 Apr;56(2):82-93.
113. Cho N, Moon WK, Cha JH, Kim SM, Kim SJ, Lee SH, Chung HK, Cho KS, Park IA, Noh DY. Sonographically guided core biopsy of the breast: comparison of 14-gauge automated gun and 11-gauge directional vacuum-assisted biopsy methods. *Korean J Radiol* 2005 Apr-Jun;6(2):102-9.
114. Costantini R, Sardellone A, Marino C, Giamberardino MA, Innocenti P, Napolitano AM. Vacuum-assisted core biopsy (mammotome) for the diagnosis of non-palpable breast lesions: Four-year experience in an Italian center. *Tumori* 2005 Jul;91(4):351-4.
115. Diebold T, Hahn T, Solbach C, Rody A, Balzer JO, Hansmann ML, Marx A, Viana F, Peters J, Jacobi V, Kaufmann M, Vogl TJ. Evaluation of the stereotactic 8G vacuum-assisted breast biopsy in the histologic evaluation of suspicious mammography findings (BI-RADS IV). *Invest Radiol* 2005 Jul;40(7):465-71.
116. Doridot V, Meunier M, El Khoury C, Nos C, Vincent-Salomon A, Sigal-Zafrani B, Clough KB, Institut Curie Breast Cancer Group. Stereotactic radioguided surgery by siteSelect for subclinical mammographic lesions. *Ann Surg Oncol* 2005 Feb;12(2):181-8.
117. Doyle JM, O'Doherty A, Coffey L, Pender S, Hill A, Quinn C. Can the radiologist accurately predict the adequacy of sampling when performing ultrasound-guided core biopsy of BI-RADS category 4 and 5 lesions detected on screening mammography? *Clin Radiol* 2005 Sep;60(9):999-1005.
118. Elsheikh TM, Silverman JF. Follow-up surgical excision is indicated when breast core needle biopsies show atypical lobular hyperplasia or lobular carcinoma in situ: a correlative study of 33 patients with review of the literature. *Am J Surg Pathol* 2005 Apr;29(4):534-43.
119. Gambos EC, Godinez J, Poppiti RJ Jr.. Significance of extent of lobular neoplasia on breast core biopsy. *J Womens Imaging* 2005 Dec;7(4):150-6.
120. Grady I, Gorsuch H, Wilburn-Bailey S. Ultrasound-guided, vacuum-assisted, percutaneous excision of breast lesions: an accurate technique in the diagnosis of atypical ductal hyperplasia. *J Am Coll Surg* 2005 Jul;201(1):14-7.
121. Hanna WC, Demyttenaere SV, Ferri LE, Fleischer DM. The use of stereotactic excisional biopsy in the management of invasive breast cancer. *World J Surg* 2005 Nov;29(11):1490-4.
122. Homesh NA, Issa MA, El-Sofiani HA. The diagnostic accuracy of fine needle aspiration cytology versus core needle biopsy for palpable breast lump(s). *Saudi Med J* 2005 Jan;26(1):42-6.
123. Lehman CD, DePeri ER, Peacock S, McDonough MD, DeMartini WB, Shook J. Clinical experience with MRI-guided vacuum-assisted breast biopsy. *AJR Am J Roentgenol* 2005 Jun;184(6):1782-7.
124. Monticciolo DL. Histologic grading at breast core needle biopsy: Comparison with results from the excised breast specimen. *Breast J* 2005 Jan;11(1):9-14.
125. Pilgrim S, Ravichandran D. Fine needle aspiration cytology as an adjunct to core biopsy in the assessment of symptomatic breast carcinoma. *Breast* 2005 Oct;14(5):411-4.
126. Qazi D-E-S, Mohayuddin N. Role of fine needle aspiration cytology and core biopsy in the diagnosis of breast lumps. *J Postgrad Med Inst* 2005 Jan;19(1):67-70.
127. Riedl CC, Pfarl G, Memarsadeghi M, Wagner T, Fitzal F, Rudas M, Helbich TH. Lesion miss rates and false-negative rates for 1115 consecutive cases of stereotactically guided needle-localized open breast biopsy with long-term follow-up. *Radiology* 2005 Dec;237(3):847-53.
128. Rulli A, Lauro A, Bisacci C, Cirocchi R, Carli L. Non-palpable breast lesion-biopsy by ABBI system: A diagnostic tool. *Chirurgia* 2005 Aug;18(4):175-9.
129. Satchithananda K, Fernando RA, Ralleigh G, Evans DR, Wasan RK, Bose S, Donaldson N, Michell MJ. An audit of pain/discomfort experienced during image-guided breast biopsy procedures. *Breast J* 2005 Nov-Dec;11(6):398-402.
130. Schneider J, Lucas R, Tejerina A. Predicting complete removal of impalpable breast carcinomas using stereotactic radiologically guided surgery. *Br J Surg* 2005 May;92(5):563-4.
131. Soo MS, Kliewer MA, Ghate S, Helsper RS, Rosen EL. Stereotactic breast biopsy of noncalcified lesions: A cost-minimization analysis comparing 14-gauge multipass automated core biopsy to 14- and 11-gauge vacuum-assisted biopsy. *Clin Imaging* 2005 Jan;29(1):26-33.
132. Wahner-Roedler DL, Whaley DH, Brandt KR, Reynolds C. Vacuum-assisted breast biopsy device (Mammotome) malfunction simulating microcalcifications. *Breast J* 2005 Nov;11(6):474-5.
133. Wiratkapun C, Wibulpholprasert B, Wongwaisayawan S, Pulpinyo K. Nondiagnostic core needle biopsy of the breast under imaging guidance: result of rebiopsy. *J Med Assoc Thai* 2005 Mar;88(3):350-7.

134. Wong TT, Cheung PS, Ma MK, Lo GG. Experience of stereotactic breast biopsy using the vacuum-assisted core needle biopsy device and the advanced breast biopsy instrumentation system in Hong Kong women. *Asian J Surg* 2005 Jan;28(1):18-23.
135. You JK, Kim EK, Kwak JY, Kim MJ, Oh KK, Park BW, Yang WI. Focal fibrosis of the breast diagnosed by a sonographically guided core biopsy of nonpalpable lesions: imaging findings and clinical relevance. *J Ultrasound Med* 2005 Oct;24(10):1377-84.
136. Zuiani C, Londero V, Bestagno A, Puglisi F, Di Loreto C, Bazzocchi M. Proliferative high-risk lesions of the breast: Contribution and limits of US-guided core biopsy. *Radiol Med (Torino)* 2005 Nov;110(5-6):589-602.
137. Agoff SN, Lawton TJ. Papillary lesions of the breast with and without atypical ductal hyperplasia: Can we accurately predict benign behavior from core needle biopsy. *Am J Clin Pathol* 2004 Sep;122(3):440-3.
138. Arpino G, Allred DC, Mohsin SK, Weiss HL, Conrow D, Elledge RM. Lobular neoplasia on core-needle biopsy--clinical significance. *Cancer* 2004 Jul 15;101(2):242-50.
139. Carmon M, Rivkin L, Abu-Dalo R, Goldberg M, Olsha O, Hadas I, Zagal I, Strano S, Fisher A, Lerna O. Increased mammographic screening and use of percutaneous image-guided core biopsy in non-palpable breast cancer: Impact on surgical treatment. *Isr Med Assoc J* 2004 Jun;6(6):326-8.
140. Chagpar AB, Martin II RCG, Hagendoorn LJ, Chao C, McMasters KM. Lumpectomy margins are affected by tumor size and histologic subtype but not by biopsy technique. *Am J Surg* 2004 Oct;188(4 Spec issue):399-402.
141. Chen X, Lehman CD, Dee KE. MRI-guided breast biopsy: clinical experience with 14-gauge stainless steel core biopsy needle. *AJR Am J Roentgenol* 2004 Apr;182(4):1075-80.
142. Collins LC, Connolly JL, Page DL, Goulart RA, Pisano ED, Fajardo LL, Berg WA, Caudry DJ, McNeil BJ, Schnitt SJ. Diagnostic agreement in the evaluation of image-guided breast core needle biopsies: results from a randomized clinical trial. *Am J Surg Pathol* 2004 Jan;28(1):126-31.
143. Docktor BJ, MacGregor JH, Burrowes PW. Ultrasonographic findings 6 months after 11-gauge vacuum-assisted large-core breast biopsy. *Can Assoc Radiol J* 2004 Jun;55(3):151-6.
144. Foster MC, Helvie MA, Gregory NE, Rebner M, Nees AV, Paramagul C. Lobular carcinoma in situ or atypical lobular hyperplasia at core-needle biopsy: is excisional biopsy necessary? *Radiology* 2004 Jun;231(3):813-9.
145. Gan FY, Wettlaufer JR, Lundell AL. Breast imaging in a military setting: a comparison with civilian breast imaging. *Mil Med* 2004 May;169(5):361-7.
146. Geller BM, Oppenheimer RG, Mickey RM, Worden JK. Patient perceptions of breast biopsy procedures for screen-detected lesions. *Am J Obstet Gynecol* 2004 Apr;190(4):1063-9.
147. Gendler LS, Feldman SM, Balassanian R, Riker MA, Frencher SK, Whelan DB, Anne S, Gross JD, Cohen JM, Boolbol SK. Association of breast cancer with papillary lesions identified at percutaneous image-guided breast biopsy. *Am J Surg* 2004 Oct;188(4):365-70.
148. Georgian-Smith D, Kricun B, McKee G, Yeh E, Rafferty EA, D'Alessandro HA, Kopans DB. The mammary hamartoma: appreciation of additional imaging characteristics. *J Ultrasound Med* 2004 Oct;23(10):1267-73.
149. Golshan M, Fung BB, Wiley E, Wolfman J, Rademaker A, Morrow M. Prediction of breast cancer size by ultrasound, mammography and core biopsy. *Breast* 2004 Aug;13(4):265-71.
150. Golub RM, Bennett CL, Stinson T, Venta L, Morrow M. Cost minimization study of image-guided core biopsy versus surgical excisional biopsy for women with abnormal mammograms. *J Clin Oncol* 2004;22(12):2430-7.
151. Hansen NM, Ye X, Grube BJ, Giuliano AE, Grant C, Neumayer LA, Putnam CW, Remine SG, Morris DM. Manipulation of the primary breast tumor and the incidence of sentinel node metastases from invasive breast cancer. *Arch Surg* 2004 Jun;139(6):634-40.
152. Hoorntje LE, Peeters PH, Mali WP, Borel Rinkes IH. Is stereotactic large-core needle biopsy beneficial prior to surgical treatment in BI-RADS 5 lesions? *Breast Cancer Res Treat* 2004 Jul;86(2):165-70.
153. Hoorntje LE, Schipper MEI, Kaya A, Verkooijen HM, Klinkenbijn JG, Borel Rinkes IHM. Tumour cell displacement after 14G breast biopsy. *Eur J Surg Oncol* 2004 Jun;30(5):520-5.
154. Ivan D, Selinko V, Sahin AA, Sneige N, Middleton LP. Accuracy of core needle biopsy diagnosis in assessing papillary breast lesions: histologic predictors of malignancy. *Mod Pathol* 2004 Feb;17(2):165-71.
155. Margolin FR, Kaufman L, Jacobs RP, Denny SR, Schrupf JD. Stereotactic core breast biopsy of malignant calcifications: Diagnostic yield of cores with and cores without calcifications on specimen radiographs. *Radiology* 2004 Oct;233(1):251-4.

