BREAST SCHOOL
Ljubljana 29. - 31. 3. 2012

5th International School of Breast Imaging

Ljubljana, 29th - 31st March 2012

www.breast-school.com

ONKOLOŠKI INŠTITUT LJUBLJANA

INSTITUTE OF ONCOLOGY LJUBLJANA

Urban Zdešar Mr. Sc.

Urban Zdešar graduated in physics from Faculty of Science and Technology, Ljubljana, Slovenia in 1994 and has got his Master in Science degree at Biotechnical Faculty in 2000.
Since 1994 he works at ZVD – Institute of Occupational Safety and is currently Head of Dosimetry laboratory and is an expert in radiation protection and medical physics. Between 1999 and 2007 M.Sc. Zdešar was a Legal Asisstant in field of radiological technology at Faculty of health and is now an Assistant and senior Lecturer there. He has published more than 20 scientific articles in international journals. His main scientific interests are radiation protection and quality assurance in diagnostic radiology.

Bob Martins

Senior Product Manager (International) Hologic

He is working for the women's health care compagny Hologic Inc.
He has engineering background with 20 years experience in the field of medical imaging gained acros the range of service, professional trainings and product management, on modalities from emission based SPECT imaging to 3D X-Ray Mammography. He had presentatios at different congresses, workshops and seminars, including the National French Congress Radiology show (JFR) in 2006, 2007, 2008, 2009.

He is accountable for new product introduction into international markets and has contacts with key opinion leaders. He supports research programs of strategic importance to international markets.

He has extensive experience with establishment of technical training programs, creation of documentation and efficient distribution of support materials.

Prof. Per Skaane

Per Skaane graduated from Medical studies at University Tuebingen, Germany in 1970. The same year he had national examination in medicine at University Tubingen, then was approved by Educational Council for Foreign Medical Graduate in USA, and later had examination in medicine at University Oslo, Norway. Between 1972 and 1974 he completed training in Pathology at University Tuebingen, and Psychiatry at Roenvik Hospital, Bodø, Norway. Between 1975 and 1977 had training in Surgery and Gyneology/Obstetrics in Harstad Hospital, Norway and from 1977 to 1981 completed training in Diagnostic Radiology at University Tuebingen, Germany.

Since 1982 he is working in Diagnostic Radiology at Ullevaal University Hospital, Oslo. He is also a leader of the Mammography Screening Program in Oslo from 1996, and from 2001 he is a professor at the Department of Radiology, Ullevaal University Hospital. Professor Skaane held a number of positions in faculty and has recived a number of awards including: Best performance from Norwegian Radiological Society in 1999, Acta Radiologica's prize Scandinavian "Xenia Forsselliana" in 1999 and 2005, and is Honorary member of the Norwegian Radiological Society from 2011.

He is also a full member of several other societies: Norsk lægeforening, Norsk radiologisk forening, European Society of Radiology, European Society of Breast Imaging (EUSOBI), Deutsche Roentgengesellschaft (DRG), Radiological Society of North America (RSNA). Profesor Skaane has published more than 50 scientific articles in international journals. His main scientific interest include breast imaging and constant improving detection of breast neoplasms.

Simona Borštnar MD, PhD

Dr. Simona Borštnar M.D., PhD, is a specialist of internal medicine at the Division of Medical Oncology at the Institute of Oncology in Ljubljana, Slovenia. As an oncologist she works in the filed of breast and genitourinary cancers while as a researcher she collaborates with several Slovenian projects and international clinical trials. Currently shy are the head of mammary team at the Institute of Oncology and the president of Slovenian Society of Senology.

Hildegard Aust

Hildegard Aust graduated in 1974 as Radiographer at Heidelberg University (Institute for technical medical assistents). From 1974-2001 she practiced in different institutes of radiology in Germany. In 2001 she became a member of reference sreening unit in Wiesbaden, under guidance of Margit Reichel.

Since 2005 she was responsible for training of radiographers with a focus on education in screening to improve the quality of positioning including the training in self-dependent work with the women. In 2007 she founded her own company, specialized for training in relation to the positioning and she produced a DVD.

Between 2007-2011 she worked in reference center South West at Marburg. She visited screening units in the region of Hessen, Rheinland-Pfalz, Saarland and Baden-Württemberg, where she cooperated with radiographers and their daily problems and tried to find solutions for a quality based work. In 2011 she received the »Eugenie and Felix Wachsmann Award« by the German Society of Radiology in Hamburg. . She is currently working as conducting radiographer at Wiesbaden; as part time freelancer she pays site-visits for the reference center South-West.

Mateja Krajc MD, Mr. Sc.

Mateja Krajc, MD, MSc., specialist in public health, graduated at the Medical school, University of Ljubljana in 1998. She is employed at the Institute of Oncology Ljubljana Slovenia since 2001 and works at Epidemiology and Cancer Registry department and at the Familial Cancer Clinic. She obtained master degree in cancer genetics in September 2000 from the Vrije Universiteit Brussel, Belgium, where she was involved in cancer genetic counseling and testing in families with breast and ovarian cancer. As an epidemiologist she is currently involved in the national population based breast cancer screening program in Slovenia and in the screening and genetic counseling of high risk individuals from cancer families.
Her bibliography covers fields of cancer genetic counseling, testing and high risk screening, genetic epidemiology as well as scientific reports form population based breast cancer screening program and other public health topics.

Urska Lunder, MD

Urska Lunder, MD, is the head of Palliative Care Unit at the University Hospital for Respiratory and Allergic Diseases, Golnik and a Director of the Palliative Care Development Institute, Ljubljana. She graduated from Ljubljana Medical Faculty, Slovenia in 1984; she received her specialist degree in hematology and transfusion in 1988. She completed the International Policy Fellowship on Public Health Strategies Program - Palliative Care, at the Central European University, Budapest. She completed communication trainings for teachers in palliative care at Oncology Hospital Manchester, UK (in 2003) and Marie Curie Hospice, Liverpool, UK (in 2007). In 2009 she completed her second specialist degree as an International Palliative Medicine Fellow at San Diego Institute for Palliative Medicine, a primary teaching affiliate of University of California San Diego School of Medicine.

Dr Lunder is a former president of the Professional Board for Palliative Medicine at the Ministry of Health, Slovenia. She is a president of Slovene Society of Palliative Medicine. She is a member of the European Association of Palliative Care. She is a member of the International Reference Group for the research of the Liverpool Clinical Pathway for the dying patients.

Dr. Lunder has received grants from the Ministry of Science and Education in the area of projects on communication skills development in health care, with development of new models of teaching with role play, video recording and shared reflecting. She has published in the area of communication and palliative care, as textbook chapters, articles and abstracts, and she edited a Slovene textbook on palliative care. She is actively involved in undergraduate and graduate education on palliative care in medicine and also in nursing.

Maja Mušič MD, PhD

Maja Mušič Md., PhD, graduated at the Medical school, University of Ljubljana in 1992 and she passed Board exam for Radiology in 2000.

Between 2000 and 2002 she was working at Institute Of Radiology, Clinical Centre of Ljubljana, mainly involved in abdominal pathology. In 2002 she moved to Institute of Oncology, Ljubljana and since 2007 she is Head of Department.

Since 2005 she is a Legal Asisstant in field of Oncology and Radiotherapy at Medical Faculty, University of Ljubljana. She was a lecturer in previous Breast School Courses in Ljubljana. She is Leading radiologist in Breast Screening Programme in Slovenia. In 2010 she achieved her PhD degree.

Since 2010 she is vice- president of Slovenian Assotiation of Radiology.

Kristiana Hertl MD, Mr. Sc.

Kristiana Hertl, MD, Mr.Sc., specialist in radiology, graduated from the Medical Faculty in Ljubljana in 1987. She passed her Board Exam for Radiology and since she has been working at the Institute of Oncology in Ljubljana, in the Radiology Department. In 2004 she finished Postgraduate MSc programme on Medical faculty, University of Ljubljana and she became Consultante Radiologist. Since 2005 she is a Legal Asisstant in field of Oncology and Radiotherapy at Medical Faculty, University of Ljubljana.

She is a Leading Radiologist in Slovenian Breast Screening Programme and responsible for Quality control.

She has published several scientific articles in international journals. She was lecturer and speaker in previous Breast School Courses in Ljubljana.
Her main interest includes breast imaging and constant improving in detection of breast neoplasms.

Margrit Reichel MD

Margrit Reichel graduated from Medical studies at University of Frankfurt, Germany 1982 and in 1983 completed doctor's degree in medicine. From 1982 to 1983 she completed training in internal medicine and from 1983 to 1988 had specialist training in radiology which she completed in 1989. Dr. Reichel is full member of German Radiology Society, Society of Breast Imaging, Preston, USA and German society of Senology. In 1998 she had course for leading Radiographers in Europe, Paris, between 1998 and 2003 she organised private courses in Diagnostic Mammography.

From 2001 to 2005 dr. Reihel was Leading Radiologist of the first German Pilot Project of Mammography Screening, Wiesbaden, and from 2005 to 2008 was Director of reference centre of Mammography-Screening in Wiesbaden. In years 1999 to 2001 she taught at Fellowship in Mammography Screening in Udevalla (Sweden), Nottingham (UK) and Nijmegen (Netherlands). From 2008 until today she is involved in training courses and professional help to implement Screening in European Countries as Slovenia, Switzerland and Cyprus.

Dr. Reichel also received a number of awards including Felix Wachsmann-Prize for educational skills in Mammography Training (German Radiology Society) in 2003, Letter of Honour from Association Statutory Health Insurance Physicians in 2007 and Order of Merit of the Federal Republic of Germany (Bundesverdienstkreuz) for implementing Mammography Screening in Germany in 2010.

Prof. Janez Žgajnar MD, PhD

Janez Žgajnar graduated from Medical studies at University of Ljubljana in 1991. The same year he became research fellow in surgical oncology at Institute of Oncology in Ljubljana. On July 1995 he has got his Master in Science degree. In October 1998 he passed Board exam in general surgery. Between January and December 2000 he spent as fellow at the Senology departement of the European Institute of Oncology in Milan, Italy. Between 2003 and 2007 he was Head of breast team at the Institute of Oncology, Ljubljana. In 2004 he acieved his PhD degree.From 2001 he was a assistant professor and since june 2010 associated professor of surgery at Medical faculty of the University of Ljubljana. Since 2001 he is regularly invited speaker for the European school of oncology. Since 2007 he is Medical director at Institute of Oncology, Ljubljana. He is a member of EUSOMA, ESSO and ISNS. His main scientific interest includes predominantly breast cancer and melanoma. He is colaborating with the International Breast Cancer Study Group (IBCSG). He is the author or coautor of 41 articles in peer reviewed jornals.

Tanja Marinko, MD

Tanja Marinko, MD, specialist in oncology and radiotherapy, graduated from the Medical Faculty in Ljubljana in 2006. During her studies, the Medical Faculty awarded her the Prešeren Students' Prize in 1995 for her research paper "Frequency of Activated C Protein Resistance in Patients with Venal Thrombosis".

When she had nearly completed her specialisation in family medicine in 2005, she pursued further specialisation in oncology and radiotherapy. She passed her specialist examination with honours in 2009.

Since 2005, she has been working at the Institute of Oncology in Ljubljana, in the Radiotherapy Department. She is a member of the Breast Cancer Radiotherapy Team. In 2009, she enrolled in the University Doctoral Study Programme of Biomedicine at the Medical Faculty in Ljubljana. In the framework of her studies, she has been researching cardiotoxic side effects of concurrent radiation therapy with adjuvant trastuzumab in women with breast cancer.

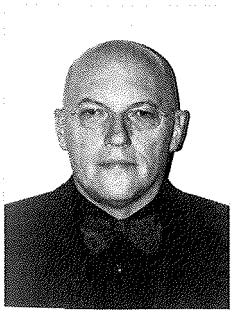
Prof. Werner Alois Kaiser MD MS

Department of Radiology, Jena University Hospital (Friedrich Schiller University) Jena, Germany

Werner Alois Kaiser has in 1975 graduated from Chemical studies and by 1980 also from Medical School, both at Freiburg University. He completed his radiology residency in Nürnberg in 1988 where he worked until 1990, later moving to Bonn where he became a professor of Radiology for his contribution in Magnetic Resonance Tomography of the breast. Since 1994 he has been a professor of Diagnostic Imaging at University of Jena where he has since 2001 also been the Chairman of the Division of Diagnostic and Interventional Radiology.

He constructed the first commercially available single breast coil in 1983 and has continuously been contributing to the field of MR-Mammography. He evaluated dynamic contrast enhanced MR imaging, constructed the first commerically available double breast coil and evaluated many signs for differentiation between benign and malignant lesions. Among more than 420 scientific publications he is author of two important textbooks: MR-Mammography (MRM), Springer 1993 and Signs in MR-Mammography, Springer 2008.

He has received a number of awards, including European Magnetic Resonance Award in 1991 and European Journal of Radiology - Editor's Recognition Award in 2005. He was a visiting professor at Harvard Medical School in 2006 and 2010.

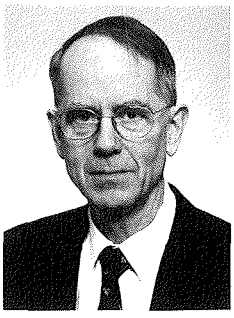


Maksimiljan Kadivec MD, Mr. Sc.

Maksimiljan Kadivec completed Medical Faculty in Ljubljana in June 1978. He passed Board Exam in Radiology in December 1985. From 1985- 95 he was employed as specialist in Radiology at the University Medical Centre Ljubljana, where he implemented FNA, interventional US and intraoperative US procedures, later he was involved in neuroradiology.

In 1995 he moved to Institute of Oncology Ljubljana, Department of Radiology, where from 1997- 2007 he held the position as Head of Department. From 1995 – 2004 he was Teaching Assitant at the Medical Faculty, University of Ljubljana, Slovenia. In 2006 he achieved Master's Degree.

Since 2007 is Head of the Breast Screening Program in Slovenia and Head of the Screening and Assessment Center at the Institute of Oncology Ljubljana He was principle moderator and chief organizer of the courses of Breast imaging, held in Ljubljana in 1998, 1999, 2001 and 2004.

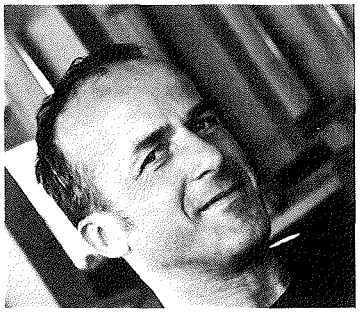


Prof. Peter Berridge Dean

Peter Berridge Dean completed Harvard Medical School in 1971. He enrolled in Radiology Residency program at Turku University Central Hospital in Finland, which he completed in 1976. He has continued to work there until present day and has held a position as Chief Radiologist since 2005. He has been Director of Breast Imaging at Turku University Central hospital since 1976.

He obtained his PhD in 1977 and has been an Associate Professor of Radiology from 1986 to 1998 and a Professor of Radiology at University of Turku since 1998. He was a Visiting Professor of Radiology at several US medical schools, including Harvard Medical School 2004-2005.
Besides 87 scientific publications he is coauthor of 5 textbooks dedicated to breast imaging. One of these books was awarded First Prize for Radiology by the British Medical Association in 2008. Also he was awarded the Beaver Award in 2010 for his work on the scientific basis of breast cancer screening and Nordic Prize for Research in Radiology (2011).

He was a member of the Board of Editors for journals Acta Radiologica and Investigative Radiology, besides being a reviewer at several other journals.
He has served on the Board of the European Society of Breast Imaging (EUSOBI) and is a member of many other international societies. He is a Visiting Scientist at the International Association for Research on Cancer (IARC) at UN and advisor to WHO. From 2000 to 2002 he was the President of Radiology Society of Finland, where he was also Secretary in Mammography Working Group (1986-2008) and Chairman of Breast Radiology Section (2008-2010).



Harald Rott

Harald Rott graduated from the medical faculty University of Cologne in 1996. He worked at Breast Centre University of Cologne and Breast Centre Hospital of the city Cologne till 2002. From 2002 till 2007 he worked as Head of Department at Breast Centre Hospital of the city Leverkusen.

Since 2008 he is running private practice, specialiced in breast ultrasound. He is nstructor for breast ultrasound for the association of panel doctors, the General Medical Council and the DEGUM (German Society for Ultrasound in the Field of Medicine).

He held more than 100 invited lectures in the field of breast ultrasound and is Lecturer for SonoProMedico since 1998.

Doc. Uroš Ahčan MD, PhD

Uroš Ahčan, M.D., Ph.D., Department of Surgery at Faculty of Medicine, University of Ljubljana

After having graduated from University of Ljubljana, Faculty for Medicine in 1995, he completed Residency in General Surgery in 2000 and Plastic, Reconstructive and Aesthetic Surgery in 2006 at University Medical Centre Ljubljana.
He has been a member of Department of Surgery at Faculty of Medicine, University of Ljubljana since 1997. He obtained his PhD in 1999 and has been Professor of Surgery since 2010. He has been the Head of the Department for Plastic Surgery and Burns, University Medical Center Ljubljana since 2008.

His scientific work includes more than 35 published articles and more than 70 invited lectures in the field of Plastic and Reconstructive surgery with special interest in laser therapies and breast reconstruction. He is collaborating with researchers at Faculty of Engineering, where they recently patented a method of 3D laser imaging based breast replica cast for autologous breast reconstruction.

He is a member of several national and international professional societies and a reviewer with professional journals, including Breast and Lasers in Surgery and Medicine.

Prof. Werner Böcker MD, PhD

Werner Böcker, Consultation and Reference Center for Gyneco- and Breast Pathology, Hematopathologie Hamburg

Werner Böcker has obtained his PhD in 1976 and became a Professor of Pathology at the University of Hamburg in 1978.

He was Head of the Department of Pathology of the General Hospital Hamburg Altona (now Asklepius Clinic Hamburg Altona) from 1984-1987, later becoming Chief and Director of the Institute of Pathology of the University of Münster where he worked until 2008.

He currently works at Hematopathologie Hamburg, in Consultation and Reference Center for Gyneco- and Breast Pathology.

His scientific work focuses on thyroid and breast pathology, tumor- and molecular pathology.

Among numerous scientific articles he authored or co-authored several books and book chapters, most notable: Preneoplasia of the Breast, 2003; Pathologie 4th edition, 2008 and Fibrocystic change and usual ductal Hyperplasia (in Breast Pathology, 2012).