156. Mendez A, Cabanillas F, Echenique M, Malekshamran K, Perez I, Ramos E. Evaluation of Breast Imaging Reporting and Data System Category 3 mammograms and the use of stereotactic vacuum-assisted breast biopsy in a nonacademic community practice. *Cancer* 2004 Feb 15;100(4):710-4.
157. O'Leary R, Hawkins K, Beazley JCS, Lansdawn MRJ, Hanby AM. Agreement between preoperative core needle biopsy and postoperative invasive breast cancer histopathology is not dependent on the amount of clinical material obtained. *J Clin Pathol* 2004 Feb;57(2):193-5.
158. Peters-Engl C, Konstantiniuk P, Tausch C, Haid A, Hoffmann B, Jagoutz-Herzlinger M, Kugler F, Redtenbacher S, Roka S, Schrenk P, Steinmassl D. The impact of preoperative breast biopsy on the risk of sentinel lymph node metastases: Analysis of 2502 cases from the Austrian sentinel node biopsy study group. *Br J Cancer* 2004 Nov 15;91(10):1782-6.
159. Piana De Andrade V, Gobbi H. Accuracy of typing and grading invasive mammary carcinomas on core needle biopsy compared with the excisional specimen. *Virchows Arch* 2004 Dec;445(6):597-602.
160. Pijnappel RM, van den Donk M, Holland R, Mali WP, Peterse JL, Hendriks JH, Peeters PH. Diagnostic accuracy for different strategies of image-guided breast intervention in cases of nonpalpable breast lesions. *Br J Cancer* 2004 Feb 9;90(3):595-600.
161. Renshaw AA. Minimal (< or =0.1 cm) invasive carcinoma in breast core needle biopsies. Incidence, sampling, associated findings, and follow-up. *Arch Pathol Lab Med* 2004 Sep;128(9):996-9.
162. Renshaw AA, Derhagopian RP, Tizol-Blanco DM, Gould EW. Papillomas and atypical papillomas in breast core needle biopsy specimens: Risk of carcinoma in subsequent excision. *Am J Clin Pathol* 2004 Aug;122(2):217-21.
163. Rotenberg L, Verhille R, Schulz-Wendtland R, Verswijfel G, Gelin J, Van Migem D, Janssens JP. Multicenter clinical experience with large core soft tissue biopsy without vacuum assistance. *Eur J Cancer Prev* 2004 Dec;13(6):491-8.
164. Agarwal T, Patel B, Rajan P, Cunningham DA, Darzi A, Hadjiminis DJ. Core biopsy versus FNAC for palpable breast cancers. Is image guidance necessary? *Eur J Cancer* 2003 Jan;39(1):52-6.
165. Baez E, Huber A, Vetter M, Hackeloer BJ. Minimal invasive complete excision of benign breast tumors using a three-dimensional ultrasound-guided mammotome vacuum device. *Ultrasound Obstet Gynecol* 2003 Mar;21(3):267-72.
166. Bauer VP, Ditkoff BA, Schnabel F, Brenin D, El-Tamer M, Smith S. The management of lobular neoplasia identified on percutaneous core breast biopsy. *Breast J* 2003 Jan;9(1):4-9.
167. Berg WA, Campassi CI, Ioffe OB. Cystic lesions of the breast: sonographic-pathologic correlation. *Radiology* 2003 Apr;227(1):183-91.
168. Bonnett M, Wallis T, Rossmann M, Pernick NL, Bouwman D, Carolin KA, Visscher D. Histopathologic analysis of atypical lesions in image-guided core breast biopsies. *Mod Pathol* 2003 Feb 1;16(2):154-60.
169. Brenner RJ, Jackman RJ, Parker SH, Evans WP 3rd, Philpotts L, Deutch BM, Lechner MC, Lehrer D, Sylvan P, Hunt R, Adler SJ, Forcier N. Percutaneous core needle biopsy of radial scars of the breast: when is excision necessary? *AJR Am J Roentgenol* 2003 Jul;181(1):275; author reply 275.
170. Carder PJ, Liston JC. Will the spectrum of lesions prompting a "B3" breast core biopsy increase the benign biopsy rate? *J Clin Pathol* 2003 Feb;56(2):133-8.
171. Cawson JN, Malara F, Kavanagh A, Hill P, Balasubramaniam G, Henderson M. Fourteen-gauge needle core biopsy of mammographically evident radial scars: Is excision necessary? *Cancer* 2003 Jan 15;97(2):345-51.
172. Charles M, Edge SB, Winston JS, Hurd TC, Driscoll DL, Stomper PC. Effect of stereotactic core needle biopsy on pathologic measurement of tumor size of T1 invasive breast carcinomas presenting as mammographic masses. *Cancer* 2003 May 1;97(9):2137-41.
173. Chen SC, Yang HR, Hwang TL, Chen MF, Cheung YC, Hsueh S. Intraoperative ultrasonographically guided excisional biopsy or vacuum-assisted core needle biopsy for nonpalpable breast lesions. *Ann Surg* 2003 Nov;238(5):738-42.
174. Corn CC. Review of 125 SiteSelect stereotactic large-core breast biopsy procedures. *Breast J* 2003 May-Jun;9(3):147-52.
175. Crisi GM, Mandavilli S, Cronin E, Ricci Jr A. Invasive mammary carcinoma after immediate and short-term follow-up for lobular neoplasia on core biopsy. *Am J Surg Pathol* 2003 Mar 1;27(3):325-33.
176. Crowe Jr JP, Rim A, Patrick RJ, Rybicki LA, Grundfest-Broniatowski SF, Kim JA, Lee KB, Williams GB. Does core needle breast biopsy accurately reflect breast pathology? *Surgery* 2003 Oct;134(4):523-8.
177. Dennison G, Anand R, Makar SH, Pain JA. A Prospective Study of the Use of Fine-Needle Aspiration Cytology and Core Biopsy in the Diagnosis of Breast Cancer. *Breast J* 2003 Nov;9(6):491-3.

178. Dmytrasz K, Tartter PI, Mizrachy H, Chinitz L, Smith SR, Estabrook A. The significance of atypical lobular hyperplasia at percutaneous breast biopsy. *Breast J* 2003 Jan;9(1):10-2.
179. Farshid G, Rush G. The use of fine-needle aspiration cytology and core biopsy in the assessment of highly suspicious mammographic microcalcifications: analysis of outcome for 182 lesions detected in the setting of a population-based breast cancer screening program. *Cancer Cytol* 2003 Dec 25;99(6):357-64.
180. Fine RE, Whitworth PW, Kim JA, Harness JK, Boyd BA, Burak WE Jr. Low-risk palpable breast masses removed using a vacuum-assisted hand-held device. *Am J Surg* 2003 Oct;186(4):362-7.
181. Fures R, Bukovic D, Lez C, Zadro M, Bukovic N, Smud D, Giudici E. Large-gauge needle biopsy in diagnosing malignant breast neoplasia. *Coll Antropol* 2003 Jun;27(1):259-62.
182. Harris GC, Denley HE, Pinder SE, Lee AHS, Ellis IO, Elston CW, Evans A. Correlation of histologic prognostic factors in core biopsies and therapeutic excisions of invasive breast carcinoma. *Am J Surg Pathol* 2003 Jan 1;27(1):11-5.
183. Hoorntje LE, Schipper MEI, Peeters PHM, Bellot F, Storm RK, Borel Rinkes IHM. The finding of invasive cancer after a preoperative diagnosis of ductal carcinoma-in-situ: Causes of ductal carcinoma-in-situ underestimates with stereotactic 14-gauge needle biopsy. *Ann Surg Oncol* 2003;10(7):748-53.
184. Jackman RJ, Marzoni FA Jr. Stereotactic histologic biopsy with patients prone: technical feasibility in 98% of mammographically detected lesions. *AJR Am J Roentgenol* 2003 Mar;180(3):785-94.
185. Kneeshaw PJ, Turnbull LW, Smith A, Drew PJ. Dynamic contrast enhanced magnetic resonance imaging aids the surgical management of invasive lobular breast cancer. *Eur J Surg Oncol* 2003 Feb;29(1):32-7.
186. Komenaka IK, El-Tamer M, Pile-Spellman E, Hibshoosh H. Core needle biopsy as a diagnostic tool to differentiate phyllodes tumor from fibroadenoma. *Arch Surg* 2003 Sep 1;138(9):987-90.
187. Lee AHS, Denley HE, Pinder SE, Ellis IO, Elston CW, Vujovic P, Macmillan RD, Evans AJ. Excision biopsy findings of patients with breast needle core biopsies reported as suspicious of malignancy (B4) or lesion of uncertain malignant potential (B3). *Histopathology* 2003 Apr 1;42(4):331-6.
188. Leifland K, Lagerstedt U, Svane G. Comparison of stereotactic fine needle aspiration cytology and core needle biopsy in 522 non-palpable breast lesions. *Acta Radiol* 2003 Jul;44(4):387-91.
189. Leifland K, Lundquist H, Lagerstedt U, Svane G. Comparison of preoperative simultaneous stereotactic fine needle aspiration biopsy and stereotactic core needle biopsy in ductal carcinoma in situ of the breast. *Acta Radiol* 2003 Mar;44(2):213-7.
190. Liberman L, Morris EA, Dershaw DD, Thornton CM, Van Zee KJ, Tan LK. Fast MRI-guided vacuum-assisted breast biopsy: initial experience. *AJR Am J Roentgenol* 2003 Nov;181(5):1283-93.
191. Mariotti C, Feliciotti F, Baldarelli M, Serri L, Santinelli A, Fabris G, Baccarini M, Maggi S, Angelini L, De Marco M, Lezoche E. Digital stereotactic biopsies for nonpalpable breast lesion. *Surg Endosc* 2003 Jun;17(6):911-7.
192. Masood S, Loya A, Khalbuss W. Is core needle biopsy superior to fine-needle aspiration biopsy in the diagnosis of papillary breast lesions? *Diagn Cytopathol* 2003 Jun;28(6):329-34.
193. Middleton LP, Grant S, Stephens T, Stelling CB, Sneige N, Sahin AA. Lobular carcinoma in situ diagnosed by core needle biopsy: When should it be excised? *Mod Pathol* 2003 Feb 1;16(2):120-9.
194. Miller KL, Marks LB, Barrier RC Jr, Leight GS, Clough RW, Prosnitz RG, Bentley RC. Increased sectioning of pathologic specimens with ductal carcinoma in situ of the breast: are there clinical consequences? *Clin Breast Cancer* 2003 Aug;4(3):198-202.
195. Puglisi F, Zuiani C, Bazzocchi M, Valent F, Aprile G, Pertoldi B, Minisini AM, Cedolini C, Londero V, Piga A, Di Loreto C. Role of mammography, ultrasound and large core biopsy in the diagnostic evaluation of papillary breast lesions. *Oncology* 2003;65(4):311-5.
196. Shah VI, Raju U, Chitale D, Deshpande V, Gregory N, Strand V. False-negative core needle biopsies of the breast: An analysis of clinical, radiologic, and pathologic findings in 27 consecutive cases of missed breast cancer. *Cancer* 2003 Apr 15;97(8):1824-31.
197. Sneige N, Lim SC, Whitman GJ, Krishnamurthy S, Sahin AA, Smith TL, Stelling CB. Atypical ductal hyperplasia diagnosis by directional vacuum-assisted stereotactic biopsy of breast microcalcifications. Considerations for surgical excision. *Am J Clin Pathol* 2003 Feb;119(2):248-53.
198. Sperber F, Blank A, Metser U, Flusser G, Klausner JM, Lev-Chelouche D. Diagnosis and treatment of breast fibroadenomas by ultrasound-guided vacuum-assisted biopsy. *Arch Surg* 2003 Jul;138(7):796-800.
199. Tsang FHF, Lo JJ, Wong JLN, Lee FCW, Chow LWC. Application of image-guided biopsy for impalpable breast lesions in Chinese women. *ANZ J Surg* 2003 Jan;73(1-2):23-5.

200. Verkooijen HM, Peterse JL, Schipper MEI, Buskens E, Hendriks JHCL, Pijnappel RM, Peeters PHM, Borel Rinkes IHM, Mali WPTM, Holland R. Interobserver variability between general and expert pathologists during the histopathological assessment of large-core needle and open biopsies of non-palpable breast lesions. *Eur J Cancer* 2003 Oct;39(15):2187-91.
201. Winchester DJ, Bernstein JR, Jeske JM, Nicholson MH, Hahn EA, Goldschmidt RA, Watkin WG, Sener SF, Bilimoria MB, Barrera E Jr, Winchester DP. Upstaging of atypical ductal hyperplasia after vacuum-assisted 11-gauge stereotactic core needle biopsy. *Arch Surg* 2003 Jun;138(6):619-22; discussion 622-3.
202. Witt A, Yavuz D, Walchetseder C, Strohmer H, Kubista E. Preoperative core needle biopsy as an independent risk factor for wound infection after breast surgery. *Obstet Gynecol* 2003 Apr 1;101(4):745-50.
203. Yeh I-T, Dimitrov D, Otto P, Miller AR, Kahlenberg MS, Cruz A. Pathologic review of atypical hyperplasia identified by image-guided breast needle core biopsy: Correlation with excision specimen. *Arch Pathol Lab Med* 2003 Jan;127(1):49-54.
204. Zhao L, Freimanis R, Bergman S, Shen P, Perrier ND, Lesko N, Pulaski T, Pulaski S, Carr JJ, Levine EA. Biopsy needle technique and the accuracy of diagnosis of atypical ductal hyperplasia for mammographic abnormalities. *Am Surg* 2003 Sep;69(9):757-62; discussion 762.
205. Acheson MB, Patton RG, Howisey RL, Lane RF, Morgan A, Rowbotham RK. Three- to six-year followup for 379 benign image-guided large-core needle biopsies of nonpalpable breast abnormalities. *J Am Coll Surg* 2002 Oct;195(4):462-6.
206. Bonnett M, Wallis T, Rossmann M, Pernick NL, Carolin KA, Segel M, Bouwman D, Visscher D. Histologic and radiographic analysis of ductal carcinoma in situ diagnosed using stereotactic incisional core breast biopsy. *Mod Pathol* 2002;15(2):95-101.
207. Chen AM, Haffty BG, Lee CH. Local recurrence of breast cancer after breast conservation therapy in patients examined by means of stereotactic core-needle biopsy. *Radiology* 2002 Dec;225(3):707-12.
208. Chun K, Velanovich V. Patient-perceived cosmesis and satisfaction after breast biopsy: Comparison of stereotactic incisional, excisional, and wire-localized biopsy techniques. *Surgery* 2002;131(5):497-501.
209. Fine RE, Boyd BA, Whitworth PW, Kim JA, Harness JK, Burak WE. Percutaneous removal of benign breast masses using a vacuum-assisted hand-held device with ultrasound. *Am J Surg* 2002 Oct 1;184(4):332-6.
210. Gal-Gombos EC, Esserman LE, Recine MA, Poppiti RJ Jr. Large-needle core biopsy in atypical intraductal epithelial hyperplasia including immunohistochemical expression of high molecular weight cytokeratin: analysis of results of a single institution. *Breast J* 2002 Sep-Oct;8(5):269-74.
211. Giardina C, Guerrieri AM, Ingravallo G, Serio G, Mastropasqua MG, Lomele M, Lattanzio V. [Mammary stereotactic core-biopsy by Mammotome: An alternative to frozen section examination]. *Pathologica* 2002 Aug;94(4):182-9. (Ita).
212. Haj M, Kniaz D, Eitan A, Solomon V, Cohen I, Loberant N. Three years of experience with advanced breast biopsy instrumentation (ABBI). *Breast J* 2002 Sep;8(5):275-80.
213. Harvey JM, Sterrett GF, Frost FA. Atypical ductal hyperplasia and atypia of uncertain significance in core biopsies from mammographically detected lesions: correlation with excision diagnosis. *Pathology* 2002 Oct;34(5):410-6.
214. Hoorntje LE, Peeters PHM, Borel Rinkes IHM, Verkooijen HM, Pijnappel RM, Mali WPTM. Stereotactic large core needle biopsy for all nonpalpable breast lesions? *Breast Cancer Res Treat* 2002;73(2):177-82.
215. Hui JY, Chan LK, Chan RL, Lau AW, Lo J, Chan JC, Lam HS. Prone table stereotactic breast biopsy. *Hong Kong Med J* 2002 Dec;8(6):447-51.
216. Insausti LP, Alberro JA, Regueira FM, Imana J, Vivas L, Martinez-Cuesta A, Bergaz E, Zornoza G, Errasti T, Rezola R. An experience with the Advanced Breast Biopsy Instrumentation (ABBI) system in the management of non-palpable breast lesions. *Eur Radiol* 2002 Jul 1;12(7):1703-10.
217. Jackman RJ, Birdwell RL, Ikeda DM. Atypical ductal hyperplasia: can some lesions be defined as probably benign after stereotactic 11-gauge vacuum-assisted biopsy, eliminating the recommendation for surgical excision. *Radiology* 2002 Aug;224(2):548-54.
218. Jan WA, Zada N, Samieullah, Israr M. Comparison of FNAC and core biopsy for evaluating breast lumps. *Med Forum Mon* 2002 Dec 1;13(12):26-8.
219. Knight R, Horiuchi K, Parker SH, Ratzner ER, Fenoglio ME. Risk of needle-track seeding after diagnostic image-guided core needle biopsy in breast cancer. *J Soc Laparoendosc Surg* 2002 Jul-Sep;6(3):207-9.
220. Liberman L, Goodstine SL, Dershaw DD, Morris EA, LaTrenta LR, Abramson AF, Van Zee KJ. One operation after percutaneous diagnosis of nonpalpable breast cancer: Frequency and associated factors. *AJR Am J Roentgenol* 2002;178(3):673-9.