AGENDA

29th March **Thursday** Austria Trend Hotel

moderator: Maksimiljan Kadivec

13:00 – 14:30	Registration
14:30 – 14:35	Introduction and welcome (A. Žličar, S. Novaković, M. Mušič)
14:35 – 15:00	Digital mammography – physics and QC (U. Zdešar)
15:00 – 15:15	Digital vs. analog (U. Zdešar)
15:15 – 15:50	Digital Breast tomosynthesis, around the clock update on technology, clinical adoption and challenges (B. Martins)
15:50 – 16:20	Thomosyntesis in clinical practice (P. Skaane)
16:20 – 16:30	Discussion
16:30 – 17:00	Break
17:00 – 17:30	Breast positioning: what is important (H. Aust)
17:30 – 18:10	Epidemiology of breast cancer and management of BRCA+ patients (M. Krajc)
18:10 – 19:00	Communicantion doctor – patient (U. Lunder)

30th March **Friday** Austria Trend Hotel

moderator: Kristijana Hertl

9:00 – 9:20	Anatomy of the breast (M. Mušič)
9:20 – 9:40	BI RADS classification (K. Hertl)
9:40 – 10:05	Microcalcifications (M. Reichel)
10:05 – 10:25	Masses and distortion (M. Reichel)
10:25 – 10:45	Break
10:45 – 11:00	US of axila (M. Mušič)
11:00 – 11:30	US of breast (H. Rott)
11:30 – 12:00	Intervention procedures in breast and non-palpable breast lesions localization (M. Kadivec)
12:00 – 13:00	MR-Mammography: a difficult childhood (W. Kaiser)
13:00 – 13:10	Discussion
13:10 – 14:10	Lunch

moderator: Maja Mušič

14:10 – 15:00	MR: Present and future indications (W. Kaiser)
15:00 – 15:30	Preoperative evaluation of breast cancer patients: factors associated with incomplete removal of breast cancer (P. Dean)
15:30 – 16:00	The role of pathology in Screening (W. Böcker)
16:00 – 16:10	Discussion
16:10 – 16:40	Break
16:40 – 17:15	Breast symptoms: clinical point of view and what surgeon needs to know (J. Žgajnar)
17:15 – 17:55	Current concepts in breast reconstruction (U. Ahčan)
17:55 – 18:20	Imaging of postoperative breast (K. Hertl)
18:20 – 18:30	Discussion

31st March **Saturday** Austria Trend Hotel

moderator: Maksimiljan Kadivec

9:00 – 9:30	Systemic treatment in breast cancer (S. Borštnar)
9:30 – 10:00	Radiotherapy in breast cancer (T. Marinko)
10:00 – 10:30	Screening in Slovenia – where are we now (M.Kadivec, K.Hertl)
10:30 – 11:00	Break
11:00 – 11:30	Double reading, interobserver variability, and the challenge of consensus (arbitration) meetings in mammography screening (P. Skaane)
11:30 – 12:00	Interval cancers (M. Reichel)
12:00 – 12:30	CAD on mammography (P. Skaane)
12:30 – 13:00	Facts and fantasy behind the breast cancer screening "Debate" (P. Dean)
13:00 – 13:10	Discussion
13:10	Closing remarks

Mammography Technical Quality (TeQ)

Urban Zdešar
Medical Physicist
ZVD Zavod za varstvo pri delu
Institute of Occupational Safety

Purpose of mamography

- To detect breast cancer earlier than is possible by clinical examination
- Routine screening with high quality mammography can reduce mortality from breast cancer
  - WHO, IARC Handbooks of Cancer Prevention Vol. 7: Breast Cancer Screening, (INTERNATIONAL AGENCY FOR RESEARCH ON CANCER, Ed.), IARC Press, Lyon (2002)

Quality by Wikipedia

WIKIPEDIA
The Free Encyclopedia

... the quality of a product or service refers to the perception of the ***degree to which the product or service meets the customer's expectations.***

Quality *has no specific meaning unless* ***related to a specific function and/or object.***

... to talk about quality

... we need
- Service or product
- Customer

Mammography

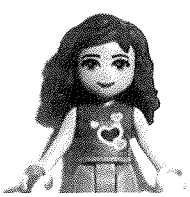
Service or product:
- Mammography
- Mammogram
- Mammography screening

Customer:
- Imaged woman
- Radiologist
- Public

...customer's expectations

Imaged woman

- Early detection of possible breast cancer



Radiologist

- Technically perfect mammogram
  - Low dose

Public

- Breast cancer mortality reduction
- 2008 DORA introduced in Slovenia

Expectation

- To lower mortality by 30%
- Slovenia:
  - 400 x 0,3 = 120
  - **Instead of 400 deaths yearly only 280**
- BUT: Results seen only after 10 or more years

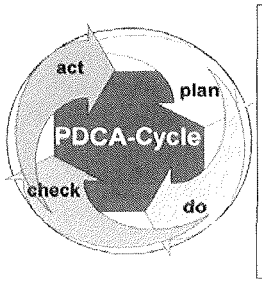
To meet expectation

- Whole process must be controlled
- Measurable quality parameters needed
  - + Defined acceptable/achievable limits
    - if limits not met, something has to be changed / improved

Example: Participation

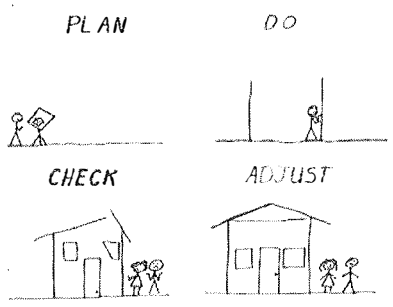
- Easy to measure (and understand)
- Goal > 70% (achievable > 75%)
- What if < 70%???
- Something is wrong. WHAT???
  - Not enough information to women?
  - Location of centers not appropriate?
  - …
- Need to act/correct…
- … and then measure again

Quality Assurance



ZVD

… to understand easier



ZVD

Quality depends on

EVERYTHING

- Personnel (training)
- Equipment (Technical Quality - TeQ)
- Procedures

o European Guidelines…

- Help us to manage the whole process
- > 400 pages

ZVD

Personnel

o Training, training, training…

o Not just strictly on matters done by group but also on **quality**

- Everybody must understand his/hers role in the process
- Everybody must understand the whole system (= what others are doing)

ZVD

Equipment

o Mammography system

- X-ray unit
- Image detector
- Image display(s)

ZVD

TeQ = Equipment Quality

is there for radiologists

TeQ depends on

o Specifications
= how good equipment is on paper

o Operation
= how good equipment perform in real life

Quality Control is testing operation to see if equipment meets specifications

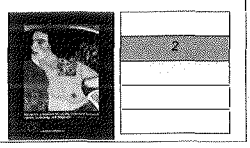
ZVD

Technical Quality Control

o **Chapter 2** in EC Guidelines

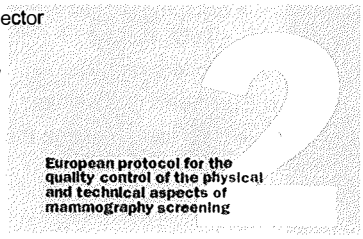
o EUREF – European Protocol for the Quality Control of the Physical and Technical Aspects of Mammography Screening

o 80 pages (1/5 of 400)



Chapter 2

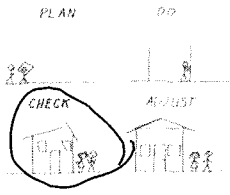
- Detailed tests of equipment
  - X-ray machine
  - AAEC in AEC
  - Image detector
  - Image Q
  - Dosimetry



QC

...is there to find problems before they affect quality of the process

- Mammography
  - Image quality
  - Dose



Who is responsible for QC

- Usually medical physicist prepare QC programme (technical)
  - Radiographers (more frequent test)
  - Physicist semi annual tests

Organization of TeQC

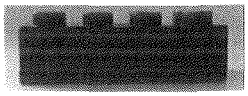
- Acceptance test
  - Detailed test before first use
- Regular tests
  - Detailed – Med Phys (every 6 months)
  - More frequent ones – radiographers (daily, weekly,...)
- Irregular tests
  - After services / changes...

WHY daily tests

- Detailed test takes lot of time (so only 2 times a year)
- To say that system is (probably) o.k. one can perform much simpler test
- TEST:
  - Image quality
  - Dose

HOW

- Mammography is simulated using an object (phantom)



Phantoms

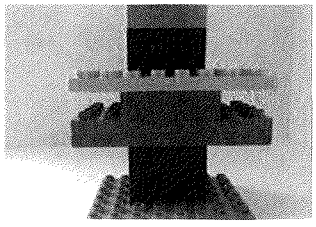
Two types of phantoms in use

- Specialized phantoms with objects mimicking objects in real breast (tumors microcalcs, fibers,...)

- Simple Plexiglass plates

(1) Mammography machine

- Phantom imaged at clinical settings
- Exposure parameters noted (kV, mAs)



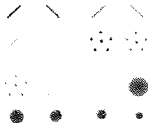
What can we see from it?

- Mammography machine operation (Automatic Exposure)
  - Because we have <u>same</u> object we expect <u>similar</u> exposure parameters

(2) Image analysis

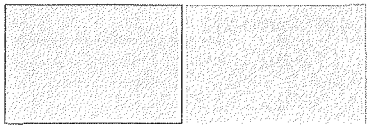
Phantom image is analyzed

- Finding objects on image
- We know they are there
- Finding nothing on image
- If there is something we have a problem

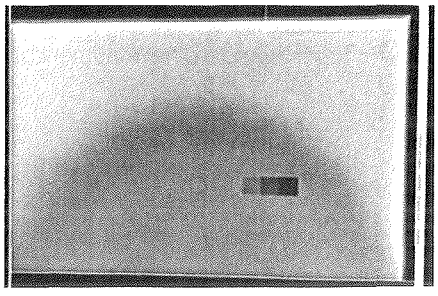


Simpler way

- Homogeneous image
  - Easy to find inhomogenities and artifacts
  - Center and narrow window (to see noise level)

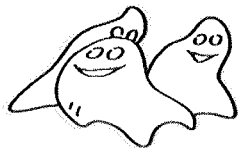


Artifacts



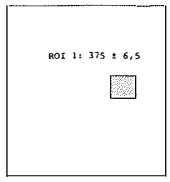
Ghosts

- Digital detectors do have memory of prior image = GHOST



(2) Image measurements

- Select ROI on image
- Measure average Pixel Value (PV) and Noise (SD)
  - Similar to OD on films



… and again

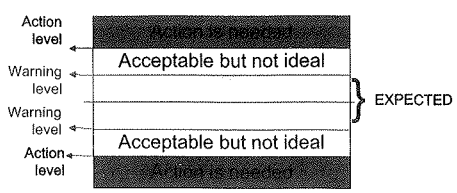
- As same object is imaged similar values of PV and SD are expected

Why similar and not same

- It's real life
- We follow parameters which are likely to change (and are changing)
- We want to find changes which are small but not "normal"

Analisys

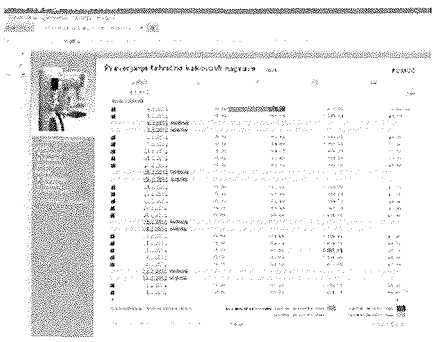
- We measure so we have numerical parameters
- Three bands



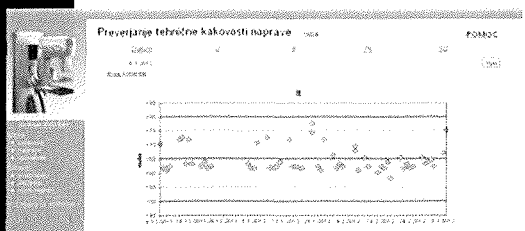
MaTKa

- www application for
  - Collecting QC data
  - Data analisys
  - Data display in graphic form
  - Warnings if limits reached
  - Reporting

Data collection

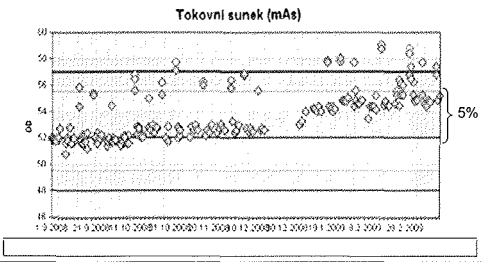


Data analysis and display

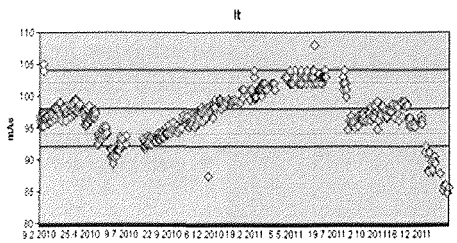


Some results

Trend noticed (app. 1% / month)

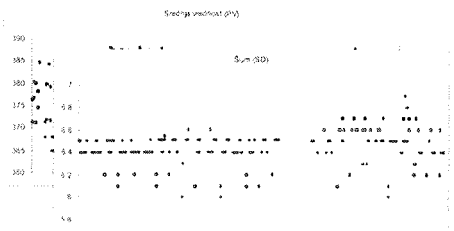


Lj Community Health Centre



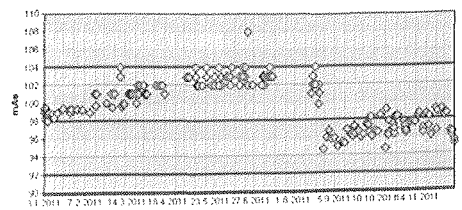
...

- But stable PV and SD values



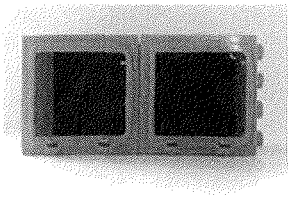
2011

Tube replacement & det. recalibration



Monitors

- Also important part of imaging chain
- Also need regular testing
- Using test images



Viewing conditions

- LCD screens are not so bright as viewboxes
- So room should be darker (10 lux, 20 lux?)

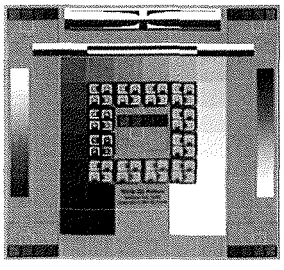
DICOM calibration

- Monitors need to be properly calibrated
- Calibration tested using test images
  - Measure luminance of 18 steps from balck to white
  - See if within ± 10 % from GSDF curve

Test images

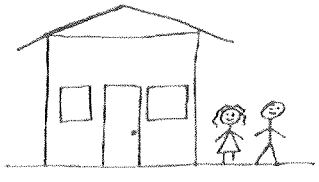
Example

- AAPM TG18
- Visualy tested for:
  - Resolution
  - Contrast
  - Distortions
  - Artefacts
  - ...



Future

- Automatic test image analysis
  - Ex: analysis of test phantom image
- Testing of image processing
  - ...still very far from



Mamography
Physics & Technology

Urban Zdešar
Medical Physicist
ZVD Zavod za varstvo pri delu
Institute of Occupational Safety

Purpose of mamography

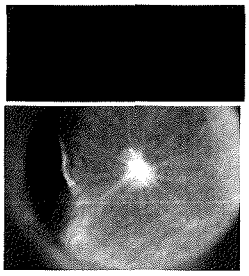
- To detect breast cancer earlier than is possible by clinical examination
- Routine screening with high quality mammography can reduce mortality from breast cancer
  - WHO, IARC Handbooks of Cancer Prevention Vol. 7: Breast Cancer Screening, (INTERNATIONAL AGENCY FOR RESEARCH ON CANCER, Ed.), IARC Press, Lyon (2002)

Signs of breast cancer

- Mass densities
- Microcalcifications
- Asymmetry between breasts
- Architectural distortion

Mass densities

- Different shapes
- Different size
  from less then mm
  to several cm
- Infiltrirated into surrounding tissue



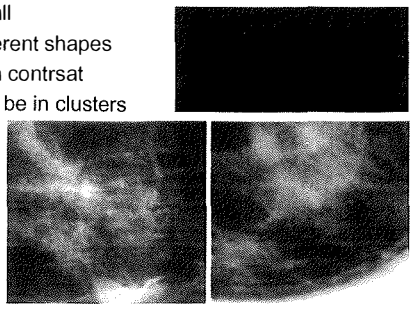
Breast tissues density

Fat	0,93	0,45
Gland	**1,035**	**0,80**
Tumor (mass)	**1,045**	**0,85**
Calcifications	2,2	12,2

- Masses can hardly be distinguished from glandular tissue only by density
- Shape is also very important

Microcalcifications

- Small
- Different shapes
- High contrsat
- Can be in clusters



HiQ mammography

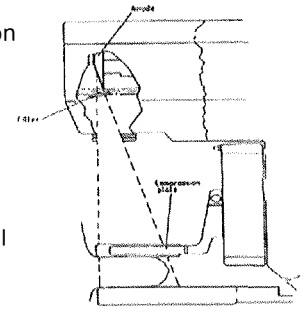
- **excellent contrast** to reveal mass densities and spiculated fibrous structures
- **excelent spatial resolution** to reveal the calcifications, their number and their shape.
- **adequate latitude** to provide same contrast and resolution over the entire breast
- **proper geometry and possitioning** to show as much breast tissue as possible
- **low noise** on the image to reveal the subtle structures in a reliable manner
- **low dose** to breast

Can we do it?

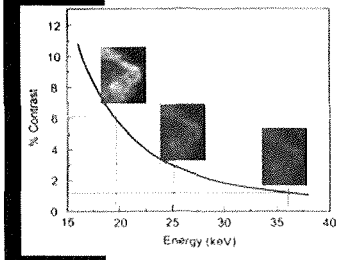
- Mammography x-ray machine
  - Special geometry of x-ray machine
  - Special x-ray spectra
  - Special image detector
- Image processing
- Image display

Mammography x-ray machine

- X-ray generation
  - Anode / filter
  - kVp
- Compression
- Scatter removal
- Detection
  - Film / digital



X-ray spectrum



- Low energy (kV) to achieve high contrast
- Special anode and filter materials

Contrast – dose compromise

Lower energy (kV) less penetrating power

☺ Higher contrast

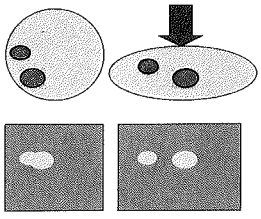
☹ Higher dose

Compression

- There is no disadvantage (besides pain)

Compression importance

- Breast tissues pushed apart
  - less object overlay – better image
- Smaller thickness in beam direction
  - less dose
- Better homogenity
  - higher contrast



...

- Less scatter = higher contrast
- Lower kV can be used = higher contrast
- Breast structures come closer to image detector = less geometric blurr
- Smaller possibility of movement during exposure

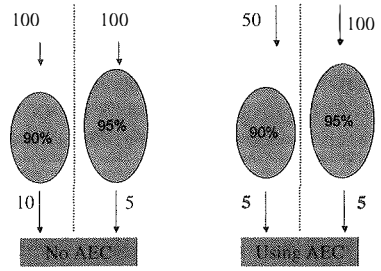
Antiscatter grid

- Scatter degrade image contrast
- Mostly moving antiscatter grids used
  - Higher grid ratios = greater scatter removal,
  - but a greater dose penalty
- Grid reduces the scatter 15 - 50%
- Grid increases dose 2 – 3 times
- Scanning systems don't use grid

Image detection

- Film/screen systems
  - Dying out
- CR systems
  - ? Dose issues
- DR systems
  - Direct a-Se (Hologic, Siemens)
  - Indirect CsI (GE)
- Photon counting systems (Sectra)

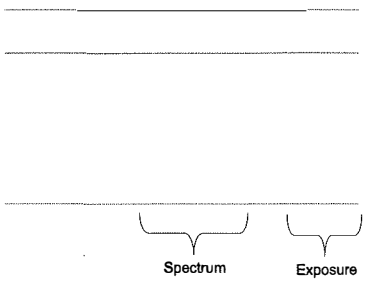
Automatic Exposure Control (AEC)



Mammography - two systems

- Automatic spectrum selection (AAEC)
  - Anode / filter selection
  - kV selection
- Automatic exposure control (AEC)
  - Tube_current x time (mAs) selection

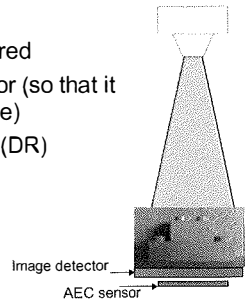
Example



How does it work

Detector dose is measured

- Behind image detector (so that it is not visible on image)
- Image detector itself (DR)

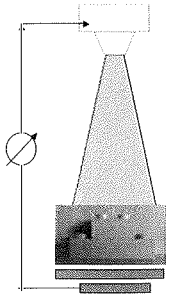


Spectrum selection (AAEC)

- Spectrum chosen based on breast thickness and composition
- Different vendors – different solutions
- Mostly two used:
  - Based on compression thickness
  - Based on short preexposure (10 – 30 ms)

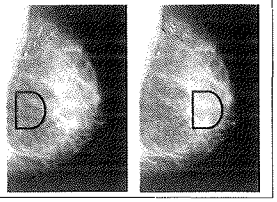
Exposure control (AEC)

- Using chosen spectrum AEC sensor is measuring signal behind object
- When preset value is reached exposure is terminated



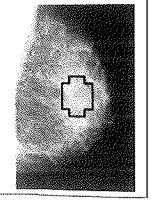
AEC sensor location

- Crucial for proper exposure
- Sensor should be positioned below the densest part of the breast
- Difficult to know



DR Systems

- No more AEC sensor
- Detector itself used
- Automatic AEC area determination
  - Image segmentation used



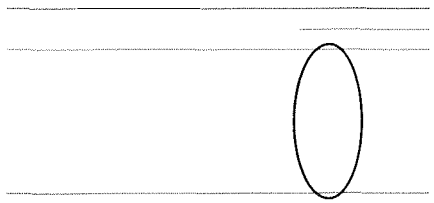
AAEC & AEC testing

- Screen film
  - System is trying to keep OD in optimal range

Fantom	Pogoji ekspozicije				Počmitov
					1,65
					1,63
					1,60
					1,60
					1,74
					1,72
					1,57
				Povprečja	1,64
				Največje odstopanje od povprečja	0,10

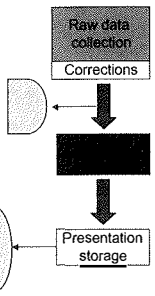
...

- DR



Proccessing

- **Corrections** before first presentation (preprocessing)
  - raw data >>> raw image
  - DICOM: "For_proccesing"
- **Postprocessing**
  - DICOM: "For_presentation"
  - Avtomatic
  - Manual



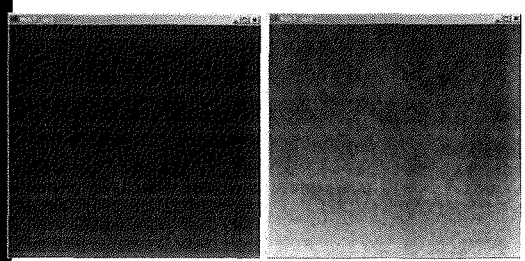
Corrections

- Raw data is corrected using (known) detector properties
  - individual DEL sensitivity
  - electric and thermic noise
  - "dead" DELs corrections
  - ...???