221. Lifrange E, Dondelinger RF, Foidart JM, Bradfer J, Quatresooz P, Colin C. Percutaneous stereotactic en bloc excision of nonpalpable breast carcinoma: A step in the direction of supraconservative surgery. *Breast* 2002 Dec;11(6):501-8.
222. Mainiero MB, Gareen IF, Bird CE, Smith W, Cobb C, Schepps B. Preferential use of sonographically guided biopsy to minimize patient discomfort and procedure time in a percutaneous image-guided breast biopsy program. *J Ultrasound Med* 2002 Nov;21(11):1221-6.
223. McKee MD, Cropp MD, Hyland A, Watroba N, McKinley B, Edge SB. Provider case volume and outcome in the evaluation and treatment of patients with mammogram-detected breast carcinoma. *Cancer* 2002 Aug 15;95(4):704-12.
224. Perlet C, Schneider P, Amaya B, Grosse A, Sittek H, Reiser MF, Heywang-Kobrunner SH. MR-Guided vacuum biopsy of 206 contrast-enhancing breast lesions. *Rofo Fortschr Geb Rontgenstr Neuen Bildgeb Verfahr* 2002 Jan;174(1):88-95.
225. Pijnappel RM, Peeters PH, Van den Donk M, Holland R, Hendriks JH, Deurloo EE, Mali WP. Diagnostic strategies in non-palpable breast lesions. *Eur J Cancer* 2002;38(4):550-5.
226. Popiela TJ, Tabor J, Nowak W, Podsiadlo-kleinrok B, Owsianski G, Mlynarczyk S. Detectability of pre-clinical breast pathologies in own experience. *Pol Przegl Chir* 2002;74(1):36-43.
227. Rao A, Parker S, Ratzler E, Stephens J, Fenoglio M. Atypical ductal hyperplasia of the breast diagnosed by 11-gauge directional vacuum-assisted biopsy. *Am J Surg* 2002 Dec;184(6):534-7; discussion 537.
228. Renshaw AA. Can mucinous lesions of the breast be reliably diagnosed by core needle biopsy? *Am J Clin Pathol* 2002;118(1):82-4.
229. Renshaw AA, Cartagena N, Derhagopian RP, Gould EW. Lobular neoplasia in breast core needle biopsy specimens is not associated with an increased risk of ductal carcinoma in situ or invasive carcinoma. *Am J Clin Pathol* 2002;117(5):797-9.
230. Rosen EL, Bentley RC, Baker JA, Soo MS. Imaging-guided core needle biopsy of papillary lesions of the breast. *AJR Am J Roentgenol* 2002 Nov;179(5):1185-92.
231. Schneider JP, Schulz T, Horn LC, Leinung S, Schmidt F, Kahn T. MR-guided percutaneous core biopsy of small breast lesions: first experience with a vertically open 0.5T scanner. *J Magn Reson Imaging* 2002 Apr;15(4):374-85.
232. Shin SJ, Rosen PP. Excisional biopsy should be performed if lobular carcinoma in situ is seen on needle core biopsy. *Arch Pathol Lab Med* 2002;126(6):697-701.
233. Smyczek-Gargya B, Krainick U, Muller-Schimpfle M, Mielke G, Mayer R, Siegmann K, Mehnert F, Vogel U, Ruck P, Wallwiener D, Fersis N. Large-core needle biopsy for diagnosis and treatment of breast lesions. *Arch Gynecol Obstet* 2002 Aug;266(4):198-200.
234. Soo MS, Baker JA, Rosen EL, Vo TT. Sonographically guided biopsy of suspicious microcalcifications of the breast: A pilot study. *AJR Am J Roentgenol* 2002;178(4):1007-15.
235. Tan SM, Behranwala KA, Trott PA, Nasiri NA, Moskovic E, Brown G, King DM, Sacks NP, Gui GP. A retrospective study comparing the individual modalities of triple assessment in the pre-operative diagnosis of invasive lobular breast carcinoma.[erratum appears in *Eur J Surg Oncol* 2002 Dec;28(8):900 Note: Nasim NA [corrected to Nasiri NA]]. *Eur J Surg Oncol* 2002 Apr;28(3):203-8.
236. Tse GM, Law BK, Ma TK, Chan AB, Pang LM, Chu WC, Cheung HS. Hamartoma of the breast: a clinicopathological review. *J Clin Pathol* 2002 Dec;55(12):951-4.
237. Verkooijen HM, Peeters PHM. Diagnostic accuracy of stereotactic large-core needle biopsy for nonpalpable breast disease: Results of a multicenter prospective study with 95% surgical confirmation. *Int J Cancer* 2002 Jun 20;99(6):853-9.
238. Verkooijen HM, Buskens E, Peeters PH, Borel Rinke IH, de Koning HJ, van Vroonhoven TJ, COBRA Study Group. Diagnosing non-palpable breast disease: short-term impact on quality of life of large-core needle biopsy versus open breast biopsy. *Surg Oncol* 2002 May;10(4):177-81.
239. Watermann DO, Einert A, Ehrhrt-Braun C, Hasenburg A, Kieback DG. Experience with the Advanced Breast Biopsy Instrumentation (ABBI) System. *Anticancer Res* 2002 Sep;22(5):3067-70.
240. Wunderbaldinger P, Wolf G, Turetschek K, Helbich TH. Comparison of sitting versus prone position for stereotactic large-core breast biopsy in surgically proven lesions. *AJR Am J Roentgenol* 2002;178(5):1221-5.
241. Bagnall MJC, Evans AJ, Wilson ARM, Pinder SE, Denley H, Geraghty JG, Ellis IO. Predicting invasion in mammographically detected microcalcification. *Clin Radiol* 2001 Oct;56(10):828-32.
242. Berg WA, Arnoldus CL, Teferra E, Bhargavan M. Biopsy of amorphous breast calcifications: Pathologic outcome and yield at stereotactic biopsy. *Radiology* 2001;221(2):495-503.
243. Berg WA, Mrose HE, Ioffe OB. Atypical lobular hyperplasia or lobular carcinoma in situ at core-needle breast biopsy. *Radiology* 2001;218(2):503-9.

244. Brem RF, Schoonjans JM, Goodman SN, Nolten A, Askin FB, Gatewood OMB. Nonpalpable breast cancer: Percutaneous diagnosis with 11- and 8-gauge stereotactic vacuum-assisted biopsy devices. *Radiology* 2001 Jun;219(3):793-6.
245. Chao C, Torosian MH, Boraas MC, Sigurdson ER, Hoffman JP, Eisenberg BL, Fowble B. Local recurrence of breast cancer in the stereotactic core needle biopsy site: case reports and review of the literature. *Breast J* 2001 Mar-Apr;7(2):124-7.
246. Clarke D, Sudhakaran N, Gateley CA. Replace fine needle aspiration cytology with automated core biopsy in the triple assessment of breast cancer. *Ann R Coll Surg Engl* 2001 Mar;83(2):110-2.
247. Daniel BL, Birdwell RL, Butts K, Nowels KW, Ikeda DM, Heiss SG, Cooper CR, Jeffrey SS, Dirbas FM, Herfkens RJ. Freehand iMRI-guided large-gauge core needle biopsy: A new minimally invasive technique for diagnosis of enhancing breast lesions. *J Magn Reson Imaging* 2001 Jun;13(6):896-902.
248. Deurloo EE, Gilhuijs KGA, Schultze Kool LJ, Muller SH. Displacement of breast tissue and needle deviations during stereotactic procedures. *Invest Radiol* 2001;36(6):347-53.
249. Ely KA, Carter BA, Jensen RA, Simpson JF, Page DL. Core biopsy of the breast with atypical ductal hyperplasia: a probabilistic approach to reporting. *Am J Surg Pathol* 2001 Aug;25(8):1017-21.
250. Fine RE, Israel PZ, Walker LC, Corgan KR, Greenwald LV, Berenson JE, Boyd BA, Oliver MK, McClure T, Elberfeld J. A prospective study of the removal rate of imaged breast lesions by an 11-gauge vacuum-assisted biopsy probe system. *Am J Surg* 2001 Oct;182(4):335-40.
251. Grimes MM, Karageorge LS, Hogge JP. Does exhaustive search for microcalcifications improve diagnostic yield in stereotactic core needle breast biopsies? *Mod Pathol* 2001;14(4):350-3.
252. Hung WK, Lam HS, Lau Y, Chan CM, Yip AW. Diagnostic accuracy of vacuum-assisted biopsy device for image-detected breast lesions. *Aust N Z J Surg* 2001 Aug;71(8):457-460.
253. Ibrahim AEK, Bateman AC, Theaker JM, Low JL, Addis B, Tidbury P, Rubin C, Briley M, Royle GT. The role and histological classification of needle core biopsy in comparison with fine needle aspiration cytology in the preoperative assessment of impalpable breast lesions. *J Clin Pathol* 2001;54(2):121-5.
254. Jackman RJ, Burbank F, Parker SH, Evans III WP, Lechner MC, Richardson TR, Smid AA, Borofsky HB, Lee CH, Goldstein HM, Schilling KJ, Wray AB, Brem RF, Helbich TH, Lehrer DE, Adler SJ. Stereotactic breast biopsy of nonpalpable lesions: Determinants of ductal carcinoma in situ underestimation rates. *Radiology* 2001;218(2):497-502.
255. Jacobs IA, Chevinsky AH, Diehl W, Smith TJ. Advanced breast biopsy instrumentation (ABBI) and management of nonpalpable breast abnormalities: A community hospital experience. *Breast* 2001;10(5):421-6.
256. Joshi M, Duva-Frissora A, Padmanabhan R, Greeley J, Ranjan A, Ferrucci F, Kwon J, Khettry U. Atypical ductal hyperplasia in stereotactic breast biopsies: enhanced accuracy of diagnosis with the mammotome. *Breast J* 2001 Jul-Aug;7(4):207-13.
257. Kaufman HJ, Witherspoon LE, Gwin JL Jr, Greer MS, Burns RP. Stereotactic breast biopsy: a study of first core samples. *Am Surg* 2001 Jun;67(6):572-5; discussion 575-6.
258. King TA, Hayes DH, Cederbom GJ, Champaign JL, Smetherman DH, Farr GH, Bolton JS, Fuhrman GM. Biopsy technique has no impact on local recurrence after breast-conserving therapy. *Breast J* 2001 Jan-Feb;7(1):19-24.
259. Kuhl CK, Morakkabati N, Leutner CC, Schmiedel A, Wardelmann E, Schild HH. MR imaging--guided large-core (14-gauge) needle biopsy of small lesions visible at breast MR imaging alone. *Radiology* 2001 Jul;220(1):31-9.
260. Liberman L, Benton CL, Dershaw DD, Abramson AF, LaTrenta LR, Morris EA. Learning curve for stereotactic breast biopsy: how many cases are enough? *AJR Am J Roentgenol* 2001 Mar;176(3):721-7.
261. Liberman L, Gougoutas CA, Zakowski MF, LaTrenta LR, Abramson AF, Morris EA, Dershaw DD. Calcifications highly suggestive of malignancy: comparison of breast biopsy methods. *AJR Am J Roentgenol* 2001 Jul;177(1):165-72.
262. Lifrange E, Dondelinger RF, Fridman V, Colin C. En bloc excision of nonpalpable breast lesions using the advanced breast biopsy instrumentation system: An alternative to needle guided surgery? *Eur Radiol* 2001;11(5):796-801.
263. Maganini RO, Klem DA, Huston BJ, Bruner ES, Jacobs HK. Upgrade rate of core biopsy-determined atypical ductal hyperplasia by open excisional biopsy. *Am J Surg* 2001 Oct;182(4):355-8.
264. Marti WR, Zuber M, Oertli D, Weber WP, Muller D, Kochli OR, Langer I, Harder F. Advanced breast biopsy instrumentation for the evaluation of impalpable lesions: A reliable diagnostic tool with little therapeutic potential. *Eur J Surg* 2001;167(1):15-8.
265. Meloni GB, Dessol S, Becchere MP, Soro D, Capobianco G, Ambrosini G, Nardelli GB, Canalis GC. Ultrasound-guided mammothome vacuum biopsy for the diagnosis of impalpable breast lesions. *Ultrasound Obstet Gynecol* 2001;18(5):520-4.