... that is why detector needs to be calibrated

- Calibration means imaging flat object ("flat field calibration")
- Detector "knows" what image to expect and correct what is wrong:
  - Structural noise (nonhomogenities)
  - Thermic noise
  - Dead DELs

Corrections 1

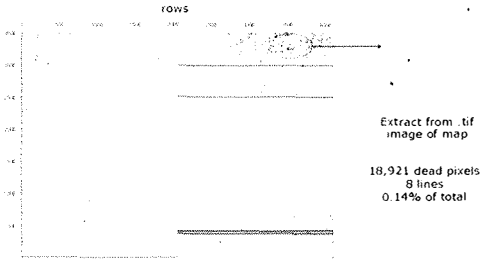


Dark noise
(signal with no dose)

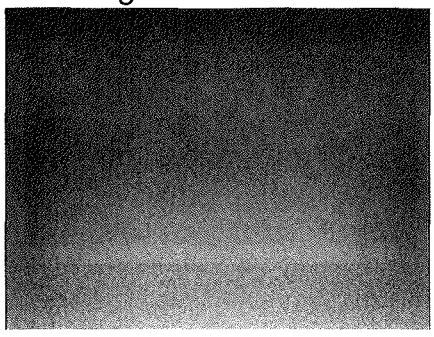
Structural noise
(nonnhomogenities)

Corrections 2

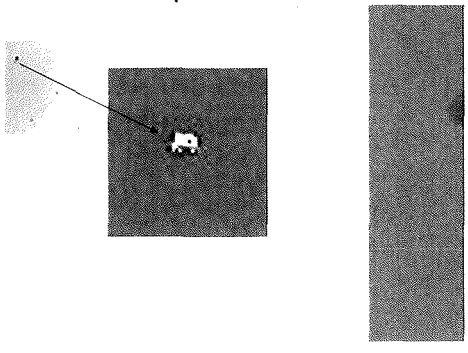
Dead DELs



Inhomogenities



Uncorrected pixels



Dead pixel map

- Dead pixel map should be accessible
  - "on-line"
  - At least at service visits
- It is a measure of detector detoriation

Postprocessing

- …is mathematical proccessing on image which **can not add information but can existing information change to be (more) visible**
- Purpose is to ease the work of radiologist (to make images look nicer)
- It is a secret (of vendors)

What do they do

- Edge enhancements
- Contrast enhancement
- Contrast equalization
- Dynamic range reduction
- Noise reduction
- LUT transformation

…it's a kind of magic

Patient dose

- Dose to glandular tissue is important
- Dose is usually expressed as Mean Glandular dose (MGD)
  - or Average Glandular Dose (AGD)
- Phantoms (PMMA) used to simulate real breasts

Phantoms

- PMMA mimicing breast

20	21	97
30	32	67
40	45	41
45	53	29
50	60	20
60	75	9
70	90	4

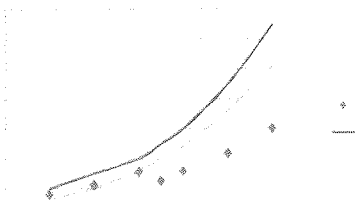
Procedure

- Phantoms imaged using clinical settings
- Exposure parameters noted
- Air kerma (dose) measured at same conditions
- MGD calculated

Reference levels

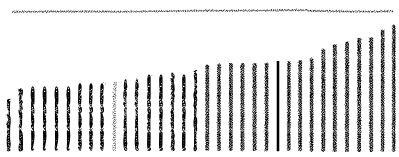
- Measured MGD is compared to reference levels
- In EUREF protocol two reference levels are used
  - Acceptable
  - Achiveable

...



MGD in Slovenia

- Comparison for 45 mm PMMA



What does it mean?

DORA (2011)

- 25 000 women screened
- MGD = 1,5 mGy x 2 = 3 mGy
- Tissue weighting factor w_t = 0,12
- Effective dose E = 0,36 mSv
- 25 000 x 0,36 mSv = 9 000 mSv

Risk:

- 9 000 mSv * (5,5 % / 1000 mSv) = **0,5**

Risk vs benefit

DORA (till 2011)

- 25 000 women screened
- MGD = 1,5 mGy x 2 = 3 mGy
- Tissue weighting factor w_t = 0,12
- Effective dose E = 0,36 mSv
- 25 000 x 0,36 mSv = 9 000 mSv

Risk:

- 0,5 cancers induced

Benefit:

- 205 cancers discovered

Future (present)

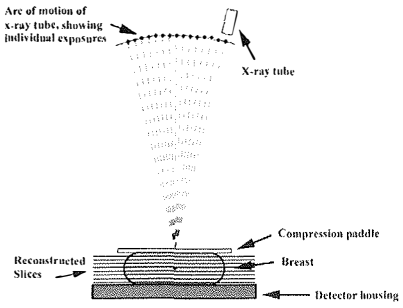
- New detectors
  - Photon counting
  - Spectrometry
- New techniques
  - Tomosynthesys
- CAD
- New ways of processing

Tomosynthesis, a round the clock update on technology, clinical adoption and challenges

Bob Martins,
Ljubljana, 29 March 2012

Tomosynthesis Principle

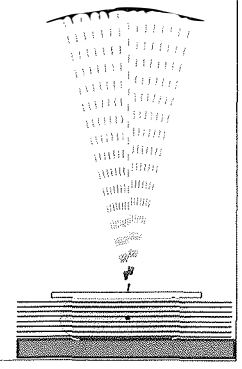
Tomosynthesis Technology



Tomo Design Considerations

System design parameters

- Scan angle
- Number of projections
- Scan time
- Dose
- Reconstruction algorithm
- Reconstruction time
- Reconstruction number of slices

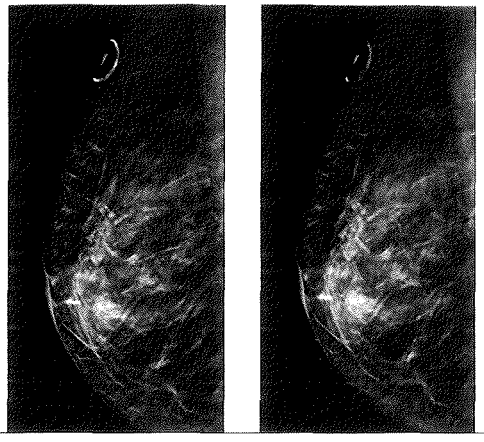


Scan Angle

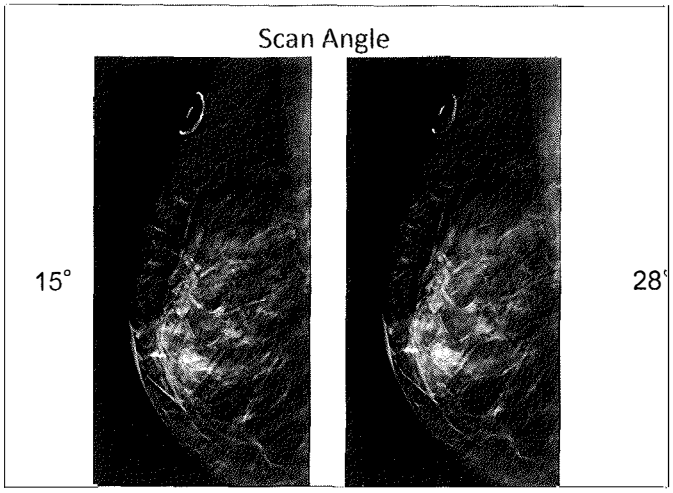
- Wide angle theoretically reduces shadows from overlapping objects (closer to true tomography)
- Narrow angle theoretically creates sharper images (reconstruction, oblique incidence)
- Clinical need: see lesion mass and spiculations both in same slice, sharply
- Clinical need: see multiple calcs in one slice
- Wide angle: objects in focus only over narrow range of axial slice location, therefore need more slices to ensure object is seen sharp.

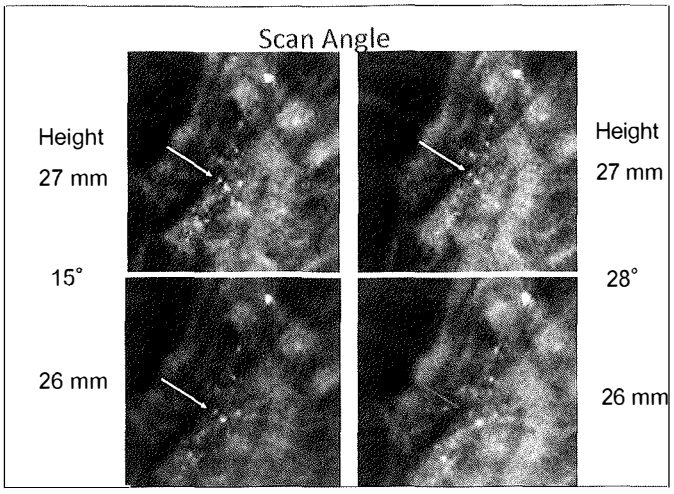
Scan Angle

??°



??°

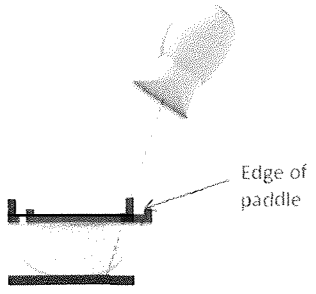




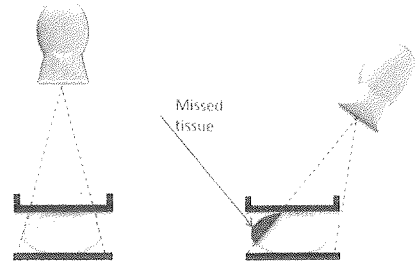
Scan Angle

- Scan angle affects number of visible calcifications
- Slice thickness determined by scan angle. Narrower scans give greater slice thickness.
- It is possible to sum slices (slab) or MIP to see more, but this degrades resolution

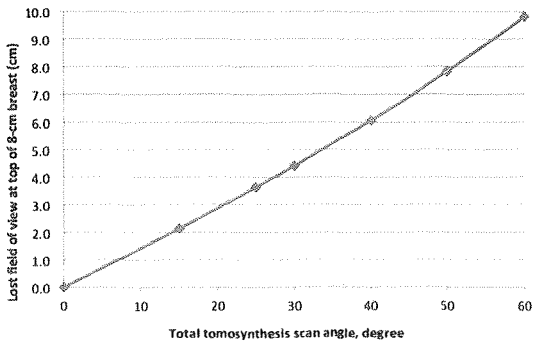
Scan Angle and Field of View (FoV)



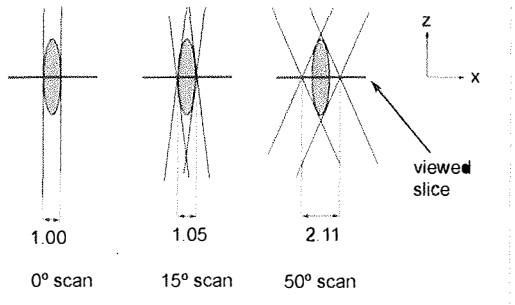
Scan Angle and Field of View (FoV)



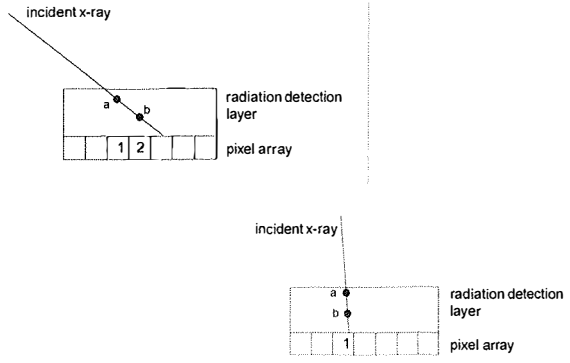
Scan Angle and Field of View (FoV)



Scan Angle and Effect on Image Resolution

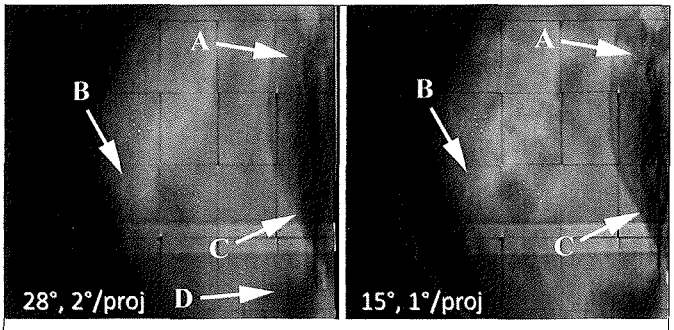


Scan Angle and Effect on Image Resolution



How Many Projections

- The total x-ray dose is split on the projections used
- Split can be done with equal dose per projection or unequally distributed over the selected projects
- The projections can be equally spaced over the scan angle or unequally distributed over the selected projections
- What is the best compromise ?



Phantom on top of breast tissue:
A: calcifications in focus
B: mass in focus
C: artifacts from out of plane object
D: artifact from projection spacing of 2°

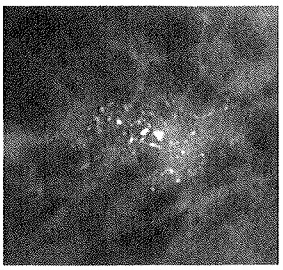
Number of Projections

- If too few projections, i.e. projection spacing is too large, results in artifacts
- Too many projections can create electronic noise problems
- Too many projections increase (file size, recon time, ...)
- Something like **1 projection / degree** is a good compromise

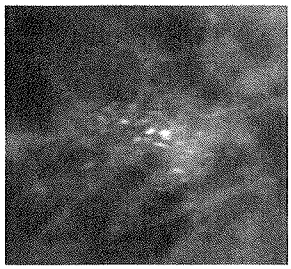
Scan Time

- Faster is better
  - Reduce patient motion
- Continuous motion and focal spot blur
  - Better with slower scans or small angle
- Step and shoot motion issues
  - Increase scan time
- Longer scan time increase possible patient motion
  - 0.1 mm motion degrades micro-calcifications

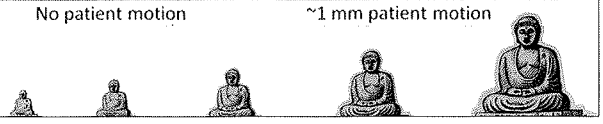
An example of patient motion in tomosynthesis



No patient motion



~1 mm patient motion



Reconstruction Algorithm

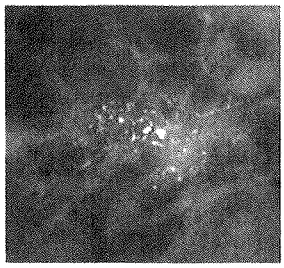
- Limited angle tomography
- Iterative methods (ART, ML)
- Filtered backprojection
- Little difference in image quality using blinded reader comparisons
- Reconstruction times much faster with FPB
- Fast reconstruction times important in clinical routine

Pixel Binning – Noise and Resolution

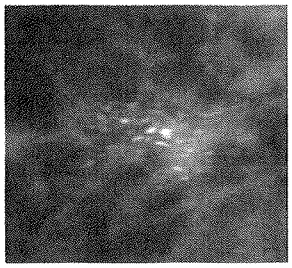
- Pixel binning ; Noise/Dose versus Resolution
- *binning is the procedure of combining a cluster of pixels into a single pixel*
- *reduces the impact of noise in image at the cost of a lower resolution*

Technology Update – Review

- Scan time impact on resolution...



No patient motion



~1 mm patient motion

Practical Considerations

- CC View with Tomo
- Image size and format
- Reliable and user friendly equipment

CC View with Tomo

- Moving tube head create fear of patient head collision
  - Introduce perception CC is not possible with Tomo
- Moving face shield create fear reaction (retraction)
  - Possible movement artifact impact on calc sharpness
- How to solve this issue ?
  - Increase the SID
  - Non moving face shield

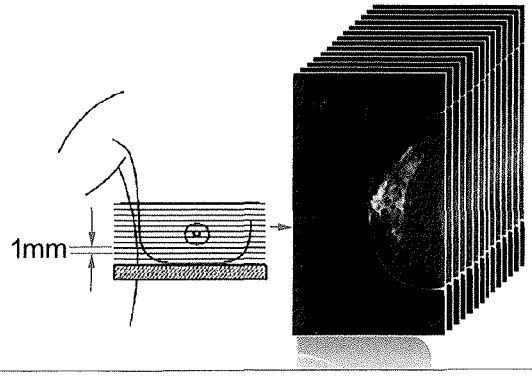
Face Shield - Example

Face Shield Should not be attached to x-ray tube head

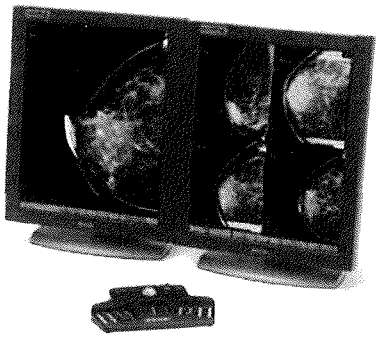
Face Shield - Example

Face Shield Should not be attached to x-ray tube head

Image Size and Format



Display & Storage



PACS and WS with Tomo

- Review of Tomo images : a new challenge
  - Compatibility with workstations (BTO)
  - Mammography (Tomo) workflow
- Storage and communication of Tomo images
  - Increased storage and increased bandwith
  - Established format versus new BT● format

Reliable and User Friendly

- Reliability increase with product maturity
- New features should integrate smoothly

What to remember ?

- Scan time should be short
- New pratical considerations
- Maturity bring reliability and user friendliness

Clinical Adoption

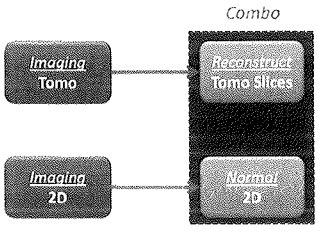
What can be used for Tomo ?

- DR detector technology
  - Direct or indirect conversion
  - Flat panel or slot scanning
- CR detector technology (not adequate)
  - Limitations : multiple images in fast succession
  - Limitation : mechanical precision (alignment) between images
- Moving x-ray tube or multi-tube solutions
  - Short exposure times or step /shoot approach
  - Nanno tube technology (many technical challenges)

FDA Approval in USA

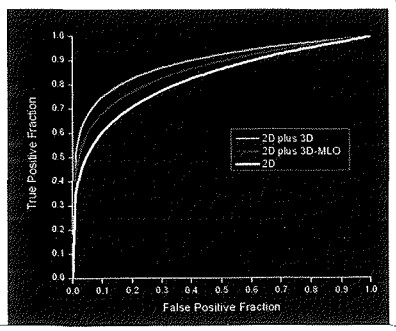
- PMA approval for superior performance
- Use in diagnostic and 'screening'
- Combo (2D + Tomo)
  - Dose increase justified by superior performance

What is Combo imaging ?



Combo Imaging the new Gold Standard ?

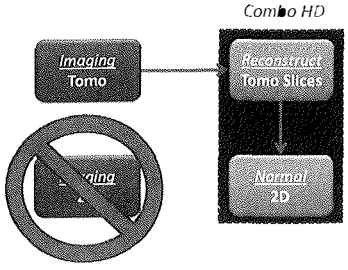
- FDA panel vote and international acceptance...



How to reduce dose of Combo

- Reduce dose of 2D or Tomo or both ?
- Reduce use of Tomo (one view combo) ?
- Synthetized 2D image (Combo HD) ?

Combo with Synthetic 2D

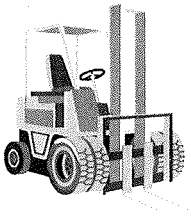


Tomo Associated Technologies

- Synthezised 2D
- Tomo CAD
- Tomosynthesis guided biopsy
- Tomo in combination with contrast

Market Adoption

- Some of the Challenges



Tomosynthesis units in Europe

- University or research environments
  - Typically sceptic and low volume
  - Focussed with clinical evidence...
- Private clinics or private pratices
  - Typically very positive and high volume
  - Asymptomatic use is the eye opener...

Polarisation in Market Adoption ?

- Public hestiation versus quick private adoption
- *In some countries private leading clinics show very fast adoption - in other locations the public health have limited funds plus a long adoption processes for new technology*
- Some difference already present in the current FFDM market...

Tomosynthesis in Screening

- European trials in progress
  - Oslo, Norway ~25.000
  - Malmo, Sweden ~15.000
  - Verona, Italy ~5.000
  - Others ...
- Outside Europe
  - TMIST discussion in USA
  - Asia ...

Tomosynthesis Training & Test

- Workshops by manufacturers
  - Training existing customers
  - Introduction to the technology
- National training programs ?
- National evaluation sets ?