266. Mendez I, Andreu FJ, Saez E, Sentis M, Jurado I, Cabezuelo MA, Castaner E, Gallardo X, Diaz-Ruiz MJ, Lopez E, Marco V. Ductal carcinoma in situ and atypical ductal hyperplasia of the breast diagnosed at stereotactic core biopsy. *Breast J* 2001;7(1):14-8.
267. Mercado CL, Hamele-Bena D, Singer C, Koenigsberg T, Pile-Spellman E, Higgins H, Smith SJ. Papillary lesions of the breast: evaluation with stereotactic directional vacuum-assisted biopsy. *Radiology* 2001 Dec;221(3):650-5.
268. Morrow M, Venta L, Stinson T, Bennett C. Prospective comparison of stereotactic core biopsy and surgical excision as diagnostic procedures for breast cancer patients. *Ann Surg* 2001 Apr;233(4):537-41.
269. O'Driscoll D, Britton P, Bobrow L, Wishart GC, Sinnatamby R, Warren R. Lobular carcinoma in situ on core biopsy - What is the clinical significance? *Clin Radiol* 2001 Mar 1;56(3):216-20.
270. Parker SH, Klaus AJ, McWey PJ, Schilling KJ, Cupples TE, Duchesne N, Guenin MA, Harness JK. Sonographically guided directional vacuum-assisted breast biopsy using a handheld device. *AJR Am J Roentgenol* 2001 Aug;177(2):405-8.
271. Parker SJ, Wheaton M, Wallis MG, Harries SA. Why should diagnostic benign breast biopsies weight less than twenty grams? *Ann R Coll Surg Engl* 2001 Mar;83(2):113-6.
272. Renshaw AA. Adequate histologic sampling of breast core needle biopsies. *Arch Pathol Lab Med* 2001;125(8):1055-7.
273. Renshaw AA, Cartagena N, Schenkman RH, Derhagopian RP, Gould EW. Atypical ductal hyperplasia in breast core needle biopsies. Correlation of size of the lesion, complete removal of the lesion, and the incidence of carcinoma in follow-up biopsies. *Am J Clin Pathol* 2001 Jul;116(1):92-6.
274. Saarenmaa I, Salminen T, Geiger U, Heikkinen P, Hyvarinen S, Isola J, Kataja V, Kokko ML, Kokko R, Kumpulainen E, Karkkainen A, Pakkanen J, Peltonen P, Piironen, Salo A, Talviala ML, Hakama M. Validity of radiological examinations of patients with breast cancer in different age groups in a population based study. *Breast* 2001;10(1):78-81.
275. Schneider E, Rohling KW, Schnall MD, Giaquinto RO, Morris EA, Ballon D. An apparatus for MR-guided breast lesion localization and core biopsy: Design and preliminary results. *J Magn Reson Imaging* 2001;14(3):243-53.
276. Schoonjans JM, Brem RF. Fourteen-gauge ultrasonographically guided large-core needle biopsy of breast masses. *J Ultrasound Med* 2001;20(9):967-72.
277. Shannon J, Douglas-Jones AG, Dallimore NS. Conversion to core biopsy in preoperative diagnosis of breast lesions: is it justified by results? *J Clin Pathol* 2001 Oct;54(10):762-5.
278. Sklair-Levy M, Samuels TH, Catzavelos C, Hamilton P, Shumak R. Stromal fibrosis of the breast. *AJR Am J Roentgenol* 2001;177(3):573-7.
279. Smith LF, Henry-Tillman R, Mancino AT, Johnson A, Price Jones M, Westbrook KC, Harms S, Klimberg VS. Magnetic resonance imaging-guided core needle biopsy and needle localized excision of occult breast lesions. *Am J Surg* 2001 Oct;182(4):414-8.
280. Sun W, Li A, Abreo F, Turbat-Herrera E, Grafton WD. Comparison of fine-needle aspiration cytology and core biopsy for diagnosis of breast cancer. *Diagn Cytopathol* 2001;24(6):421-5.
281. Verkooijen HM, Borel Rinkes IH, Peeters PH, Landheer ML, van Es NJ, Mali WP, Klinkenbijn JH, van Vroonhoven TJ, COBRA Study Group. Impact of stereotactic large-core needle biopsy on diagnosis and surgical treatment of nonpalpable breast cancer. *Eur J Surg Oncol* 2001 Apr;27(3):244-9.
282. Westenend PJ, Sever AR, Beekman-de Volder HJC, Liem SJ. A comparison of aspiration cytology and core needle biopsy in the evaluation of breast lesions. *Cancer* 2001;93(2):146-50.
283. Adrales G, Turk P, Wallace T, Bird R, Norton HJ, Greene F. Is surgical excision necessary for atypical ductal hyperplasia of the breast diagnosed by Mammotome? *Am J Surg* 2000 Oct;180(4):313-5.
284. Bagnall MJ, Evans AJ, Wilson AR, Burrell H, Pinder SE, Ellis IO. When have mammographic calcifications been adequately sampled at needle core biopsy? *Clin Radiol* 2000 Jul;55(7):548-53.
285. Burns RP, Brown JP, Roe SM, Sprouse II LR, Yancey AE, Witherspoon LE, Rush BF Jr, Numann PJ, Mueller CB. Stereotactic core-needle breast biopsy by surgeons: Minimum 2-year follow-up of benign lesions. *Ann Surg* 2000;232(4):542-8.
286. Darling ML, Smith DN, Lester SC, Kaelin C, Selland DL, Denison CM, DiPiro PJ, Rose DI, Rhei E, Meyer JE. Atypical ductal hyperplasia and ductal carcinoma in situ as revealed by large-core needle breast biopsy: results of surgical excision. *AJR Am J Roentgenol* 2000 Nov;175(5):1341-6.
287. Cangiarella JF, Waisman J, Weg N, Tata M, Gross J, Symmans WF. The use of stereotactic core biopsy and stereotactic aspiration biopsy as diagnostic tools in the evaluation of mammary calcification. *Breast J* 2000;6(6):366-72.

288. Cangiarella J, Gross J, Symmans WF, Waisman J, Petersen B, D'Angelo D, Singer C, Axelrod D. The incidence of positive margins with breast conserving therapy following mamotome biopsy for microcalcification. *J Surg Oncol* 2000 Aug;74(4):263-6.
289. Gukas ID, Nwana EJ, Ihezue CH, Momoh JT, Obekpa PO. Tru-cut biopsy of palpable breast lesions: a practical option for pre-operative diagnosis in developing countries. *Cent Afr J Med* 2000 May;46(5):127-30.
290. Hatada T, Ishii H, Ichii S, Okada K, Fujiwara Y, Yamamura T. Diagnostic value of ultrasound-guided fine-needle aspiration biopsy; core-needle biopsy; and evaluation of combined use in the diagnosis of breast lesions. *J Am Coll Surg* 2000 Mar;190(3):299-303.
291. Lamm RL, Jackman RJ. Mammographic abnormalities caused by percutaneous stereotactic biopsy of histologically benign lesions evident on follow-up mammograms. *AJR Am J Roentgenol* 2000 Mar;174(3):753-6.
292. Lee CH, Carter D, Philpotts LE, Couce ME, Horvath LJ, Lange RC, Tocino I. Ductal carcinoma in situ diagnosed with stereotactic core needle biopsy: can invasion be predicted? *Radiology* 2000 Nov;217(2):466-70.
293. Liberman L, Drotman M, Morris EA, LaTrenta LR, Abramson AF, Zakowski MF, Dershaw DD. Imaging-histologic discordance at percutaneous breast biopsy: an indicator of missed cancer. *Cancer* 2000 Dec 15;89(12):2538-46.
294. Melotti MK, Berg WA. Core needle breast biopsy in patients undergoing anticoagulation therapy: preliminary results. *AJR Am J Roentgenol* 2000 Jan;174(1):245-9.
295. Mok PM, Keepin Y. Stereotactic breast biopsies for lesions discovered on routine mammography: experience at the North Shore Hospital. *N Z Med J* 2000 Jul 14;113(1113):273-4.
296. Moritz JD, Mertens C, Westerhof JP, Oestmann JW. Role of high magnification specimen radiography in surgical and core biopsies of the breast. *Br J Radiol* 2000;73(875):1170-7.
297. Nisbet AP, Borthwick-Clarke A, Scott N. 11-gauge vacuum assisted directional biopsy of breast calcifications, using upright stereotactic guidance. *Eur J Radiol* 2000 Dec;36(3):144-6.
298. O'hea BJ, Tornos C. Mild ductal atypia after large-core needle biopsy of the breast: is surgical excision always necessary? *Surgery* 2000 Oct;128(4):738-43.
299. Philpotts LE, Lee CH, Horvath LJ, Lange RC, Carter D, Tocino I. Underestimation of breast cancer with 11-gauge vacuum suction biopsy. *AJR Am J Roentgenol* 2000 Oct;175(4):1047-50.
300. Philpotts LE, Shaheen NA, Jain KS, Carter D, Lee CH. Uncommon high-risk lesions of the breast diagnosed at stereotactic core-needle biopsy: Clinical importance. *Radiology* 2000;216(3):831-7.
301. Portincasa G, Lucci E, Navarra GG, Donato S, Parpanesi R, Garcea D. Initial experience with breast biopsy utilizing the Advanced Breast Biopsy Instrumentation (ABBI). *J Surg Oncol* 2000;74(3):201-3.
302. Schwartzberg BS, Goates JJ, Keeler SA, Moore JA. Use of advanced breast biopsy instrumentation while performing stereotactic breast biopsies: review of 150 consecutive biopsies. *J Am Coll Surg* 2000 Jul;191(1):9-15.
303. Simon JR, Kalbhen CL, Cooper RA, Flisak ME. Accuracy and complication rates of US guided vacuum-assisted core breast biopsy: Initial results. *Radiology* 2000 Jun;215(3):694-7.
304. Sneige N, Tulbah A. Accuracy of cytologic diagnoses made from touch imprints of image-guided needle biopsy specimens of nonpalpable breast abnormalities. *Diagn Cytopathol* 2000 Jul;23(1):29-34.
305. Stolier A, Skinner J, Levine EA. A prospective study of seeding of the skin after core biopsy of the breast. *Am J Surg* 2000 Aug;180(2):104-7.
306. Teh WL, Wilson ARM, Evans AJ, Burrell H, Pinder SE, Ellis IO. Ultrasound guided core biopsy of suspicious mammographic calcifications using high frequency and power doppler ultrasound. *Clin Radiol* 2000;55(5):390-4.
307. Whitlock JPL, Evans AJ, Burrell HC, Pinder SE, Ellis IO, Blamey RW, Wilson ARM. Digital imaging improves upright stereotactic core biopsy of mammographic microcalcifications. *Clin Radiol* 2000;55(5):374-7.
308. Yang J-H, Lee S-D, Nam S-J. Diagnostic utility of ABBI (Advanced Breast Biopsy Instrumentation) for nonpalpable breast lesions in Korea. *Breast J* 2000;6(4):257-62.
309. Al-Sobhi SS, Helvie MA, Pass HA, Chang AE. Extent of lumpectomy for breast cancer after diagnosis by stereotactic core versus wire localization biopsy. *Ann Surg Oncol* 1999 Jun;6(4):330-5.
310. Baker JA, Soo MS, Mengoni P. Sonographically guided percutaneous interventions of the breast using a steerable ultrasound beam. *AJR Am J Roentgenol* 1999 Jan;172(1):157-9.
311. Bloomston M, D'Angelo P, Galliano D, Butler J Jr, Dean R, Rosemurgy AS. One hundred consecutive advanced breast biopsy instrumentation procedures: complications, costs, and outcome. *Ann Surg Oncol* 1999 Mar;6(2):195-9.

312. Bokran W, Reynolds HE, Lazaridis CL, Jackson VP. Stereotactic biopsy of ductal carcinoma in situ of the breast using an 11-gauge vacuum-assisted device: Persistent underestimation of disease. *AJR Am J Roentgenol* 1999 Jul;173(1):227-9.
313. Brem RF, Behrndt VS, Sanow L, Gatewood OMB. Atypical ductal hyperplasia: Histologic underestimation of carcinoma in tissue harvested from impalpable breast lesions using 11-gauge stereotactically guided directional vacuum-assisted biopsy. *AJR Am J Roentgenol* 1999 May;172(5):1405-7.
314. Britton PD, McCann J. Needle biopsy in the NHS breast screening programme 1996/97: How much and how accurate? *Breast* 1999 Feb;8(1):5-11.
315. Damascelli B, Frigerio LF, Patelli G, Lanocita R, Viganotti G, Uslenghi E, Ticha V, Conti A, Bohm S, De Simone T, Vespro V. Stereotactic breast biopsy: En bloc excision of microcalcifications with a large-bore cannula device. *AJR Am J Roentgenol* 1999 Oct;173(4):895-900.
316. Deschryver K, Radford DM, Schuh ME. Pathology of large-caliber stereotactic biopsies in nonpalpable breast lesions. *Semin Diagn Pathol* 1999 Aug;16(3):224-34.
317. Diaz LK, Wiley EL, Venta LA. Are malignant cells displaced by large-gauge needle core biopsy of the breast. *AJR Am J Roentgenol* 1999 Nov;173(5):1303-13.
318. DiPiro PJ, Meyer JE, Denison CM, Frenna TH, Harvey SC, Smith DN. Image-guided core breast biopsy of ductal carcinoma in situ presenting as a non-calcified abnormality. *Eur J Radiol* 1999 Jun;30(3):231-6.
319. El-Tamer M, Axiotis C, Kim E, Kim J, Wait R, Homel P, Braverman A. Accurate prediction of the amount of in situ tumor in palpable breast cancers by core needle biopsy: Implications for neoadjuvant therapy. *Ann Surg Oncol* 1999 Jul;6(5):461-6.
320. Evans AJ, Whitlock JP, Burrell HC, Pinder SE, Ellis IO, Geraghty JG, Lee AHS, Wilson ARM. A comparison of 14 and 12 gauge needles for core biopsy of suspicious mammographic calcification. *Br J Radiol* 1999;72:1152-4.
321. Ferzli GS, Puza T, VanVorst-Bilotti S, Waters R. Breast biopsies with ABB1: Experience with 183 attempted biopsies. *Breast J* 1999;5(1):26-8.
322. Fraser Symmans W, Weg N, Gross J, Cangiarella JF, Tata M, Mazzo JA, Waisman J. A prospective comparison of stereotaxic fine-needle aspiration versus stereotaxic core needle biopsy for the diagnosis of mammographic abnormalities. *Cancer* 1999;85(5):1119-32.
323. Gajdos C, Levy M, Herman Z, Herman G, Bleiweiss IJ, Tartter PI. Complete removal of nonpalpable breast malignancies with a stereotactic percutaneous vacuum-assisted biopsy instrument. *J Am Coll Surg* 1999 Sep;189(3):237-40.
324. Gentry CL, Henry CA. Stereotactic percutaneous breast biopsy: A comparative analysis between surgeon and radiologist. *Breast J* 1999;5(2):101-4.
325. Gray RE, Benson GW, Lustig DD. Stereotactic breast biopsy: experience in a community setting. *J Miss State Med Assoc* 1999 Jan;40(1):3-7.
326. Harlow SP, Krag DN, Ames SE, Weaver DL. Intraoperative ultrasound localization to guide surgical excision of nonpalpable breast carcinoma. *J Am Coll Surg* 1999 Sep;189(3):241-6.
327. Harvey SC, Denison CM, Lester SC, DiPiro PJ, Smith DN, Meyer JE. Fibrous nodules found at large-core needle biopsy of the breast: Imaging features. *Radiology* 1999 May;211(2):535-40.
328. Johnson JM, Dalton RR, Wester SM, Landercasper J, Lambert PJ. Histological correlation of microcalcifications in breast biopsy specimens. *Arch Surg* 1999 Jul;134(7):712-6.
329. Klem D, Jacobs HK, Jorgensen R, Facenda LS, Baker DA, Altimari A. Stereotactic breast biopsy in a community hospital setting. *Am Surg* 1999 Aug;65(8):737-40; discussion 740-1.
330. LaRaja RD, Saber AA, Sickles A. Early experience in the use of the advanced breast biopsy instrumentation: A report of one hundred twenty-seven patients. *Surgery* 1999;125(4):380-4.
331. Liberman L, Bracero N, Vuolo MA, David Dershaw D, Morris EA, Abramson AF, Rosen PP. Percutaneous large-core biopsy of papillary breast lesions. *AJR Am J Roentgenol* 1999 Feb;172(2):331-7.
332. Liberman L, Sama M, Susnik B, Rosen PP, LaTrenta LR, Morris EA, Abramson AF, Dershaw DD. Lobular carcinoma in situ at percutaneous breast biopsy: Surgical biopsy findings. *AJR Am J Roentgenol* 1999 Aug;173(2):291-9.
333. Liberman L, Vuolo M, Dershaw DD, Morris EA, Abramson AF, LaTrenta LR, Polini NM, Rosen PP. Epithelial displacement after stereotactic 11-gauge directional vacuum-assisted breast biopsy. *AJR Am J Roentgenol* 1999 Mar;172(3):677-81.
334. Matthews BD, Williams GB. Initial experience with the advanced breast biopsy instrumentation system. *Am J Surg* 1999 Feb;177(2):97-101.
335. Mitnick JS, Gianutsos R, Pollack AH, Susman M, Baskin BL, Ko WD, Pressman PI, Feiner HD, Roses DF. Tubular carcinoma of the breast: sensitivity of diagnostic techniques and correlation with histopathology. *AJR Am J Roentgenol* 1999 Feb;172(2):319-23.