QC of Tomosynthesis

- Same challenge with country specific QC rules as for mammography ...
  - Use manufacturers QC manual (US approach)
  - EUREF Tomo Guidelines (slow progress)
  - Several country have own initiatives
    - UK protocol used for TOMMY trial
    - Germany initiative towards DIN
    - Others ...

Tomosynthesis

a round the clock update on technology, clinical adoption and challenges

The pandora's box of questions ?

Thank you

The important thing is not to stop questioning
~Albert Einstein

Shakespeare, Hamlet. :
The day you stop learning is the day you die

5th International School of Breast Imaging
Ljubljana , 29th – 31th March 2012

Tomosynthesis in Clinical Practice

Prof.dr.med. Per Skaane

Oslo University Hospital Ullevaal
Breast Imaging Center
Oslo , Norway

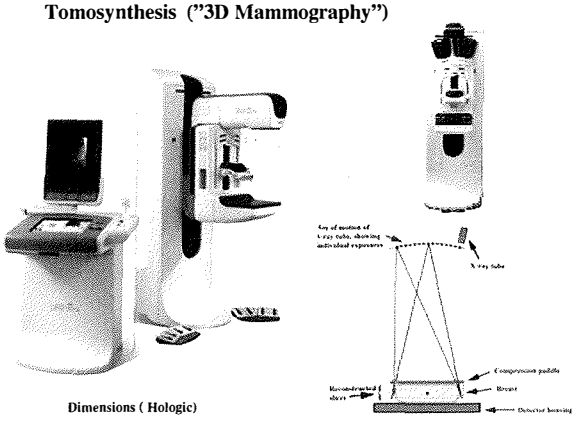
PERSKA@ous-hf.no

30 min.

Objectives:

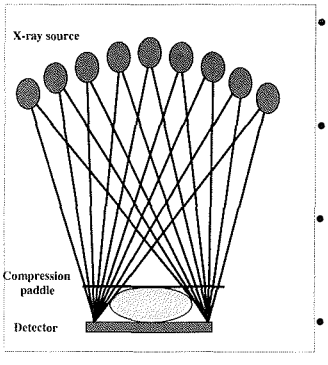
- Tomosynthesis in the clinical setting:
  - Characterization of masses
  - The challenge of microcalcifications
  - Summary of study reports
- Tomosynthesis in the screening setting:
  - Hanging protocols
  - Interpretation time
  - Increased specificity
  - Increased sensitivity

Tomosynthesis ("3D Mammography")



Dimensions (Hologic)

BREAST TOMOSYNTHESIS ACQUISITION



- X-ray tube moves through a proscribed arc of excursion
- Fifteen low-dose projection images are acquired during a 4-second sweep
- Images are reconstructed into stack of images spaced at 1 mm apart
- Total dose same as 2D

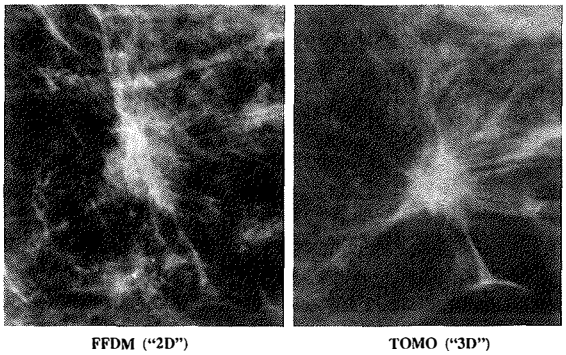
Invasive ductal carcinoma

a)

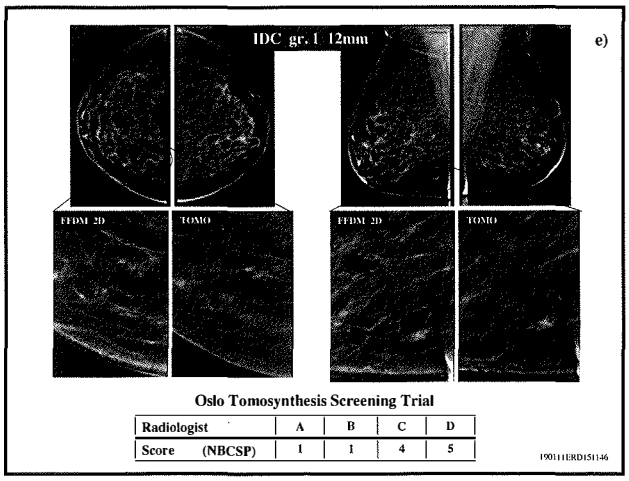
Images courtesy of Dr. Jelle Teertstra
NKI-AVL, The Netherlands

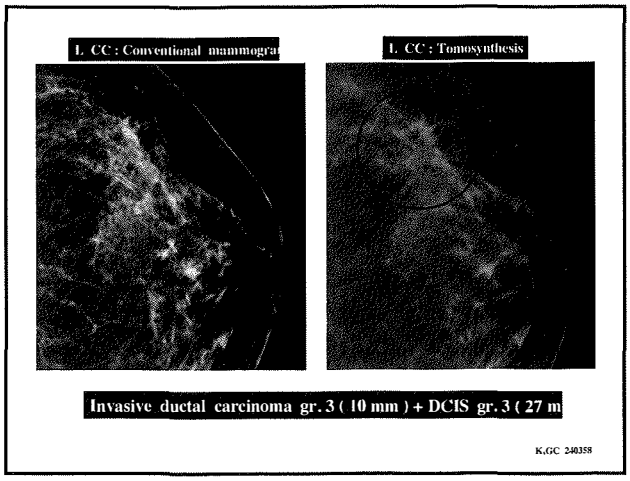
b)

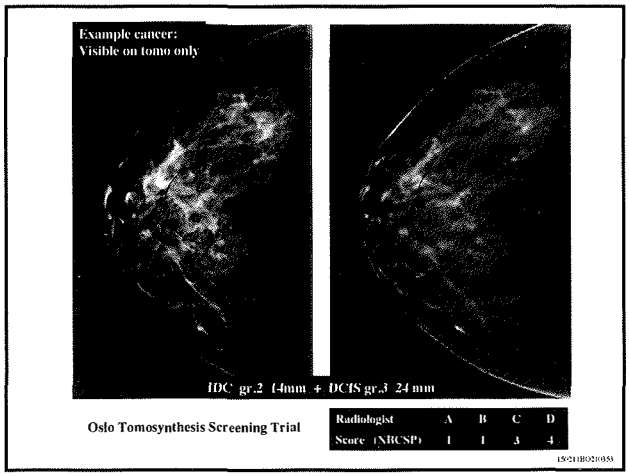
Region of interest

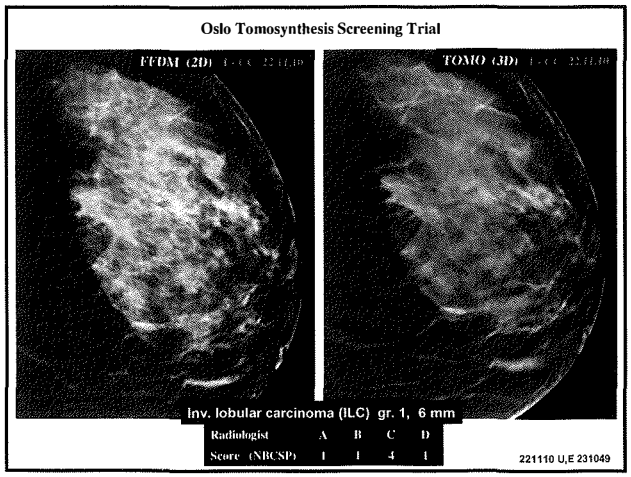


FFDM ("2D") TOMO ("3D")





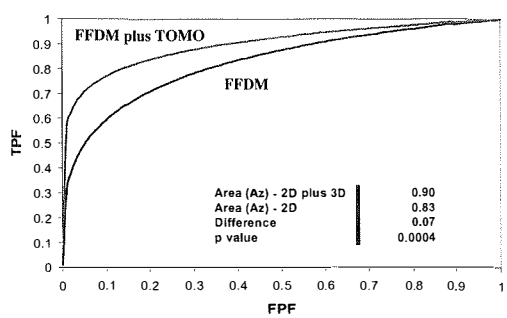




Tomosynthesis (DBT) in the Clinical Setting: Indications

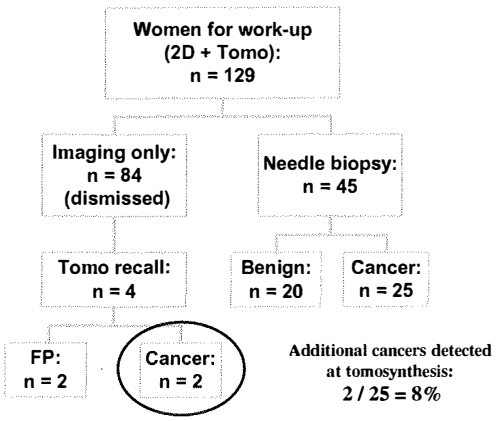
- Mass characterization:
  - Mammographic spot views not necessary when performing DBT (Noroozian M: Radiology 2912;262:61)
  - Superior cancer visibility (conspicuity) suggesting higher sensitivity (Andersson I: Eur Radiol 2008;18:2817)
- Microcalcifications:
  - FFDM slightly more sensitive than DBT for detection (Spangler ML: AJR 2011;196:320)
  - Demonstrated with equal or greater clarity on DBT (Kopans D: Breast J 2011;17:638)
- Tumor size assessment:
  - DBT superior to FFDM (Fornvik B: Acta Radiol 2010;51:240)
- Specificity increased when used adjunctively with FFDM: (Poplack SP: AJR 2007;189:616) (Gur D: AJR 2009;193:586)

All Cases (masses and mc's) – Pooled 12 Readers

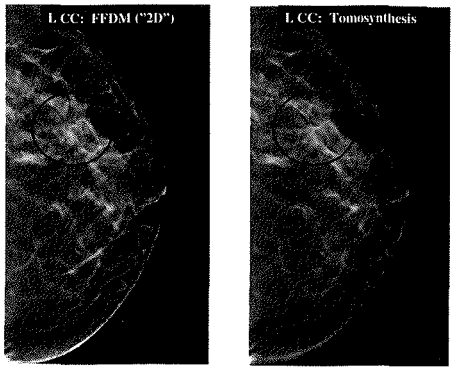


Slide courtesy: Loren Niklason Hologic

Flow chart of women included in the digital tomosynthesis study



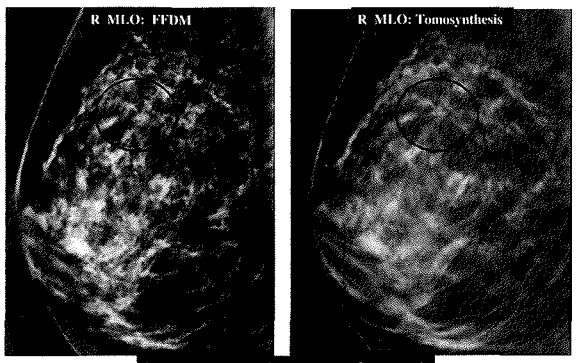
A) Tomosynthesis - detected cancer



Invasive lobular carcinoma : ILC gr. 2 , 12 mm

A.G 050147

B) Tomosynthesis - detected cancer



Invasive lobular carcinoma (ILC) : 2 mm, gr. I
(+ LCIS 20 mm and ALH / LCIS)

H.LAB 210948

Tomosynthesis (DBT): Indications

- **Mass characterization (increased "specificity")**
- **Tumor size assessment**
- **Mammography screening**

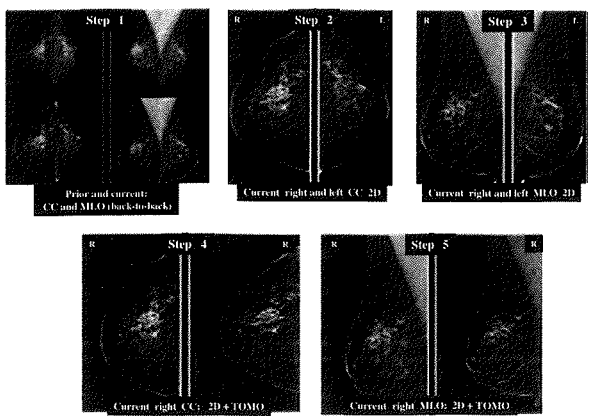
Images to be included in TOMO screening:

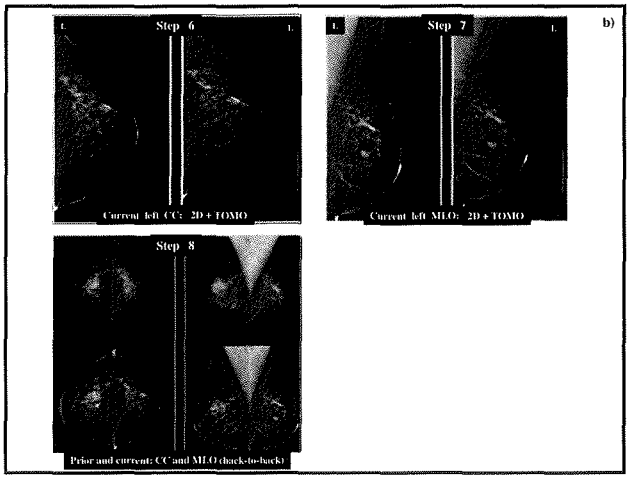
- One view TOMO only (mlo) ?
- One view 2D (cc) + one view TOMO (mlo) ?
- Two view 2D (mlo - cc) + one view TOMO (mlo) ?
- Two view TOMO (cc - mlo) ?
- Two view 2D (mlo - cc) + two view TOMO (mlo - cc) ?

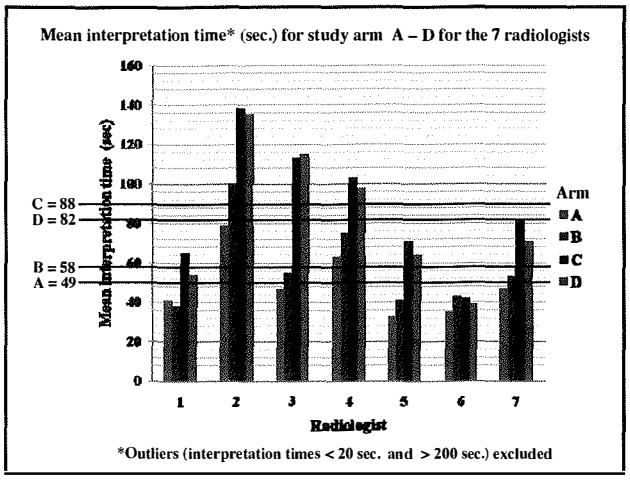
Oslo Tomosynthesis Screening Trial:
Two view 2D (mlo – cc) + two view TOMO (mlo – cc)
i.e., "double" radiation dose !

Hanging Protocol (Oslo Tomosynthesis Screening Trial)

a)





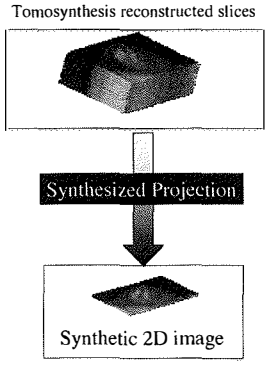


Why FFDM plus Tomo in mammography screening ?

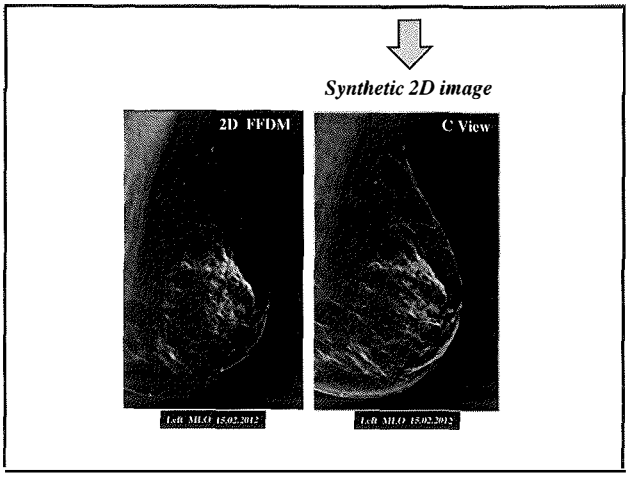
- **Benefit of TOMO expected to be greater for masses and architectural distortion than for calcifications; therefore inclusion of 2D FFDM should maximize calcification detection**
- **Transition to tomosynthesis will likely involve combined use of both 2D FFDM and TOMO**
- **Prior investigations suggest that two-view TOMO will be needed for optimal detection**
- **Comparison with prior imaging is facilitated if the current examination includes both FFDM and TOMO**

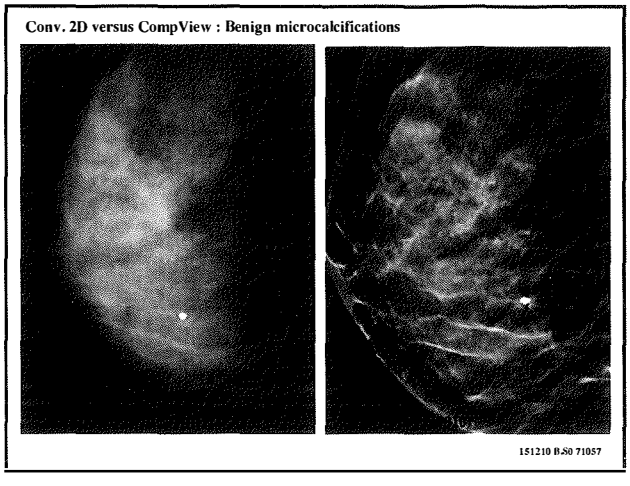
Synthetic C-Views may substitute for FFDM images, when combined with tomosynthesis, without additional radiation dose !!

Synthetic 2D generation:



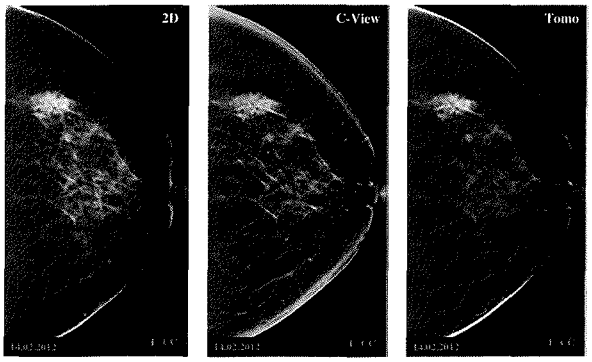
Synthetic 2D image (called C-View by Hologic) shows a roadmap of the important features from tomosynthesis slices





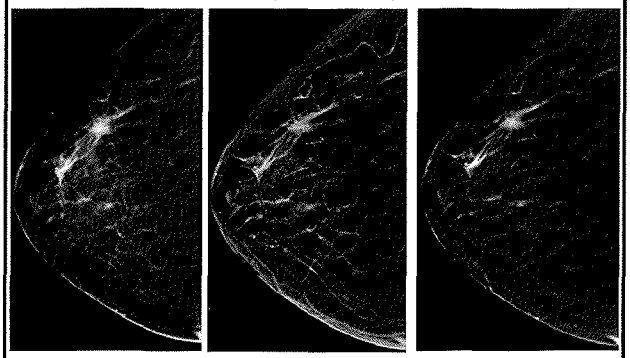
C-views and diagnostic performance:

Do we see the same on C-View as on conventional 2D FFDM and tomosynthesis (3D) ?



Do we see the same on C-View as on conventional 2D FFDM and tomosynthesis (3D) ?