336. Philpotts LE, Shaheen NA, Carter D, Lange RC, Lee CH. Comparison of rebiopsy rates after stereotactic core needle biopsy of the breast with 11-gauge vacuum suction probe versus 14-gauge needle and automatic gun. *AJR Am J Roentgenol* 1999 Mar;172(3):683-87.
337. Rebner M, Chesbrough R, Gregory N. Initial experience with the advanced breast biopsy instrumentation device. *AJR Am J Roentgenol* 1999 Jul;173(1):221-6.
338. Rich PM, Michell MJ, Humphreys S, Howes GP, Nunnerley HB. Stereotactic 14G core biopsy of non-palpable breast cancer: What is the relationship between the number of core samples taken and the sensitivity for detection of malignancy? *Clin Radiol* 1999 Jun;54(6):384-9.
339. Rosen EL, Soo MS, Bentley RC. Focal fibrosis: A common breast lesion diagnosed at imaging-guided core biopsy. *AJR Am J Roentgenol* 1999 Dec;173(6):1657-62.
340. Roth WD, von Smitten K, Heikkila P, Edgren J, Laasonen L. Automated stereotactic core needle biopsy of microcalcifications with correlation to surgical biopsy. *Acta Radiol* 1999 Jul;40(4):390-3.
341. Sharifi S, Peterson MK, Baum JK, Raza S, Schnitt SJ. Assessment of pathologic prognostic factors in breast core needle biopsies. *Mod Pathol* 1999 Oct;12(10):941-5.
342. Sheth D, Wesen CA, Schroder D, Boccaccio JE, Lloyd LR. The Advanced Breast Biopsy Instrumentation (ABBI) experience at a community hospital. *Am Surg* 1999 Aug;65(8):726-30.
343. Shin HJC, Sneige N, Staerke GA. Utility of punch biopsy for lesions that are hard to aspirate by conventional fine-needle aspiration. *Cancer* 1999 Jun 25;87(3):149-54.
344. Staren ED, O'Neill TP. Ultrasound-guided needle biopsy of the breast. *Surgery* 1999;126(4):629-35.
345. Tran DQ, Wilkerson DK, Namm J, Zeis MA, Cottone FJ. Needle-localized breast biopsy for mammographic abnormalities: A community hospital experience. *Am Surg* 1999 Mar;65(3):283-8.
346. Velanovich V, Lewis FR Jr, Nathanson SD, Strand VF, Talpos GB, Bhandarkar S, Elkus R, Szymanski W, Ferrara JJ. Comparison of mammographically guided breast biopsy techniques. *Ann Surg* 1999 May;229(5):625-30; discussion 630-3.
347. Williams AB, Roberts JV, Michell MJ, Humphreys S. Prone stereotactic breast core biopsy: The impact on surgical management of nonpalpable breast cancers. *Breast* 1999 Feb;8(1):12-5.
348. Won B, Reynolds HE, Lazaridis CL, Jackson VP. Stereotactic biopsy of ductal carcinoma in situ of the breast using an 11-gauge vacuum-assisted device: persistent underestimation of disease. *AJR Am J Roentgenol* 1999 Jul;173(1):227-9.
349. Yong WS, Chia KH, Poh WT, Wong CY. A comparison of trucut biopsy with fine needle aspiration cytology in the diagnosis of breast cancer. *Singapore Med J* 1999 Sep;40(9):587-9.
350. Andreu FJ, Sentis M, Castaner E, Gallardo X, Jurado I, Diaz-Ruiz MJ, Mendez I, Rey M, Florensa R. The impact of stereotactic large-core needle biopsy in the treatment of patients with nonpalpable breast lesions: a study of diagnostic accuracy in 510 consecutive cases. *Eur Radiol* 1998;8(8):1468-74.
351. Antley CM, Mooney EE, Layfield LJ. A comparison of accuracy rates between open biopsy, cutting-needle biopsy, and fine-needle aspiration biopsy of the breast: A 3-year experience. *Breast J* 1998;4(1):3-8.
352. Bleznak AD, Magaram D. Surgical biopsy techniques for mammographically detected abnormalities. *Breast J* 1998;4(6):426-9.
353. Damascelli B, Frigerio LF, Lanocita R, Patelli G, Viganotti G, Di Tolla G, Magnoni S, Ticha V, Galante E, Attili A, Saccozzi R, Tomasich G. Stereotactic excisional breast biopsy performed by interventional radiologists using the advanced breast biopsy instrumentation system. *Br J Radiol* 1998 Oct;71(850):1003-11.
354. Doyle AJ, King AR, Miller MV, Collins JP. Implementation of image-guided large-core needle biopsy of the breast on a limited budget. *Australas Radiol* 1998;42(3):199-203.
355. Goodman KA, Birdwell RL, Ikeda DM. Compliance with recommended follow-up after percutaneous breast core biopsy. *AJR Am J Roentgenol* 1998;170(1):89-93.
356. Helbich TH, Rudas M, Haitel A, Kohlberger PD, Thurnher M, Gnant M, Wunderbaldinger P, Wolf G, Mostbeck GH. Evaluation of needle size for breast biopsy: Comparison of 14-, 16-, and 18-gauge biopsy needles. *AJR Am J Roentgenol* 1998 Jul;171(1):59-63.
357. Jackman RJ, Marzoni Jr FA, Nowels KW. Percutaneous removal of benign mammographic lesions: Comparison of automated large-core and directional vacuum-assisted stereotactic biopsy techniques. *AJR Am J Roentgenol* 1998 Nov;171(5):1325-30.
358. Johnson JM, Dalton RR, Landercasper J, Travelli R, Lambert PJ. Image-guided or needle-localized open biopsy of mammographic malignant-appearing microcalcifications? *J Am Coll Surg* 1998;187(6):604-9.

359. Kaufman CS, Delbecq R, Jacobson L. Excising the reexcision: stereotactic core-needle biopsy decreases need for reexcision of breast cancer. *World J Surg* 1998 Oct;22(10):1023-7.
360. Kelley Jr WE, Bailey R, Bertelsen C, Diaco J, Hagans JE, Kritsky K, Roe JE, Schwartzberg B, Uddo J. Stereotactic automated surgical biopsy using the ABBi biopsy device: A multicenter study. *Breast J* 1998;4(5):302-6.
361. King TA, Cederbom GJ, Champaign JL, Smetherman DH, Bolton JS, Farr GH, McKinnon WM, Kuske RR, Fuhrman GM. A core breast biopsy diagnosis of invasive carcinoma allows for definitive surgical treatment planning. *Am J Surg* 1998 Dec;176(6):497-501.
362. Liberman L, Dershaw DD, Rosen PP, Morris EA, Abramson AF, Borgen PI. Percutaneous removal of malignant mammographic lesions of stereotactic vacuum-assisted biopsy. *Radiology* 1998 Mar;206(3):711-5.
363. Liberman L, Smolkin JH, Dershaw DD, Morris EA, Abramson AF, Rosen PP. Calcification retrieval at stereotactic, 11-gauge, directional, vacuum-assisted breast biopsy. *Radiology* 1998 Jul;208(1):251-60.
364. Lin PH, Clyde JC, Bates DM, Garcia JM, Matsumoto GH, Girvin GW. Accuracy of stereotactic core-needle breast biopsy in atypical ductal hyperplasia. *Am J Surg* 1998 May;175(5):380-2.
365. Lind DS, Minter R, Steinbach B, Abbitt P, Lanier L, Haigh L, Vauthey JN, Russin M, Hackett R, Copeland III EM. Stereotactic core biopsy reduces the reexcision rate and the cost of mammographically detected cancer. *J Surg Res* 1998 Jul 15;78(1):23-6.
366. Meyer JE, Smith DN, Lester SC, DiPiro PJ, Denison CM, Harvey SC, Christian RL, Richardson A, Ko WD. Large-needle core biopsy: Nonmalignant breast abnormalities evaluated with surgical excision or repeat core biopsy. *Radiology* 1998 Mar;206(3):717-20.
367. Mitnick JS, Gianutsos R, Pollack AH, Susman M, Pressman PI, Feiner HD, Roses DF. Comparative value of mammography, fine-needle aspiration biopsy, and core biopsy in the diagnosis of invasive lobular carcinoma. *Breast J* 1998;4(2):75-83.
368. Seoudi H, Mortier J, Basile R, Curletti E. Stereotactic core needle biopsy of nonpalpable breast lesions: Initial experience with a promising technique. *Arch Surg* 1998 Apr;133(4):366-72.
369. Slanetz PJ, Giardino AA, McCarthy KA, Hall DA, Hslpern EF, Moore RH, Kopans DB. Previous breast biopsy for benign disease rarely complicates or alters interpretation on screening mammography. *AJR Am J Roentgenol* 1998 Jul;170(6):1539-41.
370. Soo MS, Walsh R, Patton J. Prone table stereotactic breast biopsy: Facilitating biopsy of posterior lesions using the arm-through-the-hole technique. *AJR Am J Roentgenol* 1998 Sep;171(3):615-7.
371. Woodcock NP, Glaves I, Morgan DR, MacFie J. Ultrasound-guided Tru-cut biopsy of the breast. *Ann R Coll Surg Engl* 1998;80(4):253-6.
372. Zardawi IM. Fine needle aspiration cytology vs. Core biopsy in a rural setting. *Acta Cytol* 1998;42(4):883-7.
373. Zonderland HM, Hermans J, Van De Vijver MJ, Postema S, Tollenaar RAEM, Van De Velde CJH. Triple diagnostic approach versus ultrasound-guided 18 gauge core biopsy in suspicious breast masses. *Breast* 1998 Jun;7(3):168-72.
374. Acheson MB, Patton RG, Howisey RL, Lane RF, Morgan A. Histologic correlation of image-guided core biopsy with excisional biopsy of nonpalpable breast lesions. *Arch Surg* 1997 Aug;132(8):815-8; discussion 819-21.
375. Anania G, Bazzocchi M, Di Loreto C, Risaliti A, Terrosu G, Donini A, Zuiani C, Puglisi F, Bresadola F. Percutaneous large core needle biopsy versus surgical biopsy in the diagnosis of breast lesions. *Int Surg* 1997 Jan;82(1):52-5.
376. Burbank F. Stereotactic breast biopsy of atypical ductal hyperplasia and ductal carcinoma in situ lesions: Improved accuracy with directional, vacuum-assisted biopsy. *Radiology* 1997 Mar;202(3):843-7.
377. Burbank F. Stereotactic breast biopsy: comparison of 14- and 11-gauge Mammotome probe performance and complication rates. *Am Surg* 1997 Nov;63(11):988-95.
378. Burbank F. Mammographic findings after 14-gauge automated needle and 14-gauge directional, vacuum-assisted stereotactic breast biopsies. *Radiology* 1997 Jul;204(1):153-6.
379. Cerwenka H, Hoff M, Rosanelli G, Hauser H, Thalhammer M, Smola MG, Klimpfinger M. Experience with a high speed biopsy gun in breast cancer diagnosis. *Eur J Surg Oncol* 1997;23(3):206-7.
380. D'Angelo PC, Galliano DE, Rosemurgy AS. Stereotactic excisional breast biopsies utilizing the advanced breast biopsy instrumentation system. *Am J Surg* 1997 Sep;174(3):297-302.
381. Devia A, Murray KA, Nelson EW. Stereotactic core needle biopsy and the workup of mammographic breast lesions. *Arch Surg* 1997 May;132(5):512-5; discussion 515-7.
382. Fenoglio ME, Gallagher JQ, Joy N, Higgins A, Miller B, Ratzner ER. Stereotactic core breast biopsy versus needle localization breast biopsy - The effect of initial diagnostic modality on surgical therapy in patients with breast cancer. *Minim Invasive Ther Allied Technol* 1997 Jun;6(3):225-7.

383. Ferzli GS, Hurwitz JB, Puza T, Van Vorst-Bilotti S. Advanced breast biopsy instrumentation: A critique. *J Am Coll Surg* 1997;185(2):145-51.
384. Florentine BD, Cobb CJ, Frankel K, Greaves T, Martin SE. Core needle biopsy: A useful adjunct to fine-needle aspiration in select patients with palpable breast lesions. *Cancer* 1997 Feb 25;81(1):33-9.
385. Gadzala DE, Cederbom GJ, Bolton JS, McKinnon WM, Farr GH Jr, Champaign J, Ordoyne K, Chung K, Fuhrman GM. Appropriate management of atypical ductal hyperplasia diagnosed by stereotactic core needle breast biopsy. *Ann Surg Oncol* 1997 Jun;4(4):283-6.
386. Hirst C, Davis N. Core biopsy for microcalcifications in the breast. *Aust N Z J Surg* 1997;67(6):320-4.
387. Howisey RL, Acheson MB, Rowbotham RK, Morgan A. A comparison of Medicare reimbursement and results for various imaging-guided breast biopsy techniques. *Am J Surg* 1997 May;173(5):395-8.
388. Jackman RJ, Marzoni Jr FA. Needle-localized breast biopsy: Why do we fail? *Radiology* 1997 Sep;204(3):677-84.
389. Jackman RJ, Burbank F, Parker SH, Evans III WP, Lechner MC, Richardson TR, Tocino I, Wray AB. Atypical ductal hyperplasia diagnosed at stereotactic breast biopsy: Improved reliability with 14-gauge, directional, vacuum-assisted biopsy. *Radiology* 1997 Aug;204(2):485-8.
390. Liberman L, Hann LE, Dershaw DD, Morris EA, Abramson AF, Rosen PP. Mammographic findings after stereotactic 14-gauge vacuum biopsy. *Radiology* 1997 May;203(2):343-7.
391. Liberman L, Latrenta LR, Dershaw DD, Abramson AF, Morris EA, Cohen MA, Rosen PP, Borgen PI. Impact of core biopsy on the surgical management of impalpable breast cancer. *AJR Am J Roentgenol* 1997;168(2):495-9.
392. Lifränge E, Kridelka F, Colin C. Stereotactic needle-core biopsy and fine-needle aspiration biopsy in the diagnosis of nonpalpable breast lesions: controversies and future prospects. *Eur J Radiol* 1997 Jan;24(1):39-47.
393. Meyer JE, Smith DN, DiPiro PJ, Denison CM, Frenna TH, Harvey SC, Ko WD. Stereotactic breast biopsy of clustered microcalcifications with a directional, vacuum-assisted device. *Radiology* 1997 Aug;204(2):575-6.
394. Pijnappel RM, van Dalen A, Borel Rinkes IH, van den Tweel JG, Mali WP. The diagnostic accuracy of core biopsy in palpable and non-palpable breast lesions. *Eur J Radiol* 1997 Feb;24(2):120-3.
395. Roe SM, Mathews JA, Burns RP, Sumida MP, Craft P Jr, Greer MS. Stereotactic and ultrasound core needle breast biopsy performed by surgeons. *Am J Surg* 1997 Dec;174(6):699-703; discussion 703-4.
396. Smith DN, Christian R, Meyer JE. Large-core needle biopsy of nonpalpable breast cancers. The impact on subsequent surgical excisions. *Arch Surg* 1997 Mar;132(3):256-9; discussion 260.
397. Stolier AJ, Rupley DG. The impact of image-directed core biopsy on the practice of breast surgery: A new algorithm for a changing technology. *Am Surg* 1997 Sep;63(9):827-30.
398. Whitten TM, Wallace TW, Bird RE, Turk PS. Image-guided core biopsy has advantages over needle localization biopsy for the diagnosis of nonpalpable breast cancer. *Am Surg* 1997 Dec;63(12):1072-7; discussion 1077-8.
399. Written TM, Wallace TW, Bird RE, Turk PS. Image-guided core biopsy has advantages over needle localization biopsy for the diagnosis of nonpalpable breast cancer. *Am Surg* 1997;63(12):1072-8.
400. Ballo MS, Sneige N. Can core needle biopsy replace fine-needle aspiration cytology in the diagnosis of palpable breast carcinoma. A comparative study of 124 women. *Cancer* 1996 Aug 15;78(4):773-7.
401. Burbank F, Parker SH, Fogarty TJ. Stereotactic breast biopsy: improved tissue harvesting with the Mammotome. *Am Surg* 1996 Sep;62(9):738-44.
402. Caines JS, Chantziantoniou K, Wright BA, Konok GP, Iles SE, Bodurtha A, Zayid I, Daniels C. Nova Scotia Breast Screening Program experience: use of needle core biopsy in the diagnosis of screening-detected abnormalities. *Radiology* 1996 Jan;198(1):125-30.
403. Chare MJB, Flowers CI, O'Brien CJ, Dawson A. Image-guided core biopsy in patients with breast disease. *Br J Surg* 1996;83(10):1415-6.
404. Crotch-Harvey MA, Loughran CF. Combined stereotactic wide-core needle biopsy and fine-needle aspiration cytology in the assessment of impalpable mammographic abnormalities detected in a breast-screening programme. *Breast* 1996;5(1):48-9.
405. Dershaw DD, Morris EA, Liberman L, Abramson AF. Nondiagnostic stereotactic core breast biopsy: results of rebiopsy. *Radiology* 1996 Feb;198(2):323-5.
406. Di Loreto C, Puglisi F, Rimondi G, Zuiani C, Anania G, Della Mea V, Beltrami CA. Large core biopsy for diagnostic and prognostic evaluation of invasive breast carcinomas. *Eur J Cancer* 1996 Sep;32A(10):1693-700.

407. Frayne J, Sterrett GF, Harvey J, Goodwin P, Townsend J, Ingram D, Parsons RW. Stereotactic 14 gauge core-biopsy of the breast: results from 101 patients. *Aust N Z J Surg* 1996 Sep;66(9):585-91.
408. Handy RB, Fajardo LL, Innis CA, Witzke DB, Hunter TB. Patient perceptions of stereotaxic large-core breast biopsy. *Acad Radiol* 1996 Dec;3(12):1007-11.
409. Hillhouse RA, Norvill KA, Buchanan SW, McFaul RB, Stone DA, Wilson CT. Analysis of malignancy detected by needle-localized breast biopsy. *J Am Osteopath Assoc* 1996 Jul;96(7):398-400.
410. Hunter TB, Roberts CC, Hunt KR, Fajardo LL. Occurrence of fibroadenomas in postmenopausal women referred for breast biopsy. *J Am Geriatr Soc* 1996 Jan;44(1):61-4.
411. Liberman L, Dershaw DD, Rosen PP, Morris EA, Cohen MA, Abramson AF. Core needle biopsy of synchronous ipsilateral breast lesions: impact on treatment. *AJR Am J Roentgenol* 1996 Jun;166(6):1429-32.
412. Pillsbury SG Jr, Haugen JA, Roux S. Reliability of multimodal evaluation of abnormal screening mammogram results. *Am J Obstet Gynecol* 1996 Jun;174(6):1683-6; discussion 1686-7.
413. Poole GH, Willsher PC, Pinder SE, Robertson JF, Elston CW, Blamey RW. Diagnosis of breast cancer with core-biopsy and fine needle aspiration cytology. *Aust N Z J Surg* 1996 Sep;66(9):592-4.
414. Taft R, Chao K, Dear P, King C. The role of core biopsy in the diagnosis of mammographically detected lesions. *Aust N Z J Surg* 1996 Oct;66(10):664-7.
415. Tocino I, Garcia BM, Carter D. Surgical biopsy findings in patients with atypical hyperplasia diagnosed by stereotaxic core needle biopsy. *Ann Surg Oncol* 1996 Sep;3(5):483-8.
416. Wallace JE, Saylor C, McDowell NG, Moseley HS. The role of stereotactic biopsy in assessment of nonpalpable breast lesions. *Am J Surg* 1996 May;171(5):471-3.
417. Yim JH, Barton P, Weber B, Radford D, Levy J, Monsees B, Flanagan F, Norton JA, Doherty GM. Mammographically detected breast cancer. Benefits of stereotactic core versus wire localization biopsy. *Ann Surg* 1996 Jun;223(6):688-97; discussion 697-70.
418. Hann LE, Liberman L, Dershaw DD, Cohen MA, Abramson AF. Mammography immediately after stereotaxic breast biopsy: is it necessary? *AJR Am J Roentgenol* 1995;165(1):59-62.
419. Israel PZ, Fine RE. Stereotactic needle biopsy for occult breast lesions: a minimally invasive alternative. *Am Surg* 1995 Jan;61(1):87-91.
420. Liberman L, Cohen MA, Dershaw DD, Abramson AF, Hann LE, Rosen PP. Atypical ductal hyperplasia diagnosed at stereotaxic core biopsy of breast lesions: an indication for surgical biopsy. *AJR Am J Roentgenol* 1995;164(5):1111-3.
421. Liberman L, Dershaw DD, Rosen PP, Cohen MA, Hann LE, Abramson AF. Stereotaxic core biopsy of impalpable spiculated breast masses. *AJR Am J Roentgenol* 1995;165(3):551-4.
422. Liberman L, Dershaw D, Durfee S, Abramson AF, Cohen MA, Hann LE, Rosen PP. Recurrent carcinoma after breast conservation: diagnosis with stereotaxic core biopsy. *Radiology* 1995 Dec;197(3):735-8.
423. McCombs MM, Bassett LW, Jahan R, Fu YS. Imaging-guided core biopsy of the breast. *Breast J* 1995 Jan-Feb;1(1):9-16.
424. Nath ME, Robinson TM, Tobon H, Chough DM, Sumkin JH. Automated large-core needle biopsy of surgically removed breast lesions: comparison of samples obtained with 14-, 16-, and 18-gauge needles. *Radiology* 1995 Dec;197(3):739-42.
425. Rubin E, Dempsey PJ, Pile NS, Bernreuter WK, Urist MM, Shumate CR, Maddox WA. Needle-localization biopsy of the breast: impact of a selective core needle biopsy program on yield. *Radiology* 1995 Jun;195(3):627-31.
426. Strong JW, Worsham GF, Austin RM, Gruber FH, Bagg MN. Stereotactic core biopsy of nonpalpable breast lesions. *J S C Med Assoc* 1995 Dec;91(12):489-96.
427. Vega A, Arrizabalaga R, Garijo F, Guerra I. Nonpalpable breast lesion. Stereotaxic core needle aspiration biopsy with a single pass. *Acta Radiol* 1995 Mar;36(2):117-21.
428. Vega A, Garijo F, Ortega E. Core needle aspiration biopsy of palpable breast masses. *Acta Oncol* 1995;34(1):31-4.
429. Youngson BJ, Liberman L, Rosen PP. Displacement of carcinomatous epithelium in surgical breast specimens following stereotaxic core biopsy. *Am J Clin Pathol* 1995 May;103(5):598-602.
430. Caines JS, McPhee MD, Konok GP, Wright BA. Stereotaxic needle core biopsy of breast lesions using a regular mammographic table with an adaptable stereotaxic device. *AJR Am J Roentgenol* 1994 Aug;163(2):317-21.
431. Jackman RJ, Nowels KW, Shepard MJ, Finkelstein SI, Marzoni FA Jr. Stereotaxic large-core needle biopsy of 450 nonpalpable breast lesions with surgical correlation in lesions with cancer or atypical hyperplasia. *Radiology* 1994 Oct;193(1):91-5.