Oslo Tomosynthesis Screening Trial

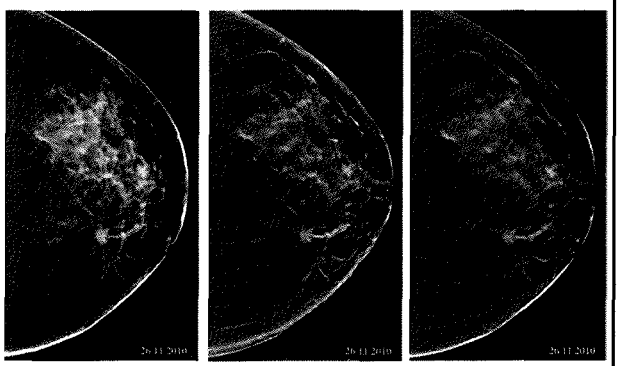


Histology: Tubular carcinoma 13 mm

B) Spiculated masses:

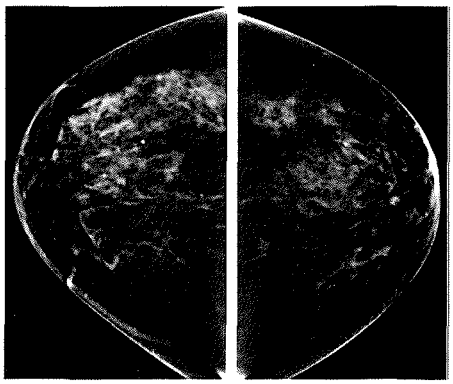
a)

Invasive ductal carcinoma , gr. 1 , 9 mm



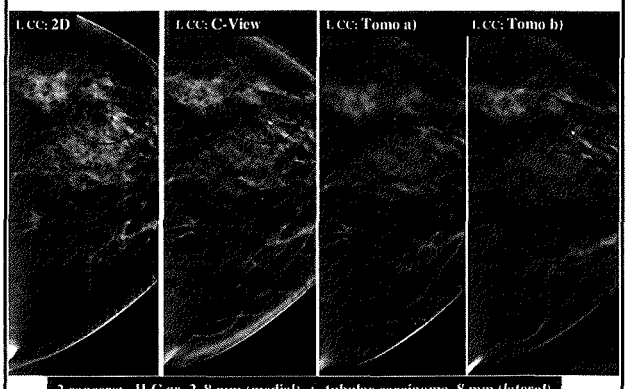
Oslo Tomosynthesis Screening Trial

a)



Oslo Tomosynthesis Screening Trial

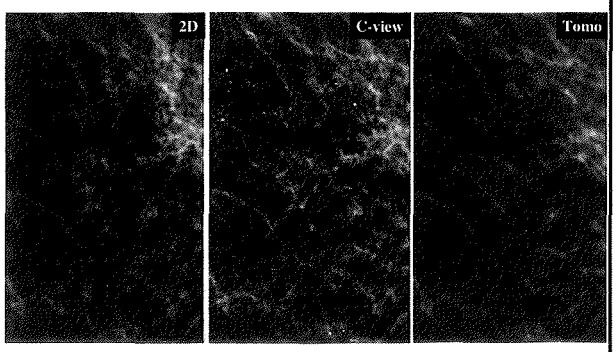
b)



2 cancers: ILC gr. 2, 8 mm (medial) + tubular carcinoma 8 mm (lateral)

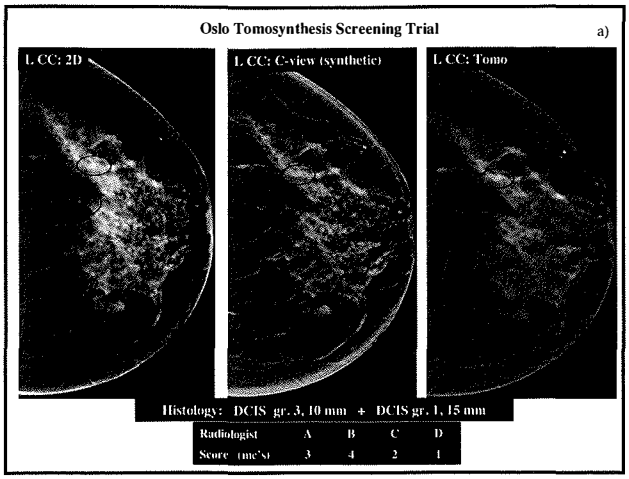
C) Microcalcifications

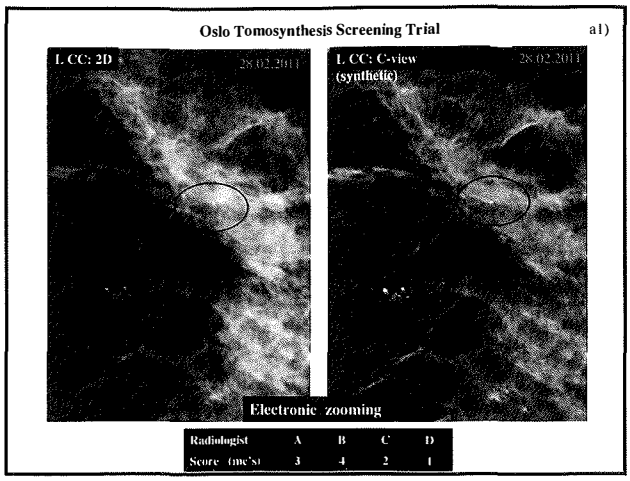
Oslo Tomosynthesis Screening Trial (OTST)

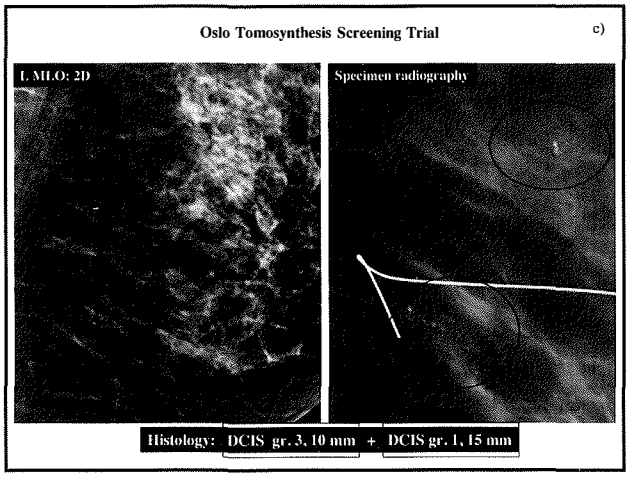


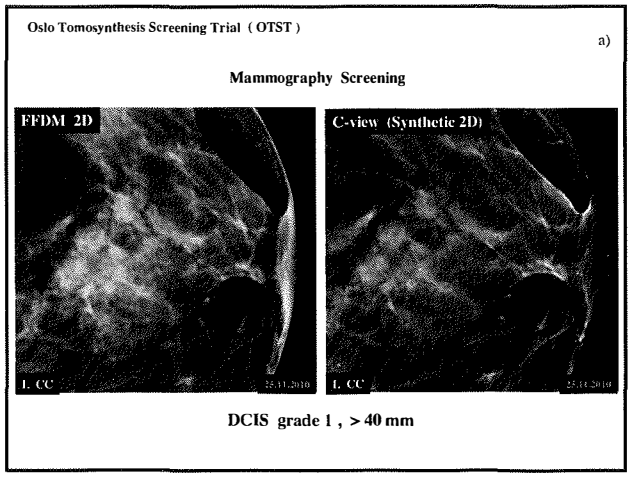
Synthetic 2D (C-view): Highlighting

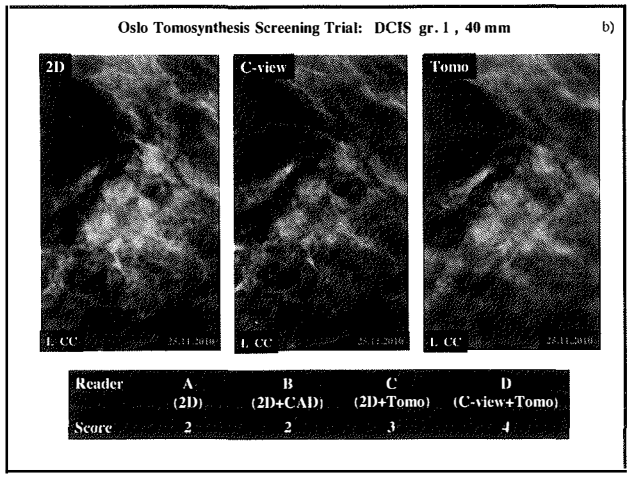
Tomo: "Thin-slice-effect"

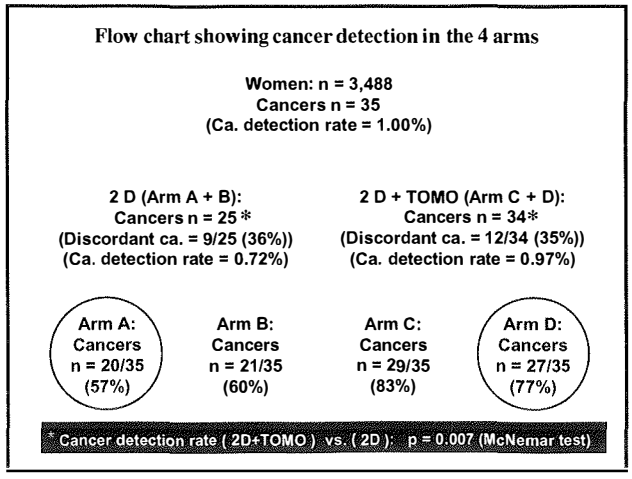

Oslo Tomosynthesis Screening Trial
a)
L CC: 2D
L CC: C-view (synthetic)
L CC: Tomo
Histology: DCIS gr. 3, 10 mm + DCIS gr. 1, 15 mm
Radiologist A B C D
Score (mc's) 3 4 2 1


Oslo Tomosynthesis Screening Trial
a1)
L CC: 2D
28.02.2011
L CC: C-view (synthetic)
28.02.2011
Electronic zooming
Radiologist A B C D
Score (mc's) 3 4 2 1


Oslo Tomosynthesis Screening Trial
c)
L MLO: 2D
Specimen radiography
Histology: DCIS gr. 3, 10 mm + DCIS gr. 1, 15 mm


Oslo Tomosynthesis Screening Trial (OTST)
a)
Mammography Screening
FFDM 2D
C-view (Synthetic 2D)
L CC
L CC
DCIS grade 1 , > 40 mm


Oslo Tomosynthesis Screening Trial: DCIS gr. 1 , 40 mm
b)
2D
C-view
Tomo
L CC
L CC
L CC
Reader A (2D) B (2D+CAD) C (2D+Tomo) D (C-view+Tomo)
Score 2 2 3 4


Flow chart showing cancer detection in the 4 arms
Women: n = 3,488
Cancers n = 35
(Ca. detection rate = 1.00%)
2 D (Arm A + B):
Cancers n = 25 *
(Discordant ca. = 9/25 (36%))
(Ca. detection rate = 0.72%)
2 D + TOMO (Arm C + D):
Cancers n = 34*
(Discordant ca. = 12/34 (35%))
(Ca. detection rate = 0.97%)
Arm A: Cancers n = 20/35 (57%)
Arm B: Cancers n = 21/35 (60%)
Arm C: Cancers n = 29/35 (83%)
Arm D: Cancers n = 27/35 (77%)
* Cancer detection rate (2D+TOMO) vs. (2D): p = 0.007 (McNemar test)

a)

Digital Breast Tomosynthesis (DBT):

Conclusions:

A) In the clinical setting:

- **DBT superior to FFDM for mass characterization (may replace spot views for mass evaluation – but not magnifications views for analysis of fine punctate amorphous and pleomorphic microcalcifications !)**
- **DBT seems to be superior to FFDM for tumor (cancer) size assessment**

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b)

Digital Breast Tomosynthesis (DBT):

Conclusions (continued):

B) In the screening setting:

- **Combination of synthetic 2D (C-View) and tomosynthesis makes combined 2D and 3D possible with approximately the same radiation dose as conventional 2D FFDM**
- **Tomosynthesis plus C-View increase the cancer detection rate as compared with conventional FFDM 2D**
- **DBT may increase the specificity (reduce the recall rate) in screening programs with high call-back rate (US)**

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5th International School of Breast Imaging
Ljubljana, 29.- 31. March 2012

Breast Positioning
What is important?

Hildegard Aust, Radiographer Screening Unit Wiesbaden and
Freelancer at Reference Center South West, Marburg

Breast Positioning is an Art

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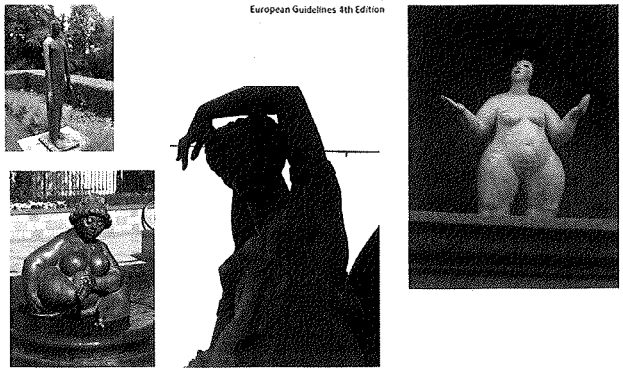

...the radiographer has to pay sufficient attention to the woman in order to produce optimal images

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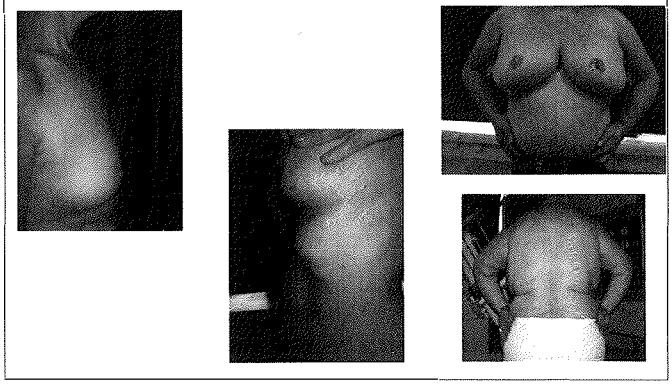
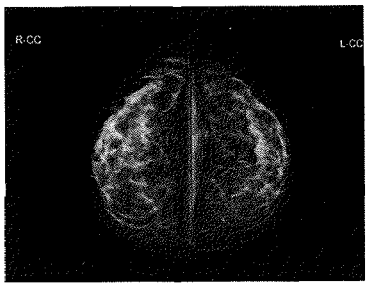


CC View



Breast completly shown:

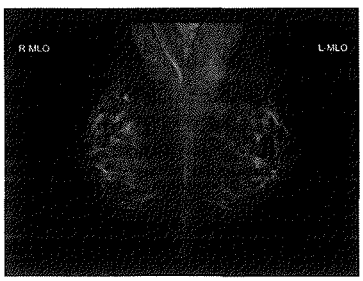
Medial border **must be shown**

As much as possible of lateral part

If possible pectoral muscle shadow is shown, if not:
PNL mlo- cc < 15 mm

Nipple in profile in the middle (10° medial or lateral)

MLO View



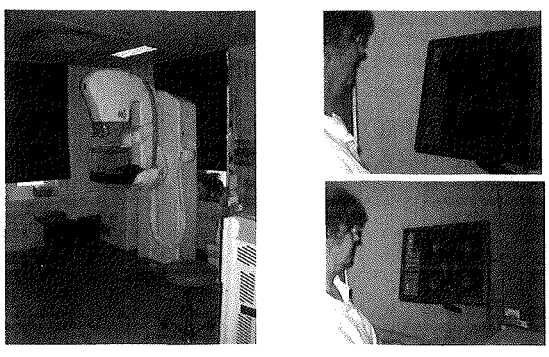
All breast tissue clearly shown

Pectoral muscle to the nipple level, relaxed in an angle of 20°

Nipple in profile

Inframammary angle clearly demonstrated

What is important?
The equipment...

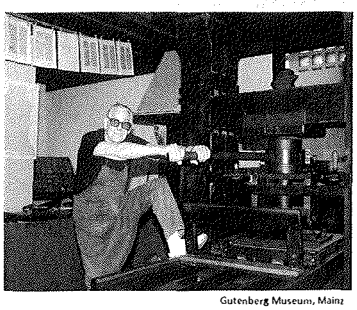


What is important?
Time

It is important that the radiographer has sufficient time to carry out the investigation ...European Guidelines 4th Edition

- Introductory talk including the following informations:
  examination procedure, an outline of the positioning and the importance of an optimal compression
- Inspection and documentation of any clinical symptoms such as scars, skin abnormalities, special nipple changes, pacemaker, port or shunt etc.
- Good positioning in order to achieve an optimal mammogram for each woman
- Evaluation of the pictures: are they well done for this woman???
  If neccessary: we have to repeat the inadequate view

What is important?
Compression

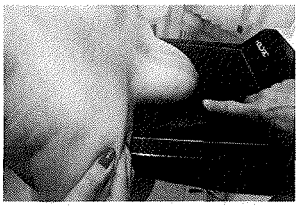


Gutenberg Museum, Mainz

Effectiveness of compression

Decreased	Increased
• Thickness of tissue	• Geometry of a picture
• Scattered radiation	• Picture contrast
• Blurring by movement	• Detail recognition
• Dose	• Equal blackness

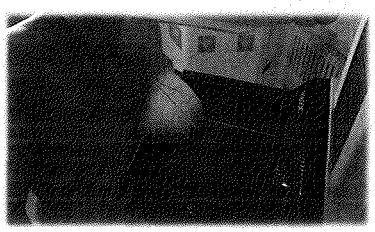
The difference:



CC View

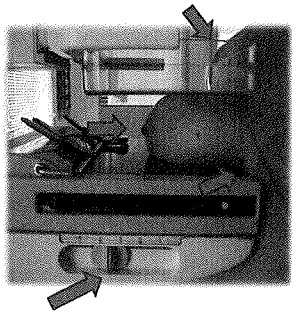
Height of the breast support table

Breast position in the middle of the breast support table



Nipple in profile
in the middle position
perhaps +/- 10°

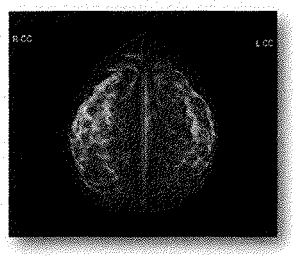
Check up the following points of view:



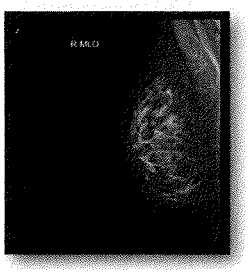
- Correct height of the breast support table
- Nipple in profile
- Is there any overlying artefact?
- Folds? Medial or lateral part
- Correct positioning of automatic exposure device

Summary CC View

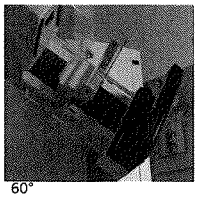
- Breast tissue?
- Medial part complete?
- Lateral part as much as possible ?
- Nipple in profile in central position
- Not any artefacts or folds?
- Correct exposure and contrast?
- Optimal compression?
- Movement?
- Symmetrical positioning



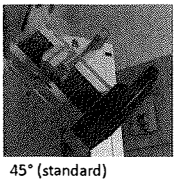
MLO View

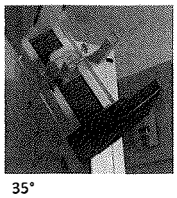


Aspects of positioning

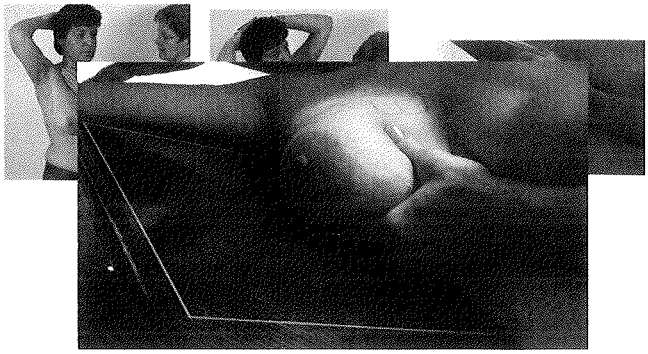

60°

Correct height and correct angle ...

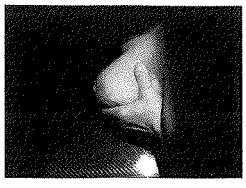

45° (standard)

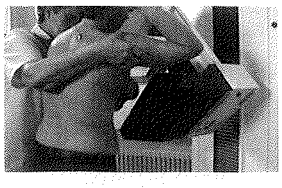

35°

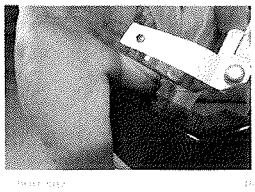
...depend on the anatomy and mobility of the woman



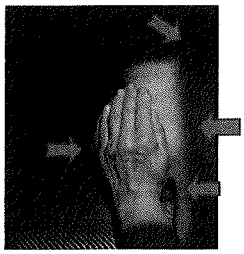
Looking from medial and dorsal...