432. Janes RH, Bouton MS. Initial 300 consecutive stereotactic core-needle breast biopsies by a surgical group. *Am J Surg* 1994 Dec;168(6):533-6; discussion 536-7.
433. Kaye MD, Vicinanza-Adami CA, Sullivan ML. Mammographic findings after stereotaxic biopsy of the breast performed with large-core needles. *Radiology* 1994 Jul;192(1):149-51.
434. Liberman L, Dershaw DD, Rosen PP, Abramson AF, Deutch BM, Hann LE. Stereotaxic 14-gauge breast biopsy: how many core biopsy specimens are needed? *Radiology* 1994 Sep;192(3):793-5.
435. Liberman L, Evans III WP, Dershaw DD, Hann LE, Deutch BM, Abramson AF, Rosen PP. Radiography of microcalcifications in stereotaxic mammary core biopsy specimens. *Radiology* 1994;190(1):223-5.
436. Mikhail RA, Nathan RC, Weiss M, Tummala RM, Mullangi UR, Lawrence L, Mukkamala A. Stereotactic core needle biopsy of mammographic breast lesions as a viable alternative to surgical biopsy. *Ann Surg Oncol* 1994 Sep;1(5):363-7.
437. Morrow M, Schmidt R, Cregger B, Hassett C, Cox S. Preoperative evaluation of abnormal mammographic findings to avoid unnecessary breast biopsies. *Arch Surg* 1994 Oct;129(10):1091-6.
438. Sadler GP, McGee S, Dallimore NS, Monypenny IJ, Douglas-Jones AG, Lyons K, Horgan K. Role of fine-needle aspiration cytology and needle-core biopsy in the diagnosis of lobular carcinoma of the breast. *Br J Surg* 1994;81(9):1315-7.
439. Youngson BJ, Cranor M, Rosen PP. Epithelial displacement in surgical breast specimens following needling procedures. *Am J Surg Pathol* 1994 Sep;18(9):896-903.
440. Rotten D, Levailant JM, Leridon H, Letessier A, Sandres M. Ultrasonographically guided fine needle aspiration cytology and core-needle biopsy in the diagnosis of breast tumors. *Eur J Obstet Gynecol Reprod Biol* 1993 May;49(3):175-86.
441. Dronkers DJ. Stereotaxic core biopsy of breast lesions. *Radiology* 1992 Jun;183(3):631-4.
442. Elliott RL, Haynes AE, Bolin JA, Boagni EM 3rd, Head JF. Stereotaxic needle localization and biopsy of occult breast lesions: first year's experience. *Am Surg* 1992 Feb;58(2):126-31.
443. Harter LP, Curtis JS, Ponto G, Craig PH. Malignant seeding of the needle track during stereotaxic core needle breast biopsy. *Radiology* 1992 Dec;185(3):713-4.
444. Pezner RD, Lorant JA, Terz J, Ben-Ezra J, Odom-Maryon T, Luk KH. Wound-healing complications following biopsy of the irradiated breast. *Arch Surg* 1992 Mar;127(3):321-4.
445. Khanna AK, Singh MR, Khanna S, Khanna NN. Fine needle aspiration cytology, imprint cytology and tru-cut needle biopsy in breast lumps: a comparative evaluation. *J Indian Med Assoc* 1991 Jul;89(7):192-5.
446. Fahrbach K, Sledge I, Cella C, Linz H, Ross SD. A comparison of the accuracy of two minimally invasive breast biopsy methods: a systematic literature review and meta-analysis. *Arch Gynecol Obstet* 2006 May;274(2):63-73.
447. Verkooijen HM, Peeters PH, Buskens E, Koot VC, Borel Rinkes IH, Mali WP, van Vroonhoven TJ. Diagnostic accuracy of large-core needle biopsy for nonpalpable breast disease: a meta-analysis. *Br J Cancer* 2000 Mar;82(5):1017-21.
448. Peters N, Hoorntje L, Mali W, Rinkes IB, Peeters P. Diagnostic performance of stereotactic large core needle biopsy for nonpalpable breast lesions in routine clinical practice. *Int J Cancer* 2008 Jan 15;122(2):468-71.
449. Tonegutti M, Girardi V. Stereotactic vacuum-assisted breast biopsy in 268 nonpalpable lesions. *Radiol Med (Torino)* 2008 Feb;113(1):65-75.
450. Ciatto S, Houssami N, Ambrogetti D, Bianchi S, Bonardi R, Brancato B, Catarzi S, Risso GG. Accuracy and underestimation of malignancy of breast core needle biopsy: the Florence experience of over 4000 consecutive biopsies. *Breast Cancer Res Treat* 2007 Mar;101(3):291-7.
451. de Lucena CE, Dos Santos Junior JL, de Lima Resende CA, do Amaral VF, de Almeida Barra A, Reis JH. Ultrasound-guided core needle biopsy of breast masses: How many cores are necessary to diagnose cancer? *J Clin Ultrasound* 2007 Sep;35(7):363-6.
452. Uematsu T, Yuen S, Kasami M, Uchida Y. Dynamic contrast-enhanced MR imaging in screening detected microcalcification lesions of the breast: is there any value? *Breast Cancer Res Treat* 2007 Jul;103(3):269-81.
453. Vag T, Pfleiderer SOR, Bottcher J, Wurdinger S, Gajda M, Camara O, Kaiser WA. Ultrasound-guided breast biopsy using a 10-gauge self-contained vacuum-assisted device. *Eur Radiol* 2007 Dec;17(12):3100-2.
454. Chapellier C, Balu-Maestro C, Amoretti N, Chauvel C, Ben-Taarit I, Birtwisle-Peyrottes I. Vacuum-assisted breast biopsies: Experience at the Antoine Lacassagne Cancer Center (Nice, France). *Clin Imaging* 2006 Mar;30(2):99-107.
455. Cipolla C, Fricano S, Vieni S, Amato C, Napoli L, Graceffa G, Latteri S, Latteri MA. Validity of needle core biopsy in the histological characterisation of mammary lesions. *Breast* 2006 Feb;15(1):76-80.
456. Dhillon MS, Bradley SA, England DW. Mammotome biopsy: Impact on preoperative diagnosis rate. *Clin Radiol* 2006 Mar;61(3):276-81.

457. Bolivar AV, Alonso-Bartolome P, Garcia EO, Ayensa FG. Ultrasound-guided core needle biopsy of non-palpable breast lesions: a prospective analysis in 204 cases. *Acta Radiol* 2005 Nov;46(7):690-5.
458. Crystal P, Koretz M, Shcharynsky S, Makarov V, Strano S. Accuracy of sonographically guided 14-gauge core-needle biopsy: Results of 715 consecutive breast biopsies with at least two-year follow-up of benign lesions. *J Clin Ultrasound* 2005 Feb;33(2):47-52.
459. Dillon MF, Hill AD, Quinn CM, O'Doherty A, McDermott EW, O'Higgins N. The accuracy of ultrasound, stereotactic, and clinical core biopsies in the diagnosis of breast cancer, with an analysis of false-negative cases. *Ann Surg* 2005 Nov;242(5):701-7.
460. Koskela AK, Sudan M, Berg MH, Karja VJ, Mustonen PK, Kataja V, Vanninen RS. Add-on device for stereotactic core-needle breast biopsy: How many biopsy specimens are needed for a reliable diagnosis? *Radiology* 2005 Sep;236(3):801-9.
461. Sauer G, Deissler H, Strunz K, Helms G, Rimmel E, Koretz K, Terinde R, Kreienberg R. Ultrasound-guided large-core needle biopsies of breast lesions: Analysis of 962 cases to determine the number of samples for reliable tumour classification. *Br J Cancer* 2005 Jan 31;92(2):231-5.
462. Weber WP, Zanetti R, Langer I, Dellas S, Zuber M, Moch H, Rimmel E, Oertli D, Wight E, Marti WR. Mamotome: Less invasive than ABBI with similar accuracy for early breast cancer detection. *World J Surg* 2005 Apr;29(4):495-9.
463. Wu YK, Huang YM, Chou AS, Chen HT, Huang SM, Lee MC, Lee YT, Chang YJ. Management of breast fibroadenomas by ultrasound-guided vacuum-assisted biopsy - Three years experience. *Tzu Chi Med J* 2005 Dec;17(6):405-8, 52.
464. Alonso-Bartolome P, Vega-Bolivar A, Torres-Tabanera M, Ortega E, Acebal-Blanco M, Garijo-Ayensa F, Rodrigo I, Munoz-Cacho P. Sonographically guided 11-G directional vacuum-assisted breast biopsy as an alternative to surgical excision: utility and cost study in probably benign lesions. *Acta Radiol* 2004 Jul;45(4):390-6.
465. Delle Chiaie L, Terinde R. Three-dimensional ultrasound-validated large-core needle biopsy: Is it a reliable method for the histological assessment of breast lesions? *Ultrasound Obstet Gynecol* 2004 Apr;23(4):393-7.
466. Fajardo LL, Pisano ED, Caudry DJ, Gatsonis CA, Berg WA, Connolly J, Schnitt S, Page DL, McNeil BJ, Radiologist Investigators of the Radiologic Diagnostic Oncology Group V. Stereotactic and sonographic large-core biopsy of nonpalpable breast lesions: results of the Radiologic Diagnostic Oncology Group V study. *Acad Radiol* 2004 Mar;11(3):293-308.
467. Kubota K, Gomi N, Wakita T, Shibuya H, Kakimoto M, Osanai T. Magnetic resonance imaging of the metal clip in a breast: safety and its availability as a negative marker. *Breast Cancer* 2004;11(1):55-9.
468. Lomoschitz FM, Helbich TH, Rudas M, Pfarl G, Linnau KF, Stadler A, Jackman RJ. Stereotactic 11-gauge vacuum-assisted breast biopsy: influence of number of specimens on diagnostic accuracy. *Radiology* 2004 Sep;232(3):897-903.
469. Abdsaleh S, Azavedo E, Lindgren PG. Semiautomatic core biopsy. A modified biopsy technique in breast diseases. *Acta Radiol* 2003 Jan;44(1):47-51.
470. Ambrogetti D, Bianchi S, Ciatto S. Accuracy of percutaneous core biopsy of isolated breast microcalcifications identified by mammography. Experience with a vacuum-assisted large-core biopsy device. *Radiol Med (Torino)* 2003 Oct;106(4):313-9.
471. Fishman JE, Milikowski C, Ramsinghani R, Velasquez MV, Aviram G. US-guided core-needle biopsy of the breast: How many specimens are necessary? *Radiology* 2003 Mar 1;226(3):779-82.
472. Han BK, Choe YH, Ko YH, Nam SJ, Kim JH, Yang JH. Stereotactic core-needle biopsy of non-mass calcifications: outcome and accuracy at long-term follow-up. *Korean J Radiol* 2003 Oct-Dec;4(4):217-23.
473. Kirshenbaum KJ, Voruganti T, Overbeeke C, Kirshenbaum MD, Patel P, Kaplan G, Maker V, August C, Cavallino RP. Stereotactic core needle biopsy of nonpalpable breast lesions using a conventional mammography unit with an add-on device. *AJR Am J Roentgenol* 2003 Aug 1;181(2):527-31.
474. March DE, Coughlin BF, Barham RB, Goulart RA, Klein SV, Bur ME, Frank JL, Makari-Judson G. Breast masses: Removal of all US evidence during biopsy by using a handheld vacuum-assisted device - Initial experience. *Radiology* 2003 May 1;227(2):549-55.
475. Pfeleiderer SOR, Reichenbach JR, Azhari T, Marx C, Malich A, Schneider A, Vagner J, Fischer H, Kaiser WA. A manipulator system for 14-gauge large core breast biopsies inside a high-field whole-body MR scanner. *J Magn Reson Imaging* 2003 Apr 1;17(4):493-8.
476. Philpotts LE, Hooley RJ, Lee CH. Comparison of automated versus vacuum-assisted biopsy methods for sonographically guided core biopsy of the breast. *AJR Am J Roentgenol* 2003 Feb;180(2):347-51.
477. Wong TE, Hisham AN. Core Needle Biopsy of Palpable Breast Lump: The Influence of Needle Size. *Med J Malaysia* 2003 Aug;58(3):399-404.

478. Apesteguía L, Mellado M, Saenz J, Cordero JL, Reparaz B, De Miguel C. Vacuum-assisted breast biopsy on digital stereotactic table of nonpalpable lesions non-recognisable by ultrasonography. *Eur Radiol* 2002 Mar;12(3):638-45.
479. Georgian-Smith D, D'Orsi C, Morris E, Clark Jr CF, Liberty E, Lehman CD. Stereotactic biopsy of the breast using an upright unit, a vacuum-suction needle, and a lateral arm-support system. *AJR Am J Roentgenol* 2002;178(4):1017-24.
480. Jackman RJ, Lamm RL. Stereotactic histologic biopsy in breasts with implants. *Radiology* 2002 Jan;222(1):157-64.
481. Johnson AT, Henry-Tillman RS, Smith LF, Harshfield D, Korourian S, Brown H, Lane S, Colvert M, Klimberg VS. Percutaneous excisional breast biopsy. *Am J Surg* 2002 Dec;184(6):550-4; discussion 554.
482. Liberman L, Kaplan JB, Morris EA, Abramson AF, Menell JH, Dershaw DD. To excise or to sample the mammographic target: What is the goal of stereotactic 11-gauge vacuum assisted breast biopsy? *AJR Am J Roentgenol* 2002 Sep;179(3):679-83.
483. Meloni GB, Becchere MP, Soro D, Feo CF, Profili S, Dettori G, Trignano M, Navarra G, Canalis GC. Percutaneous vacuum-assisted core breast biopsy with upright stereotactic equipment. Indications, limitations and results. *Acta Radiol* 2002 Nov;43(6):575-8.
484. Morris EA, Liberman L, Trevisan SG, Abramson AF, Dershaw DD. Histologic heterogeneity of masses at percutaneous breast biopsy. *Breast J* 2002 Jul-Aug;8(4):187-91.
485. Pfarl G, Helbich TH, Riedl CC, Wagner T, Gnant M, Rudas M, Liberman L. Stereotactic 11-gauge vacuum-assisted breast biopsy: a validation study. *AJR Am J Roentgenol* 2002 Dec;179(6):1503-7.
486. Verkooijen HM, Core Biopsy After Radiological Localisation (COBRA) Study Group. Diagnostic accuracy of stereotactic large-core needle biopsy for nonpalpable breast disease: results of a multicenter prospective study with 95% surgical confirmation. *Int J Cancer* 2002 Jun 20;99(6):853-9.
487. Becker L, Taves D, McCurdy L, Muscedere G, Karlik S, Ward S. Stereotactic core biopsy of breast microcalcifications: comparison of film versus digital mammography, both using an add-on unit. *AJR Am J Roentgenol* 2001 Dec;177(6):1451-7.
488. Brenner RJ, Bassett LW, Fajardo LL, Dershaw DD, Evans WP 3rd, Hunt R, Lee C, Tocino I, Fisher P, McCombs M, Jackson VP, Feig SA, Mendelson EB, Margolin FR, Bird R, Sayre J. Stereotactic core-needle breast biopsy: a multi-institutional prospective trial. *Radiology* 2001 Mar;218(3):866-72.
489. Cangiarella J, Waisman J, Symmans WF, Gross J, Cohen JM, Wu H, Axelrod D. Mammotome core biopsy for mammary microcalcification: analysis of 160 biopsies from 142 women with surgical and radiologic followup. *Cancer* 2001 Jan 1;91(1):173-7.
490. Dahlstrom JE, Jain S. Histological correlation of mammographically detected microcalcifications in stereotactic core biopsies. *Pathology* 2001;33(4):444-8.
491. Lai JT, Burrowes P, MacGregor JH. Diagnostic accuracy of a stereotactically guided vacuum-assisted large-core breast biopsy program in Canada. *Can Assoc Radiol J* 2001 Aug;52(4):223-7.
492. Levin MF, Papoff WJ, Doan L, Eliasziw M. Stereotactic percutaneous core biopsy versus surgical biopsy of nonpalpable breast lesions using a standard mammographic table with an add-on device. *Can Assoc Radiol J* 2001;52(1):29-32.
493. Margolin FR, Leung JW, Jacobs RP, Denny SR. Percutaneous imaging-guided core breast biopsy: 5 Years' experience in a community hospital. *AJR Am J Roentgenol* 2001;177(3):559-64.
494. Perez-Fuentes JA, Longobardi IR, Acosta VF, Marin CE, Liberman L. Sonographically guided directional vacuum-assisted breast biopsy: preliminary experience in Venezuela. *AJR Am J Roentgenol* 2001 Dec;177(6):1459-63.
495. Smith DN, Rosenfield Darling ML, Meyer JE, Denison CM, Rose DI, Lester S, Richardson A, Kaelin CM, Rhei E, Christian RL. The utility of ultrasonographically guided large-core needle biopsies: Results from 500 consecutive breast biopsies. *J Ultrasound Med* 2001;20(1):43-9.
496. White RR, Halperin TJ, Olson JA Jr, Soo MS, Bentley RC, Seigler HF. Impact of core-needle breast biopsy on the surgical management of mammographic abnormalities. *Ann Surg* 2001 Jun;233(6):769-77.
497. Wunderbaldinger P, Helbich TH, Partik B, Turetschek K, Wolf G. First experience with a new dedicated ultrasound system for computer-guided large-core breast biopsy. *Eur Radiol* 2001;11(12):2460-4.
498. Yeow KM, Lo YF, Wang CS, Chang HK, Tsai CS, Hsueh C. Ultrasound-guided core needle biopsy as an initial diagnostic test for palpable breast masses. *J Vasc Interv Radiol* 2001;12(11):1313-7.
499. Beck RM, Gotz L, Heywang-Kobrunner SH. Stereotactic vacuum core breast biopsy - Experience of 560 patients. *Swiss Surg* 2000;6(3):108-10.
500. Kirwan SE, Denton ER, Nash RM, Humphreys S, Michell MJ. Multiple 14G stereotactic core biopsies in the diagnosis of mammographically detected stellate lesions of the breast. *Clin Radiol* 2000;55(10):763-6.

501. Latosinsky S, Cornell D, Bear HD, Karp SE, Little S, De Paredes E. Evaluation of stereotactic core needle biopsy (SCNB) of the breast at a single institution. *Breast Cancer Res Treat* 2000;60(3):277-83.
502. Liberman L, Ernberg LA, Heerd A, Zakowski MF, Morris EA, LaTrenta LR, Abramson AF, Dershaw DD. Palpable breast masses: Is there a role for percutaneous imaging-guided core biopsy? *AJR Am J Roentgenol* 2000;175(3):779-87.
503. Makoske T, Preletz R, Riley L, Fogarty K, Swank M, Cochran P, Blisard D, Reintgen DS, Fuhrman GM. Long-term outcomes of stereotactic breast biopsies. *Am Surg* 2000;66(12):1104-9.
504. Ward SE, Taves DH, McCurdy LI. Stereotactic core needle biopsy of breast microcalcifications obtained using a standard mammography table with an add-on unit. *Can Assoc Radiol J* 2000 Feb;51(1):10-5.
505. Welle GJ, Clark M, Loos S, Pauls D, Warden D, Sheffield M, Parsells C. Stereotactic breast biopsy: recumbent biopsy using add-on upright equipment. *AJR Am J Roentgenol* 2000 Jul;175(1):59-63.
506. Helbich TH, Rudas M, Bohm G, Huber S, Wagner T, Taucher S, Wolf G, Mostbeck GH. Randomized in vitro and in vivo evaluation of different biopsy needles and devices for breast biopsy. *Clin Radiol* 1999;54(1):56-62.
507. Jackman RJ, Nowels KW, Rodriguez-Soto J, Marzoni Jr FA, Finkelstein SI, Shepard MJ. Stereotactic, automated, large-core needle biopsy of nonpalpable breast lesions: False-negative and histologic underestimation rates after long-term follow-up. *Radiology* 1999 Mar;210(3):799-805.
508. Meyer JE, Smith DN, Lester SC, Kaelin C, DiPiro PJ, Denison CM, Christian RL, Harvey SC, Selland D, Durfee SM. Large-core needle biopsy of nonpalpable breast lesions. *JAMA* 1999 May 5;281(17):1638-41.
509. Puglisi F, Pertoldi B, Ramello M, Facecchia I, Zuiani C, Bazzocchi M, Beltrami CA, Di Loreto C. Diagnostic accuracy of perforated compression grid approach for mammographically guided core needle biopsy of breast lesions. *Cancer Lett* 1999 Nov 15;146(2):181-8.
510. Soo MS, Ghate S, Delong D. Stereotactic biopsy of noncalcified breast lesions: utility of vacuum-assisted technique compared to multipass automated gun technique. *Clin Imaging* 1999 Nov-Dec;23(6):347-52.
511. Caruso ML, Gabrieli G, Marzullo G, Pirrelli M, Rizzi E, Soring F. Core biopsy as alternative to fine-needle aspiration biopsy in diagnosis of breast tumors. *Oncologist* 1998;3(1):45-9.
512. Doyle AJ, Collins JP, Forkert CD. Decubitus stereotactic core biopsy of the breast: Technique and experience. *AJR Am J Roentgenol* 1999 Mar;172(3):688-90.
513. Fuhrman GM, Cederbom GJ, Bolton JS, King TA, Duncan JL, Champaign JL, Smetherman DH, Farr GH, Kuske RR, McKinnon WMP. Image-guided core-needle breast biopsy is an accurate technique to evaluate patients with nonpalpable imaging abnormalities. *Ann Surg* 1998 Jun;227(6):932-9.
514. Heywang-Kobrunner SH, Schaumloffel U, Viehweg P, Hofer H, Buchmann J, Lampe D. Minimally invasive stereotactic vacuum core breast biopsy. *Eur Radiol* 1998;8(3):377-85.
515. Ioffe OB, Berg WA, Silverberg SG, Kumar D. Mammographic-histopathologic correlation of large-core needle biopsies of the breast. *Mod Pathol* 1998 Aug;11(8):721-7.
516. Liberman L, Feng TL, Dershaw DD, Morris EA, Abramson AF. US-guided core breast biopsy: Use and cost-effectiveness. *Radiology* 1998 Sep;208(3):717-23.
517. Schulz-Wendtland R, Kramer S, Lang N, Bautz W. Ultrasonic guided microbiopsy in mammary diagnosis: indications, technique and results. *Anticancer Res* 1998 May-Jun;18(3C):2145-6.
518. Vega Bolivar A, Ortega Garcia E, Garijo Ayensa F. Stereotactic core needle aspiration biopsy with multiple passes in nonpalpable breast lesions. *Acta Radiol* 1998 Jul;39(4):389-94.
519. Whitman GJ, Kopans DB, McCarthy KA, Stelling CB, Sneige N, Sunku K, Weiss MK. Coaxial core needle biopsy under mammographic guidance: indications and applications. *AJR Am J Roentgenol* 1998;171(1):67-70.
520. Zannis VJ, Aliano KM. The evolving practice pattern of the breast surgeon with disappearance of open biopsy for nonpalpable lesions. *Am J Surg* 1998 Dec;176(6):525-8.
521. Bauer RL, Sung J, Eckhart KH Jr, Koul A, Castillo NB, Nemoto T. Comparison of histologic diagnosis between stereotactic core needle biopsy and open surgical biopsy. *Ann Surg Oncol* 1997 Jun;4(4):316-20.
522. Britton PD, Flower CD, Freeman AH, Sinnatamby R, Warren R, Goddard MJ, Wight DGD, Bobrow L. Changing to core biopsy in an NHS Breast Screening Unit. *Clin Radiol* 1997;52(10):764-7.
523. Helbich TH, Mayr W, Schick S, Youssefzadeh S, Rudas M, Taucher S, Wagner T, Kelkar P, Wolf G, Thurnher M, Mostbeck GH. Coaxial technique: Approach to breast core biopsies. *Radiology* 1997 Jun;203(3):684-90.

524. Khattar SC, Torp-Pedersen S, Horn T, Krogh-Pedersen I, Court-Payen M, Lorentzen T. Ultrasound-guided biopsy of palpable breast masses. *Eur J Ultrasound* 1997;6(1):1-7.
525. Liberman L, Dershaw DD, Glassman JR, Abramson AF, Morris EA, LaTrenta LR, Rosen PP. Analysis of cancers not diagnosed at stereotactic core breast biopsy. *Radiology* 1997 Apr;203(1):151-7.
526. Pitre B, Baron PL, Baron LF, O'Brien PH, Cole DJ. Stereotactic core biopsy of the breast: Results of one-year follow-up of 101 patients. *Am Surg* 1997;63(12):1124-7.
527. Stoller AJ. Stereotactic breast biopsy: A surgical series. *J Am Coll Surg* 1997;185(3):224-8.
528. Sutton S, Dahlstrom JE, Jain S. Stereotactic large-gauge core biopsy: its role in the diagnosis of non-palpable mammographic abnormalities presenting to a screening service. *Australas Radiol* 1997 May;41(2):103-8.
529. Walker TM. Impalpable breast lesions: Stereotactic core biopsy with an 'add-on' unit. *Breast* 1997 Jun;6(3):126-31.
530. Frazee RC, Roberts JW, Symmonds RE, Snyder SK, Hendricks JC, Smith RW, Harrison JB. Open versus stereotactic breast biopsy. *Am J Surg* 1996 Nov;172(5):491-3; 494-5.
531. Fuhrman G, Cederbom G, Champagne J, Farr G, McKinnon W, Bolton J, Ordoyno WK. Stereotactic core needle breast biopsy is an accurate diagnostic technique to assess nonpalpable mammographic abnormalities. *J La State Med Soc* 1996 Apr;148(4):167-70.
532. Head JF, Haynes AE, Elliott MC, Elliott RL. Stereotaxic localization and core needle biopsy of nonpalpable breast lesions: two-year follow-up of a prospective study. *Am Surg* 1996 Dec;62(12):1018-23.
533. Mainiero MB, Philpotts LE, Lee CH, Lange RC, Carter D, Tocino I. Stereotaxic core needle biopsy of breast microcalcifications: correlation of target accuracy and diagnosis with lesion size. *Radiology* 1996 Mar;198(3):665-9.
534. Meyer JE, Christian RL, Lester SC, Frenna TH, Denison CM, DiPiro PJ, Polger M. Evaluation of nonpalpable solid breast masses with stereotaxic large-needle core biopsy using a dedicated unit. *AJR Am J Roentgenol* 1996;167(1):179-82.
535. Nguyen M, McCombs MM, Ghandehari S, Kim A, Wang H, Barsky SH, Love S, Bassett LW. An update on core needle biopsy for radiologically detected breast lesions. *Cancer* 1996 Dec 1;78(11):2340-5.
536. Pettine S, Place R, Babu S, Williard W, Kim D, Carter P. Stereotactic breast biopsy is accurate, minimally invasive, and cost effective. *Am J Surg* 1996 May;171(5):474-6.
537. Rosenblatt R, Fineberg SA, Sparano JA, Kaleya RN. Stereotactic core needle biopsy of multiple sites in the breast: efficacy and effect on patient care. *Radiology* 1996 Oct;201(1):67-70.
538. Scopa CD, Koukouras D, Spiliotis J, Harkoftakis J, Koureleas S, Kyriakopoulou D, Tzoracoleftherakis E. Comparison of fine needle aspiration and Tru-Cut biopsy of palpable mammary lesions. *Cancer Detect Prev* 1996;20(6):620-4.
539. Cross MJ, Evans WP, Peters GN, Cheek JH, Jones RC, Krakos P. Stereotactic breast biopsy as an alternative to open excisional biopsy. *Ann Surg Oncol* 1995 May;2(3):195-200.
540. Doyle AJ, Murray KA, Nelson EW, Bragg DG. Selective use of image-guided large-core needle biopsy of the breast: accuracy and cost-effectiveness. *AJR Am J Roentgenol* 1995 Aug;165(2):281-4.
541. Hamed H, De Freitas R Jr, Rasbridge S, Fisher C, Chaudary MA, Fentiman IS. A prospective randomized study of two gauges of biopsy-cut needle in diagnosis of early breast cancer. *Breast* 1995;4(2):135-6.
542. Burbank F, Kaye K, Belville J, Ekuan J, Blumenfeld M. Image-guided automated core biopsies of the breast, chest, abdomen, and pelvis. *Radiology* 1994 Apr;191(1):165-71.
543. Gisvold JJ, Goellner JR, Grant CS, Donohue JH, Sykes MW, Karsell PR, Coffey SL, Jung SH. Breast biopsy: a comparative study of stereotaxically guided core and excisional techniques. *AJR Am J Roentgenol* 1994 Apr;162(4):815-20.
544. Parker SH, Burbank F, Jackman RJ, Aucreman CJ, Cardenosa G, Cink TM, Coscia JL Jr, Eklund GW, Evans WP 3rd, Garver PR, et al. Percutaneous large-core breast biopsy: a multi-institutional study. *Radiology* 1994 Nov;193(2):359-64.
545. Smyth AT, Cederbom GJ. Core biopsy of breast lesions. *J La State Med Soc* 1994 Nov;146(11):499-501.
546. Elvecrog EL, Lechner MC, Nelson MT. Nonpalpable breast lesions: correlation of stereotaxic large-core needle biopsy and surgical biopsy results. *Radiology* 1993 Aug;188(2):453-5.
547. Parker SH, Jobe WE, Dennis MA, Stavros AT, Johnson KK, Yakes WF, Truell JE, Price JG, Kortz AB, Clark DG. US-guided automated large-core breast biopsy. *Radiology* 1993;187(2):507-11.
548. McMahon AJ, Lutfy AM, Matthew A, Walls AD, McOrmick JS, Henderson MA, Auld CD. Needle core biopsy of the breast with a spring-loaded device. *Br J Surg* 1992 Oct;79(10):1042-5.

549. Barreto V, Hamed H, Griffiths AB, Hanby A, Chaudary MA, Fentiman IS. Automatic needle biopsy in the diagnosis of early breast cancer. *Eur J Surg Oncol* 1991;17(3):237-9.
550. Cusick JD, Dotan J, Jaecks RD, Boyle WT Jr. The role of Tru-Cut needle biopsy in the diagnosis of carcinoma of the breast. *Surg Gynecol Obstet* 1990 May;170(5):407-10.
551. Parker SH, Lovin JD, Jobe WE, Luethke JM, Hopper KD, Yakes WF, Burke BJ. Stereotactic breast biopsy with a biopsy gun. *Radiology* 1990 Sep;176(3):741-7.
552. Verkooijen HM, Borel Rinkes IH, Peeters PH, Landheer ML, Van Es NJ, Mali WP, Klinkenbijn JH, Van Vroonhoven Th. Impact of stereotactic large-core needle biopsy on diagnosis and surgical treatment of non-palpable breast cancer. *Eur J Surg Oncol* 2001;27(3):244-9.
553. Kettritz U, Rotter K, Schreer I, Murauer M, Schulz-Wendtland R, Peter D, Heywang-Kobrunner SH. Stereotactic vacuum-assisted breast biopsy in 2874 patients: a multicenter study. *Cancer* 2004 Jan 15;100(2):245-51.