Check up the following points of view



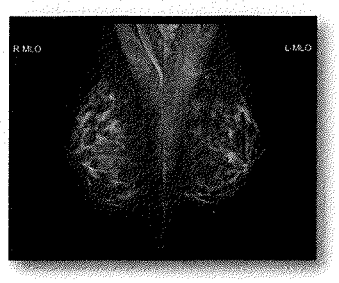
Correct height of the table:
Paddle as near as possible to clavicular

Paddle as near as possible in front of sternum

Breast is positioned parallel:
correlation between nipple in profile and IMF

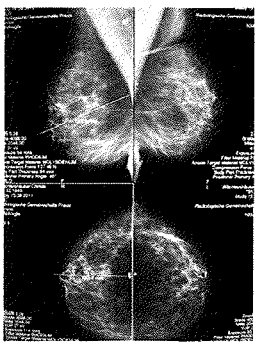
IMF clearly demonstrated without overlying tissue

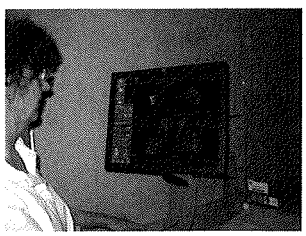
Summary MLO View



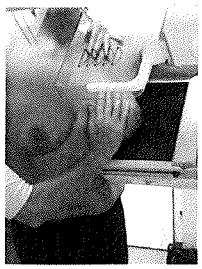
- Whole breast is imaged with the nipple in profile
- Pectoral muscle shadow shown down the back of the breast at the correct angle
- Inframammary angle clearly demonstrated without overlying tissue

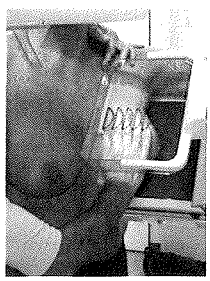
PNL measurement



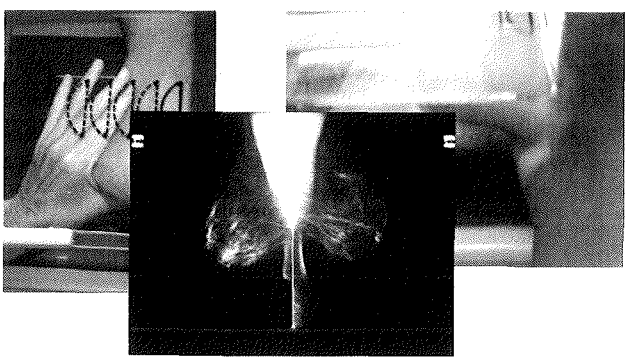


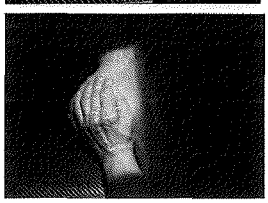
Way of working with your hands is important for producing an optimal IMF





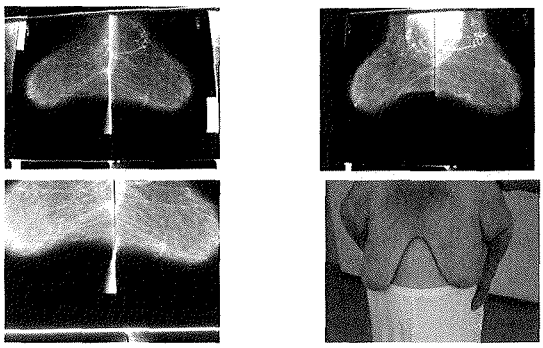
Please, never in this way....



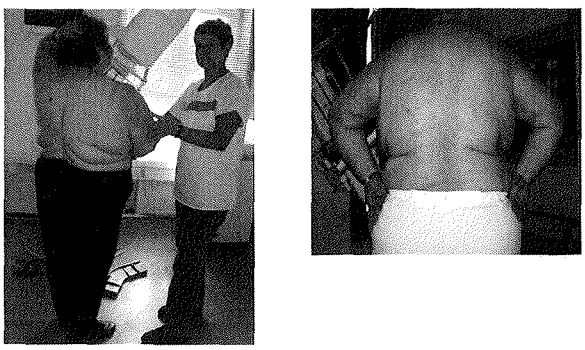


...but in this way

Type of tissue ...

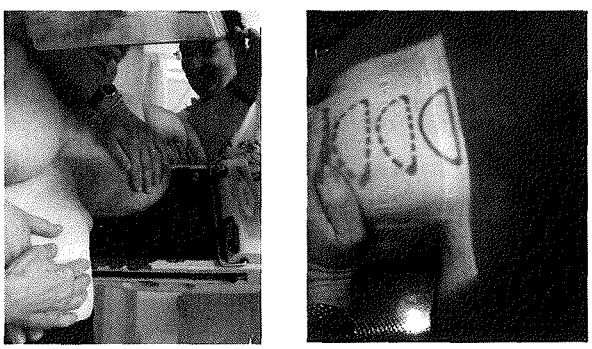


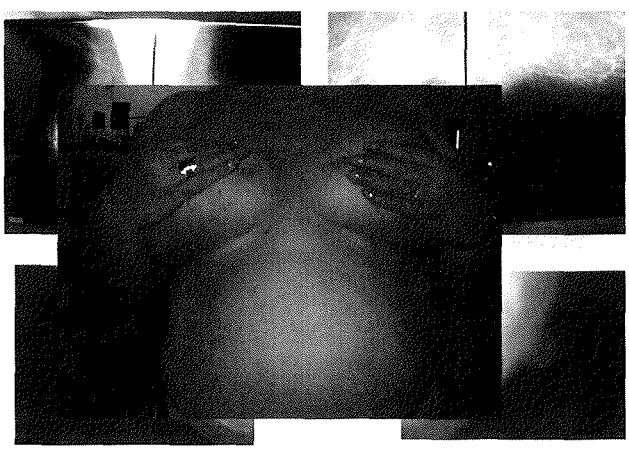
Heavy & difficult...

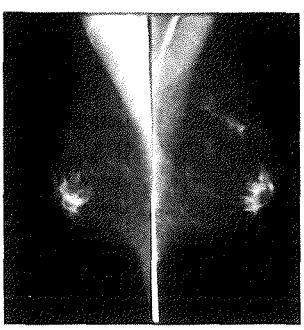


Tense tissue

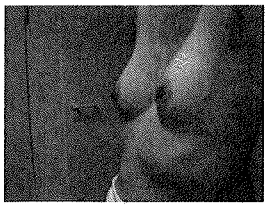
smooth and movable tissue



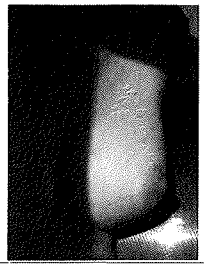




An optimal IMF demonstration depends most on the type of tissue

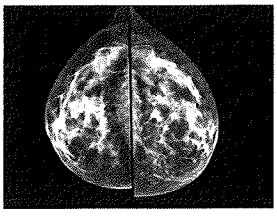


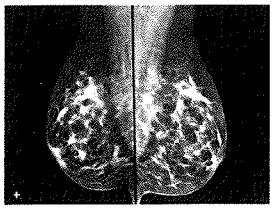
Thorax deformity



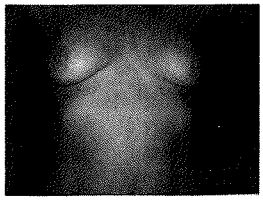
An additional view
may help you

What do you think about this?

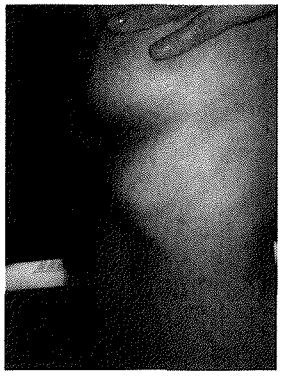


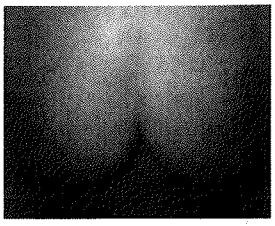


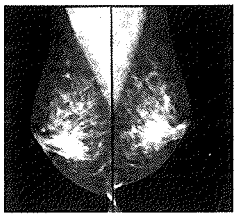
R 45° L 55°

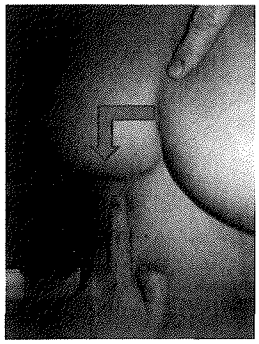


IMF demonstration
depends on the
anatomy:
adapt the angle of
the table



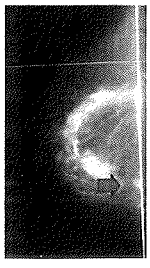






Limitation to demonstrate IMF:
Breast is placed in front of thorax lying
With a narrow medial crossing

The radiographer`s responsibility is
meeting the requirement
to produce an optimal mammogram.



The skills required to perform optimal
mammographic positioning are high.
It is important that the radiographer has
sufficient time to carry the investigation
and pay sufficient attention to the woman
in order to produce optimal images.

European Guidelines 4th edition

Thank you

very much

for

your attention!

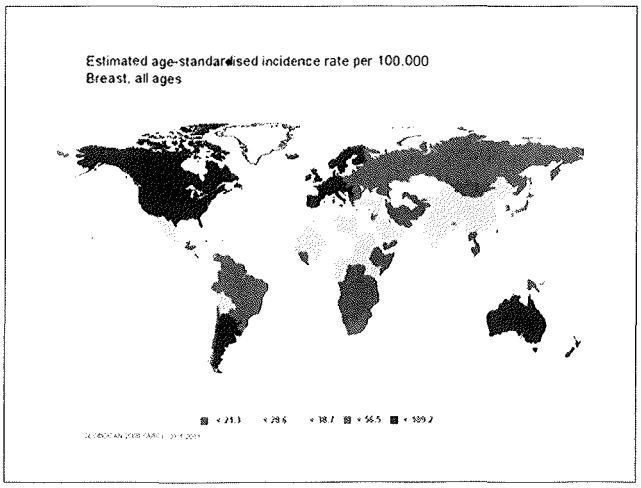
Ljubljana

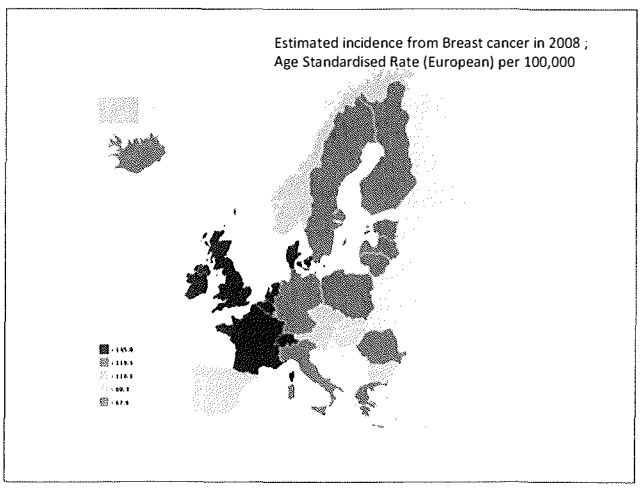
Enjoy another possibility of positioning...

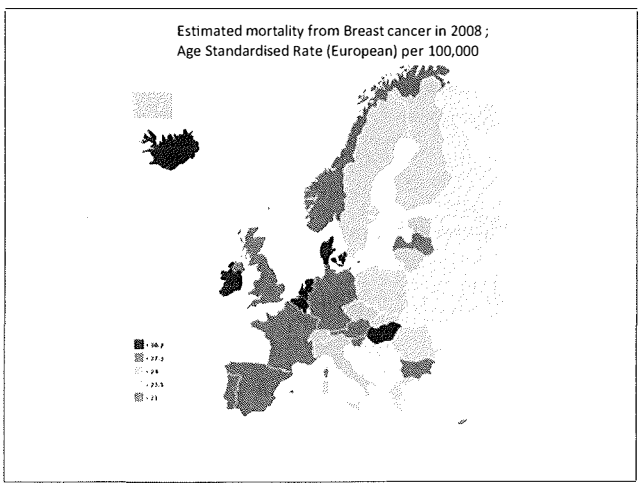
Epidemiology of breast cancer and Management of BRCA+ patients

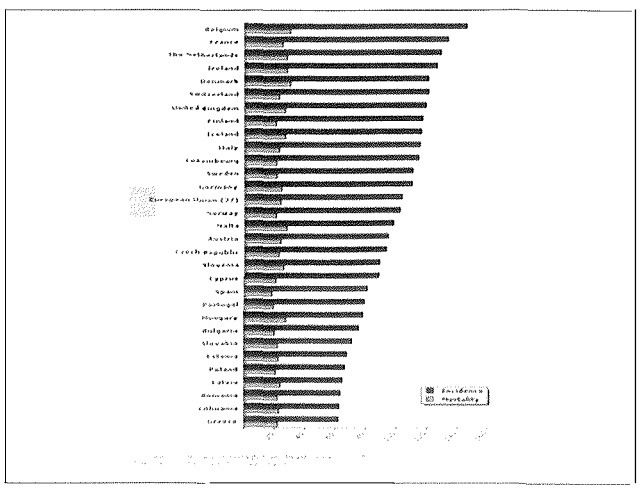
March 2012

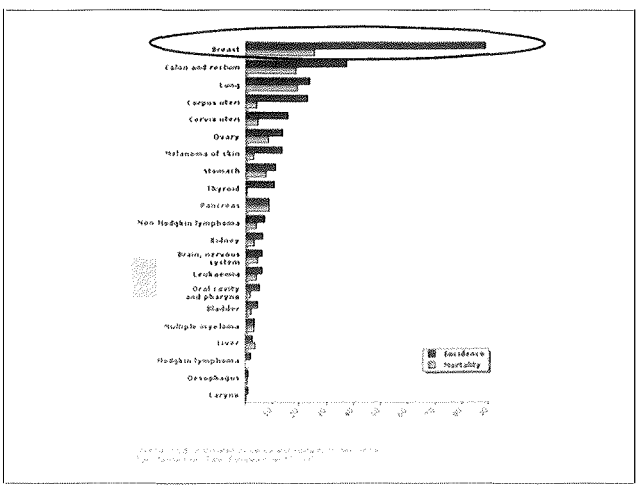
Mateja Krajc











SLOVENIAN DATA

INCIDENCE (average 2004–2008) Women

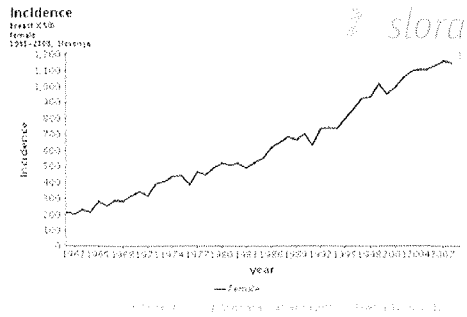
Number of new cases per year	1.127	
Proportion of all cancers (%)	20,7	
Frequency rank among all cancers	1	
Risk of getting cancer before age 75 (CR) (%)		7,0
Crude incidence rate per 100,000		110,2

MORTALITY(average 2004–2008)

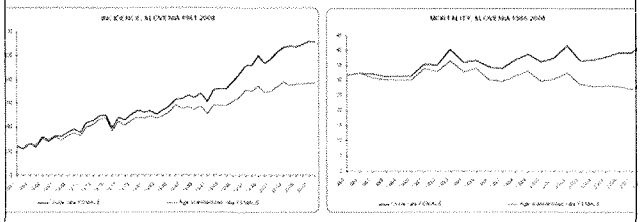
Number of deaths per year	400,4	
Proportion of all cancers deaths (%)	16,9	
Risk of dying from cancer before age 75 (CR) (%)	1,9	

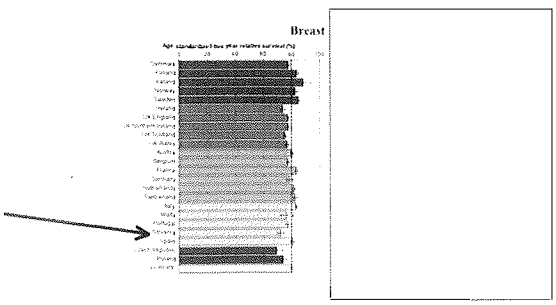
PREVALENCE(on December 31, 2008)

Persons living with cancer at the end of 2008 (prevalence)	12.517
Number of persons living with cancer per 100,000 at the end of 2008	1.220,4
1-year prevalence	1.086
5-year prevalence	3.737

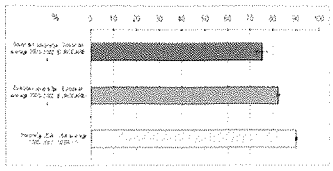


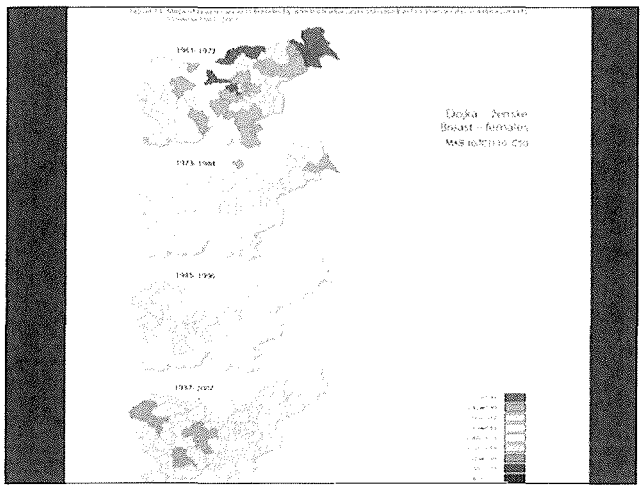
Crude and age-standardized rates per 100,000 population over time.



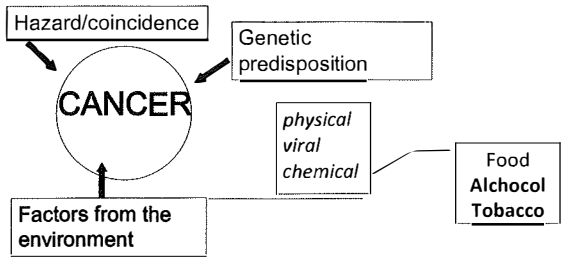


Age standarised relative 5 year survival in Europe (EUROCARE-4).





WHO WILL GET CANCER?



More than half of all cancer deaths are linked with the life style risk factors.

Majority of cancer risk factors are related to the lifestyle:

*OBESITY,

*HIGH ENERGY FOOD INTAKE

*ALCOHOL

* TOBACCO USE

* SUN EXPOSURE.

RISK FACTORS

- **Differences in BC incidence and mortality among countries**
- **Increasing BC incidence everywhere**

- **Among proven risk factors for BC:**

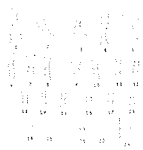
- **gender,**
- **age,**
- previous BC,
- some benign breast changes,
- family history,
- ionizing radiation,
- reproductive factors,
- obesity

- **For all other risk factors there is not enough evidence based data**

GENETIC RISK FACTORS

BRCA 3-5 % BC are due to hereditary breast cancer syndroms (known mutation in and other rare genes)

~5% of cases have a strong hereditary component
~15-20% are "familial"/multifactorial
~70-75% are thought to be sporadic



Mutations in breast cancer genes

- Inherited known mutations
- **First group**:
  High relative risk when mutation is detected, but not frequent in the population.
  5 % of all BC (***BRCA1, BRCA2***, *P53* (Li- Fraumeni sy), *PTEN* (Mb. Cowden), *ATM, etc.*
- **Second group**:
  Mutations in genes involved in the change of methabolism of carcinogens or in DNA damage repair (*CYP1A1* and *CYP2D6).*

Genetic predisposition testing is a multistep process

1. Identify at risk patient
2. Provide pre test counseling
3. Provide informed consent
4. Select and offer test
5. Disclose results
6. Provide post-test counseling and follow up

Genetic cancer susceptibility testing

- can not be used as a screening test for general population!

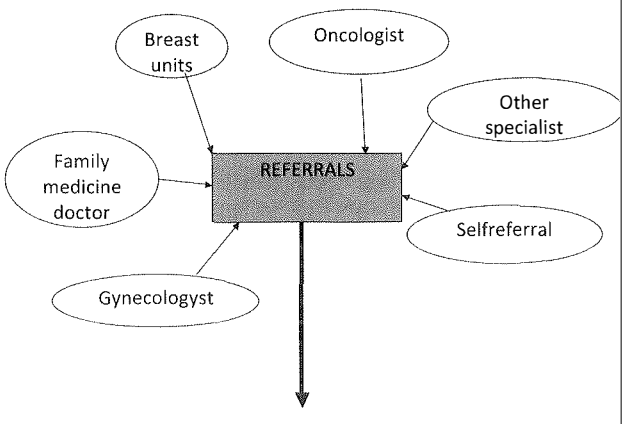
- in clinical setting it is only one component of a comprehensive cancer risk assessment plan

Psychological issues in Testing

- Anxiety
- Fear
- Depression
- Stigmatisation
- Grief
- Guilt
- Altered self-esteam
- Changes in family interactions

RESPECT FOR AUTHONOMY!

- The right "not to know"
- Privacy and confidentiality issues should be discussed



INDICATIONS FOR GENETIC TESTING

Breast/ovarian cancer families:

- breast cancer <40yrs,
- bilateral breast cancers,
- breast and ovarian cancer,
- men breast cancer,
- positive family history:
  - minimal criteria: at least 2 first degree relatives with breast and/or ovarian cancer, in case of 2 breast cancers – one should be diagnosed before 50

FIRST CONTACT WITH CANCER GENETIC COUNSELING SERVICE

Basic genetic counseling information leaflet and family history questionare

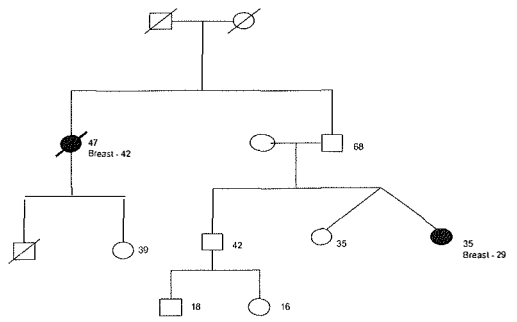
Ime in priimek					
Ali ste imeli rak dojk?		€ Ne € Da € Ne vem	Starost ob diagnozi		
Ali ste imeli rak jajčnikov?		€ Ne € Da € Ne vem	Starost ob diagnozi		
Ali ste imeli kakšno drugo obliko raka?		€ Ne € Da € Ne vem	Katerega organa	Starost ob diagnozi	
Stari	Živ/živa?	Bolezen za rakom	Rak katerega organa	Starost ob diagnozi	Bolnišnica
Oče (ime)	€ Ne Starost ob smrti:..... Vzrok smrti: ..... € Da Datum rojstva:	€ Ne € Da € Ne vem			

KAJ JE GENSKO TESTIRANJE IN KAJ POMENI
ZNANI RIZIČNI FAKTORJI ZA NASTANEK RAKA DOJK IN/ALI JAČNIKOV
Ogroženost za nastanek raka dojk in/ali jajčnikov je povezana s številnimi faktorji:
Starost
Ogroženost za nastanek raka dojk in/ali jajčnikov raste s starostjo. Med ženskim prebivalstvom je ogroženost za nastanek raka dojk do starosti 30 let 1% (od 100 žensk bo ena zbolela za rakom dojk) in do starosti 85 let je 11% (pri vsaki 9 ženski se bo razvil rak dojk). Ogroženost za nastanek raka jajčnikov do starosti 70 let je 1% in do 85 let 1,4%.

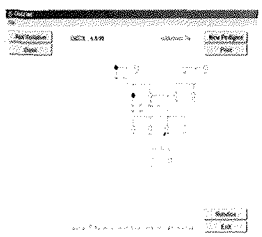
Reproduktivni in hormonalni faktorji:
imajo pomembno vlogo pri razvoju raka dojk, večja ko je nemreč izpostavljenost dojke hormonom (estrogenom in progesteronom), večja je ogroženost za nastanek raka dojk. Dojka doseže dokončno zrelost šele pod vplivom hormonov med nosečnostjo in po porodu. Po porodu je taka dojka manj občutljiva za vse vplive , ki lahko prispevajo k nastanku raka dojk.

Večja ogroženost za nastanek raka dojk so ženske, ki:
- pri tistih, ki so prvo menstruacijo doble pred 12 letom starosti in prile v menopavzo po 50 letu;
- prvič rodile po 30 letu (obratno: prvi porod pred 30. letom in še nekaj manjši meri dojenje, prispevata k zmanjšani zbolevnosti za rakom dojk)
- nekatere raziskave kažejo, da uporaba hormonske kontracepcije nekoliko veča ogroženost za nastanek raka dojk, vendar ke takrat, ko ženska začne z uporabo k mlajši, pred prvo nosečnostjo in je uporablja daljše časa (leje od 8 let);

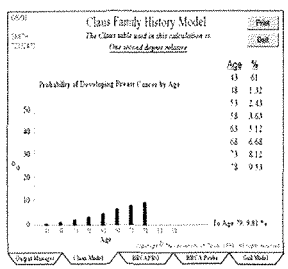
Family tree: when to susspect hereditary cancer syndrome

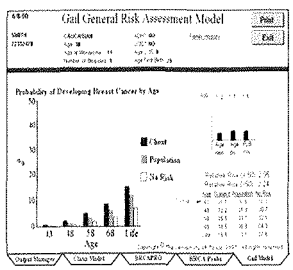


Probability of finding a mutation

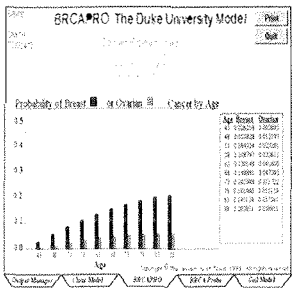


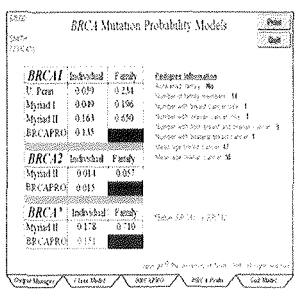
Probability of developing cancer

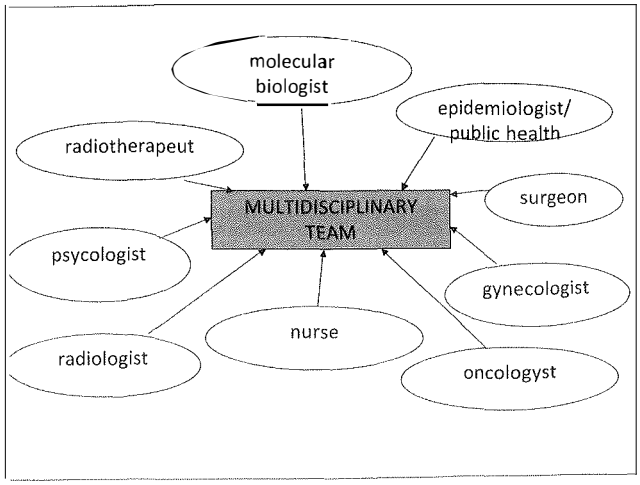




Probability of having mutation







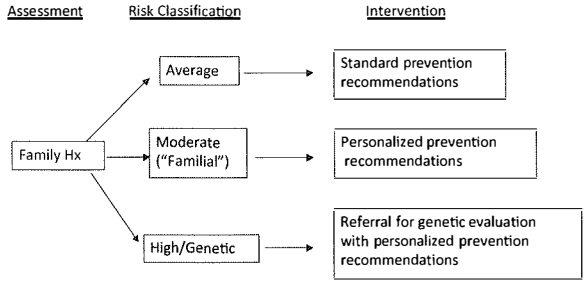
Result disclosure

- Done in person
- After personal invitation letter, stating we have the result
- Individual always has an option not to come for "result session"

SURVEILLANCE

- Offered at the insitute for BRCA+ patients
- Dates for follow up are given from the cancer genetic office
- Follow up is monitiored centrally

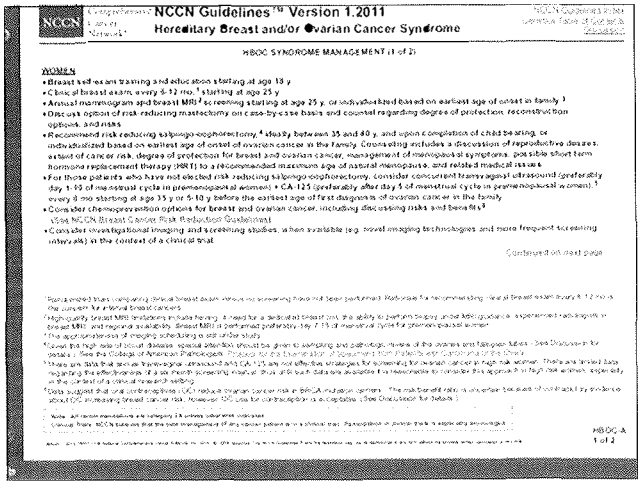
Surveillance



BRCA1/2 Mutations: Cancer Risks

	popul. (%)	BRCA1	BRCA2 (do 80. leta)
• Breast cancer to age 80	9	50-85%	50-85%
• Ovarian cancer to age 80	1.5	20-60%	do 27%
• Male breast cancer	0.1	slight ↑	~6%
• Colon cancer	5.5	6%	6%
• Prostate cancer	8.3	slight ↑	slight ↑
• Pancreatic cancer	0.7 (♀) -1.2 (m)	-	1.5-5%
• Malignant melanoma	1.5	-	slight ↑

NCCN 2002, 2011 genetic/familial high-risk assessment clinical practice guidelines in oncology



NCCN Guidelines™ Version 1.2011
Hereditary Breast and/or Ovarian Cancer Syndrome

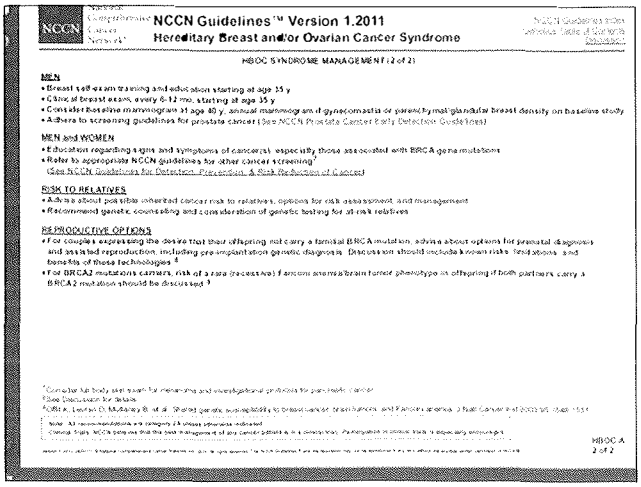
HBOC SYNDROME MANAGEMENT (1 of 2)

WOMEN

- Breast self-exam training and education starting at age 18 y
- Clinical breast exam, every 6-12 mo,[1] starting at age 25 y
- Annual mammogram and breast MRI[2] screening starting at age 25 y, or individualized based on earliest age of onset in family[3]
- Discuss option of risk-reducing mastectomy on case-by-case basis and counsel regarding degree of protection, reconstruction options, and risks
- Recommend risk-reducing salpingo-oophorectomy,[4] ideally between 35 and 40 y, and upon completion of childbearing, or individualized based on earliest age of onset of ovarian cancer in the family. Counseling includes a discussion of reproductive desires, extent of cancer risk, degree of protection for breast and ovarian cancer, management of menopausal symptoms, possible short-term hormone replacement therapy (HRT) to a recommended maximum age of natural menopause, and related medical issues
- For those patients who have not elected risk-reducing salpingo-oophorectomy, consider concurrent transvaginal ultrasound (preferably day 1-10 of menstrual cycle in premenopausal women) + CA-125 (preferably after day 5 of menstrual cycle in premenopausal women),[5] every 6 mo starting at age 35 y or 5-10 y before the earliest age of first diagnosis of ovarian cancer in the family
- Consider chemoprevention options for breast and ovarian cancer, including discussing risks and benefits[6]
  (See NCCN Breast Cancer Risk Reduction Guideline)
- Consider investigational imaging and screening studies, when available (eg, novel imaging technologies and more frequent screening intervals) in the context of a clinical trial

Continued on next page

HBOC-A
1 of 2



NCCN Guidelines™ Version 1.2011
Hereditary Breast and/or Ovarian Cancer Syndrome

HBOC SYNDROME MANAGEMENT (2 of 2)

MEN

- Breast self-exam training and education starting at age 35 y
- Clinical breast exam, every 6-12 mo, starting at age 35 y
- Consider baseline mammogram at age 40 y; annual mammogram if gynecomastia or parenchymal/glandular breast density on baseline study
- Adhere to screening guidelines for prostate cancer (See NCCN Prostate Cancer Early Detection Guidelines)

MEN and WOMEN

- Education regarding signs and symptoms of cancer(s), especially those associated with BRCA gene mutations
- Refer to appropriate NCCN guidelines for other cancer screening[7]
  (See NCCN Guidelines for Detection, Prevention, & Risk Reduction of Cancer)

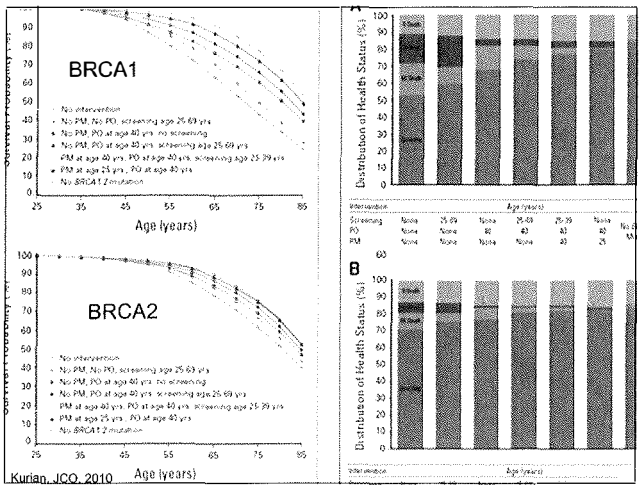
RISK TO RELATIVES

- Advise about possible inherited cancer risk to relatives, options for risk assessment, and management
- Recommend genetic counseling and consideration of genetic testing for at-risk relatives

REPRODUCTIVE OPTIONS

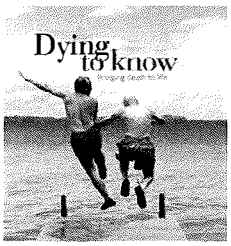
- For couples expressing the desire that their offspring not carry a familial BRCA mutation, advise about options for prenatal diagnosis and assisted reproduction, including pre-implantation genetic diagnosis. Discussion should include known risks, limitations, and benefits of these technologies[8]
- For BRCA2 mutations carriers, risk of a rare (recessive) Fanconi anemia/brain tumor phenotype in offspring if both partners carry a BRCA2 mutation should be discussed[9]

HBOC-A
2 of 2



Kurian, JCO, 2010

COMMUNICATING EFFECTIVELY



Urška Lunder, MD
University Clinic for Respiratory and Allergic Disease Golnik
Palliative Care Development Institute
Ljubljana, 29. 3. 2012

Overall messages

A structured approach to communicating helps the doctor perform this role

Objectives

- Demonstrate ability to apply a 6-step protocol for delivering difficult information
- Know what to do at each step

What adds most to the meaning and value in your life ?

6-step protocol

1. Getting started
2. What does the patinet know ?
3. How much does the patient want to know ?
4. SHARE INFORMATION
5. Respond emotion
6. Plan, follow up

Step 5 respond to emotion

- Listen quietly, attentively
- Encourage descriptions of feelings
- Use non-verbal communication

Setting goals sustains hope throughout the course of cancer care

Potential goals of care?

- Cure cancer
- Avoide premature death
- Maintain or improve function
- Prolong life
- Relieve suffering
- Qualty of life
- Stay in control
- A good death
- Support for family

Set goals to sustain hope

- Establish how information will be shared
- Define language
- Prevent surprises
- Prepare for decision points

Language, describing goals of care . .

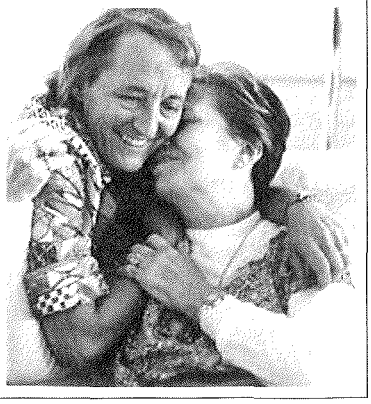
- I want to give the best care possible
- We will concentrate on improving the quality of your life

…Language, describing goals of care

- **I'll do everything I can to help you maintain your independence**
- **I want to ensure that your father receives the kind of treatment he agrees/wants**
- **Your comfort and dignity will be my top priority**

"Modern medicine is like a profet, who offers life without pain. Nonsenss..."

Elisabeth Kubler-Ross



Breast anatomy

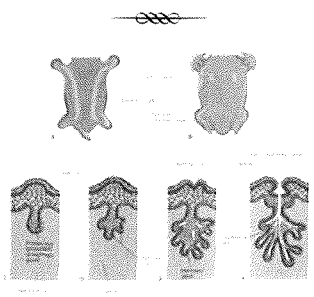
Maja Musič, M.D., PhD
Institute of Oncology
Ljubljana

5th International Breast School Ljubljana, 29-31st March 2012

Mammary gland

- bilateral gland, ectodermal origin
- modified and highly specialized type of sweat gland
- temporary produces milk for breastfeeding
- + skin = **breast**

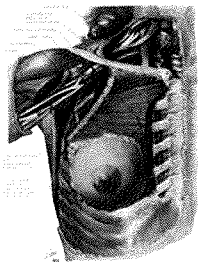
Embrional development



Moore, Persaud: The developing human (Saunders Comp)

Breast Anatomy

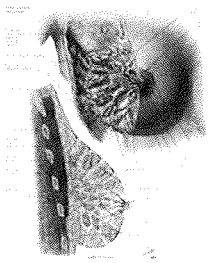
- m. pectoralis major
- m. serratus ant.
- m. obliqus ext. abdominis
- m. pectoralis minor



Netter: Atlas of human Anatomy

Breast anatomy

- **skin**
- **subcutaneus fat**
- **breast tissue**
  - ephithelial parenhymal elements
  - stroma
    - **fat**
    - **fibrous tissue**(Copper ligaments)
- **fascia**



Netter: Atlas of human Anatomy

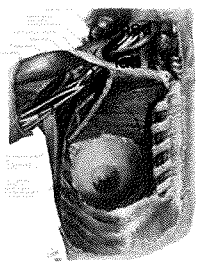
Arterial and Venous supply

ARTERIES

- a. thoracica int → rr.mammarii
- a. thoracica lat. → rr.mammarii
- rr. intercostales

VEINS

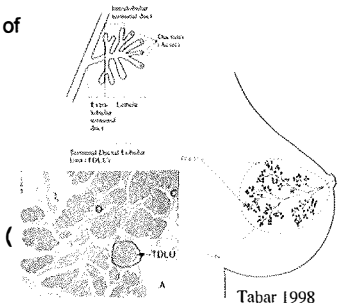
- vv. axilares
- v. subclavia
- vv. intercostales



Netter: Atlas of human Anatomy

TDLU – terminal duct lobular unit

- **TDLU is functional unit of the breast**
  - lobule
  - terminal duct
- normal size: 1 – 2 mm
- milk production
- **TDLU merge into lobes (10-15)**



Tabar 1998

Breast – pathologic changes

TDLU

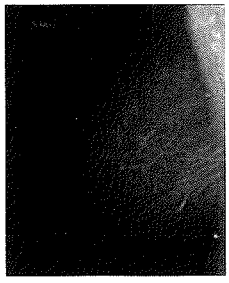
- fibrocystic changes
- cyst, adenosis ciste,apokrina metaplazija, adenoze
- DCIS, IDC

Duct

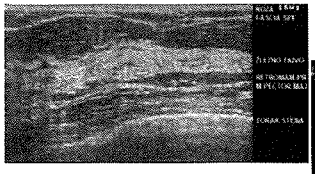
- ectasia, huperplasia
- papilloma
- paillary cancinoma

Breast - structures

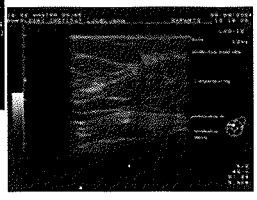
- m. pectoralis
- skin
- fat
- lymph nodes
- epithelial tissue (TDLU)
- stromal tissue (Cooper lig.)
- vessels



US - structures

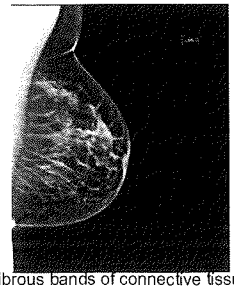


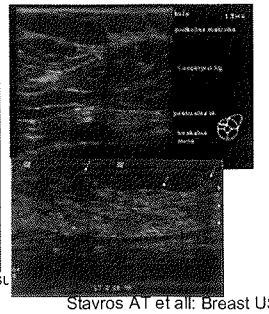
Outer upper quadrant



Inner upper quadrant

Cooper ligaments





fibrous bands of connective tissu

Stavros AT et all: Breast US , 2003

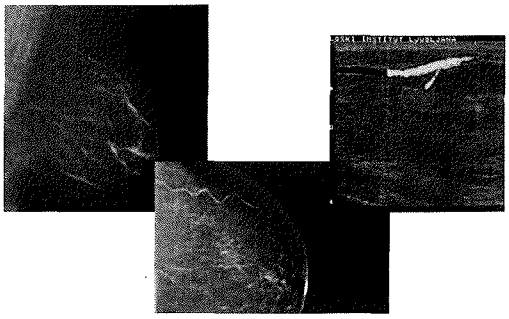
TDLU

- 1-2 mm
- size varies
- constant change
- normally not seen:
  - to small
  - isoechoic to surrounding fatty or lobular and stromal tissue

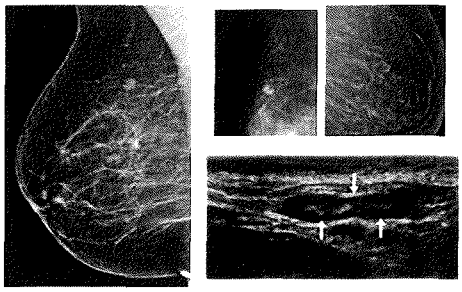
normal, atrophic, hialinized TDLU

Stavros AT et all: Breast US, 2003

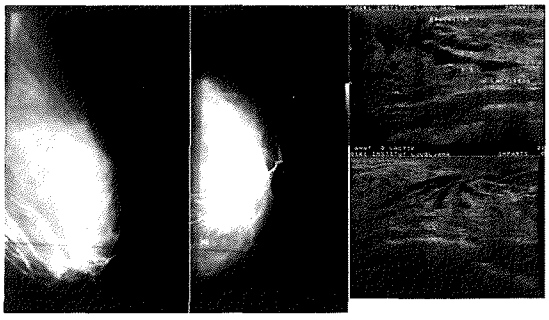
Vessels



Intramamay lymph node



Ducts



ductography

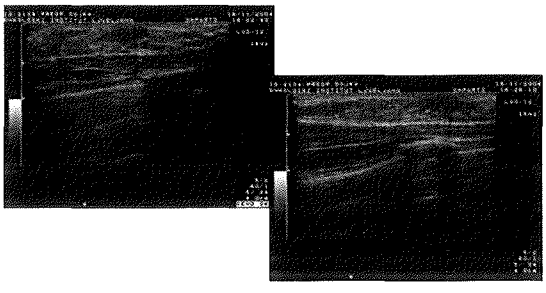
US

Breast in different life periods

before puberty: primary bud in fibrous stroma

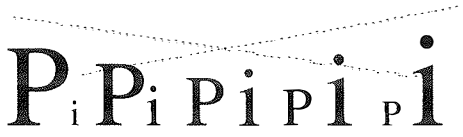
- influence of estrogen and progesteron: breast bud proliferates and enlarges
- evolution of lobes
- assimmertical development
- hyhoechoic nodules

Breast – before puberty



Brest – adult female

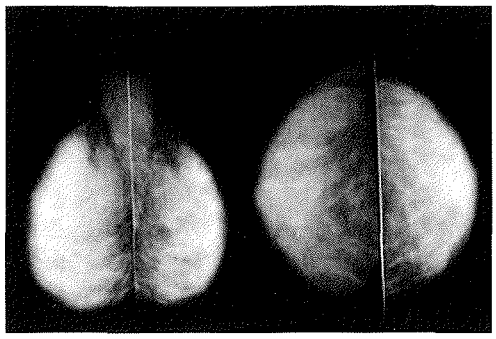
- before ovulation: proliferation of ephytelial breast tissue
- followed by involution



Breast in young females

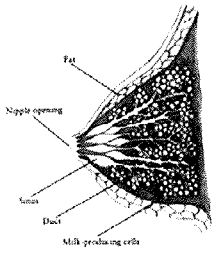
- mostly glandullar tissue
- dense structure, not suitable for mammography
- US: hypoechoic structures,nodules

Gosta, mlada dojka



Pregnancy/Lacation

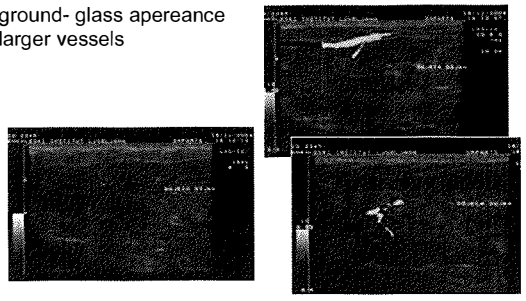
- during the onset of pregnancy development of breast is comleted
- dense breast
- ↑ number and size of TDLU
- mmg only in high suspition of ca presence after lactation



Pregnancy/lactation

:

- ground- glass apereance
- larger vessels



Fibrocystic changes

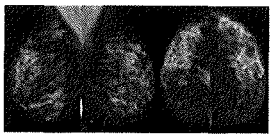
- 4th, 5th decade
- increased fibrosis, dilation of lobules
- breast pain, tenderness or assimptomatic
- mmg: increased density due to srtomal fibrosis, multiple cysts, MC

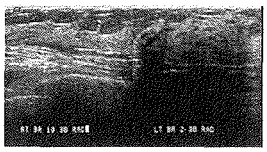
Fibroglandular tissue

- in 32% cause of palpable lump
- due to normal interlobular stromal elements protruding into subcutaneus fat
- reporting negative results increases biopsy rate
- reporting normal breast strucures- more confidence for patient and doctor (focal fibrosis, cysts, fat lobule)

Accessory gland

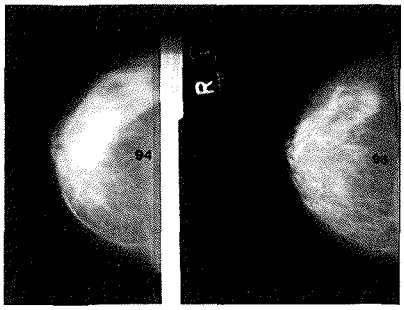
- anywhere along milkline
- most frequent part is axillary tail
- cause of focal assimetry or palpable lump
- may not drain into nipple
- may develop secteroty changes and severe





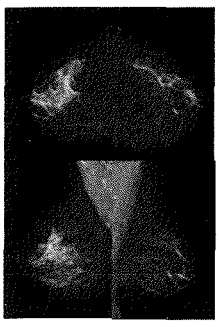
Stavros AT et all: Breast US 2003

Involutive changes



Global asymmetry

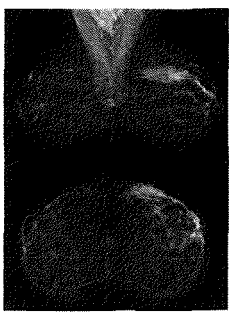
- grearer volume of fibroglandular tissue in one breast
- occupying at at least one quadrant
- without ass. mass, MC, structure distortion
- normal variant
- < 2% of mlg



BI-RADS , 2003

Focal asymmetry

- smaller asymmetry, less than one quadrant
- two projections
- no convex- outvard contures
- island of normal breast tissue
- < 0.67% mlg

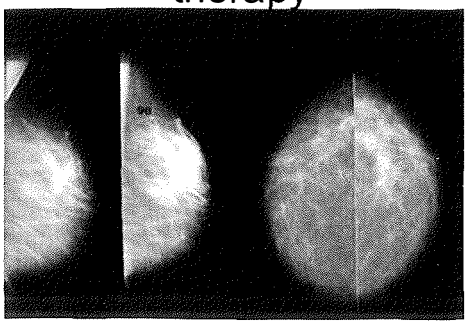


BI-RADS, 2003

Developing asymmerty

- new or larger than prior mmg
- due to hormone replacement (normally bilateral)
- 13-27% of mlg

Hormone replacement therapy

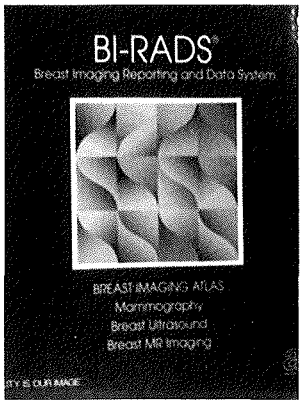


5th International School of Breast Imaging
Ljubljana, 29th-31th March 2012

BI-RADS

Breast Imaging Reporting and Data System

Hertl Kristijana, MD, MSc
Institute of Oncology
Ljubljana
Slovenia



Radiologists often use in their reports

different expresions for the same lesion and no conclusion

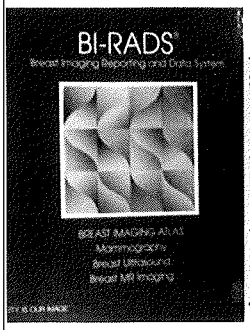
opacity

lesion

mass

how serious are the lesions we described and what are our suggestions

Main goals of BIRADS lexicon



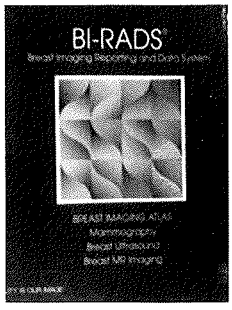
- BREAST IMAGING LEXICON
Standardize terminology- same expresions for the same changes

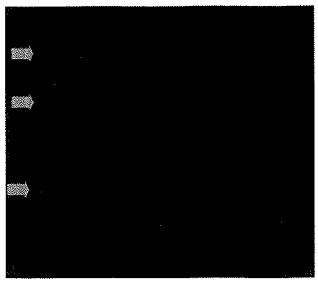
- REPORTING SISTEM
Final assessment categories

- REPORT ORGANISATION
Standardize mammographic reports

- to avoid misinterpretation

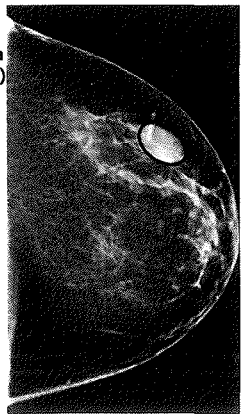
1. BREAST IMAGING LEXICON





BI-RADS, 4th Edition

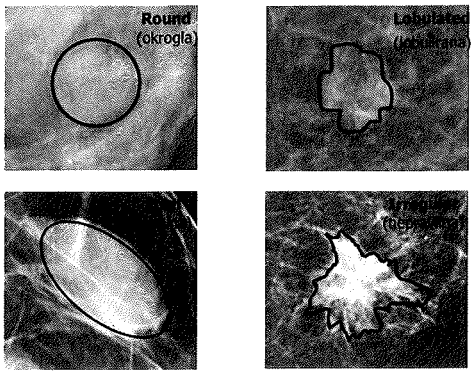
MASS
(tumorska formacija)



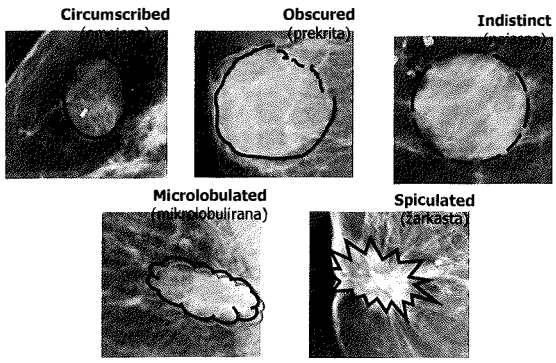
- a space occupying lesion (3D)
- seen in two different projections
- convex outward borders

MASS

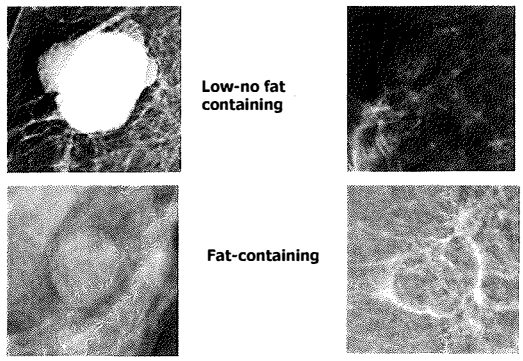
MASS
Shape (oblika)



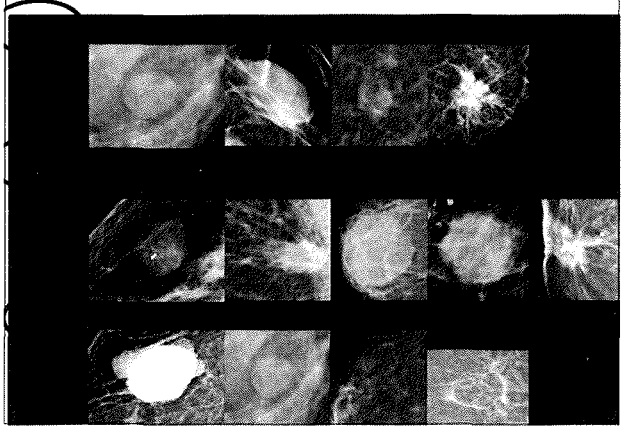
MASS
margins **(robovi)**



MASS
density **(gostota)**



MASS

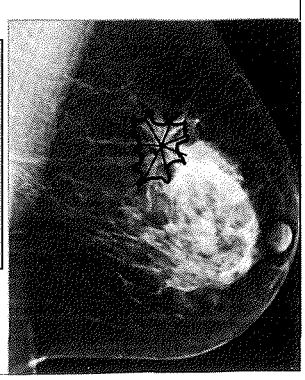


BI-RADS Mammography, 4th Edition

ARCHITECTURAL DISTORTION (stukturna motnja)

- normal architecture distorted
- thin lines (spiculations) radiating from a point
- no features of a mass or focal asymmetry
- concav outward borders

Cancer, radial scar, postop fibrosis

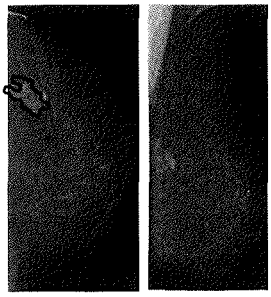


BI-RADS Mammography, 4th Edition

Focal Asymmetry
Asymetric Density
(asimetrična zgostitev)

- not fit criteria of a mass
- similar shape on two views
- volume < than one quadrant
- concav- convex outward borders

Cancer, ectopic breast tissue



2. REPORTING SYSTEM

BI-RADS ASSESSMENT CATEGORIES

BI-RADS Mammography, 4th Edition

BIRADS 1

BIRADS 2 ??

BIRADS 4A ??

BIRADS 4B ??

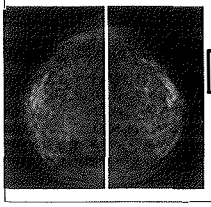
BIRADS 5 ??

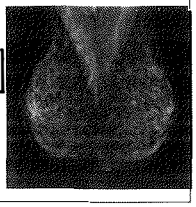
BI-RADS **0**

Additional (noninvasive) evaluation needed
before final assessment
(additional views, US, previous films...)

BI-RADS **1**

routine follow-up

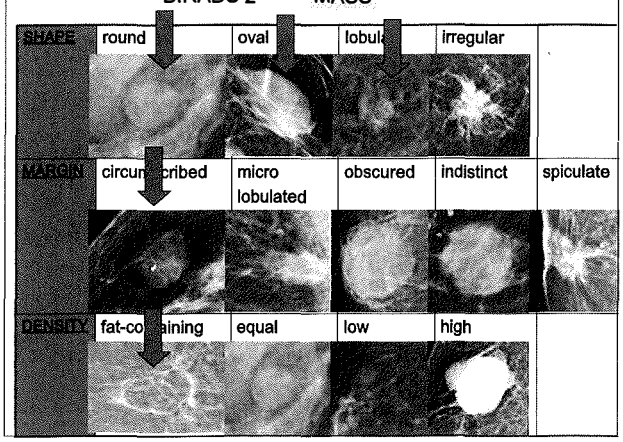




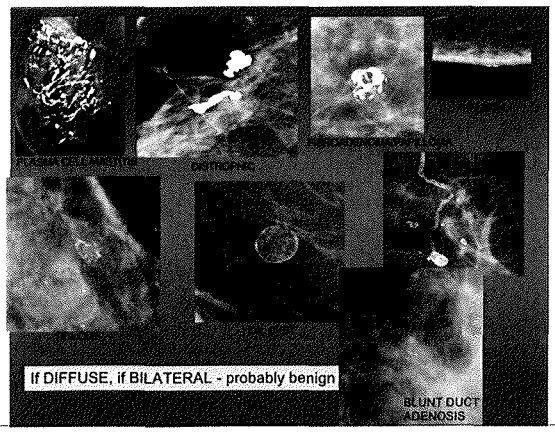
BI-RADS **2**

routine follow-up

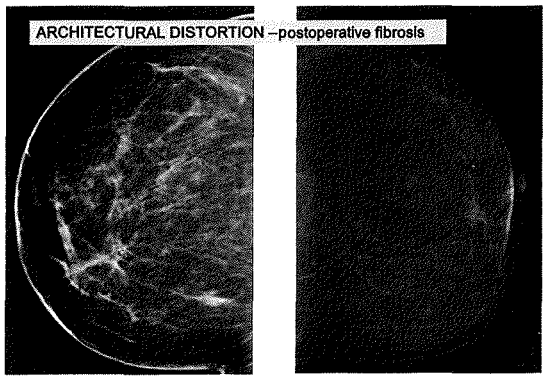
BIRADS 2 MASS



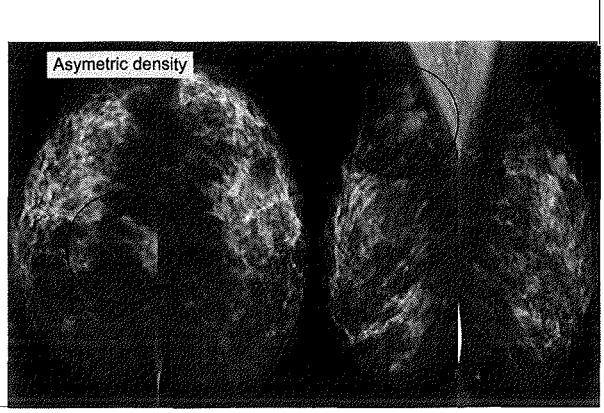
BIRADS 2 MICROCALCINATION



BIRADS 2



BIRADS 2

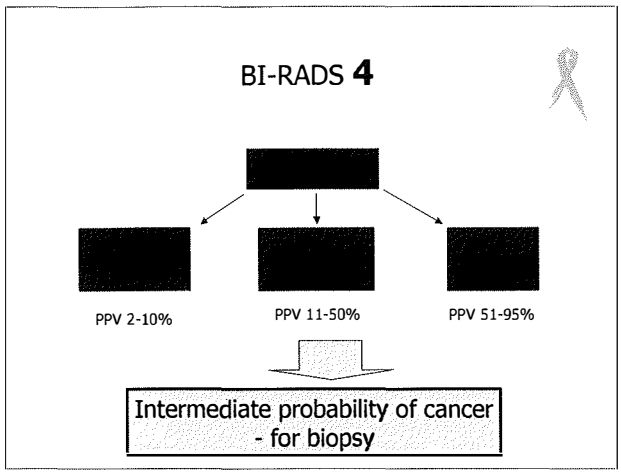


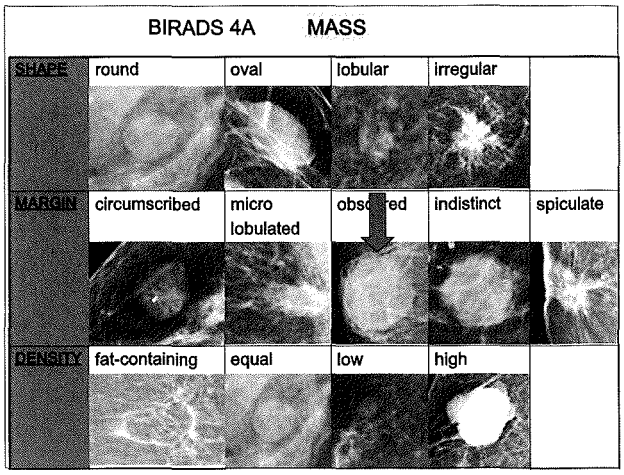
BI-RADS **3**

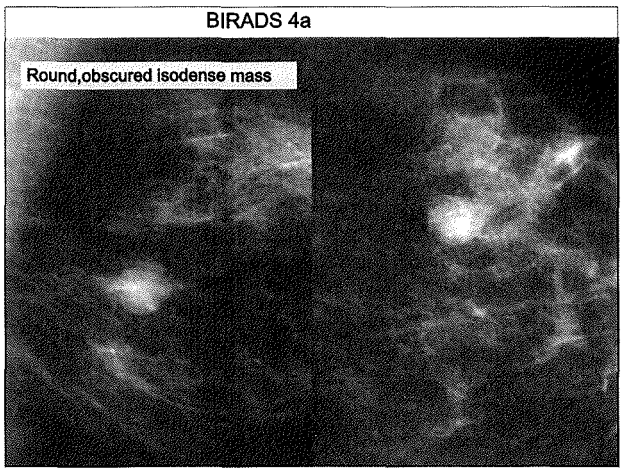
PPV<2%

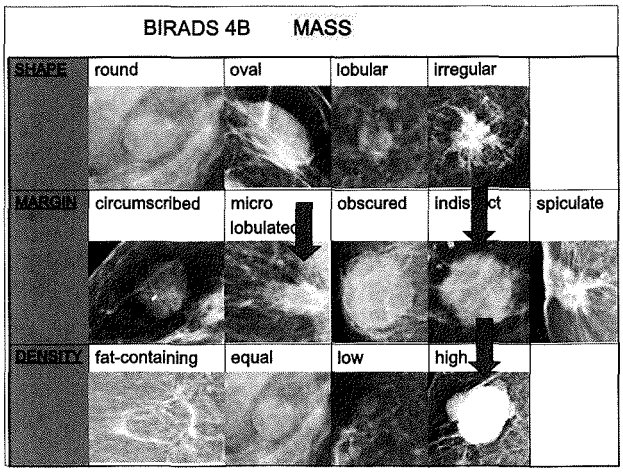
short interval follow-up
-usually in 6-12 months

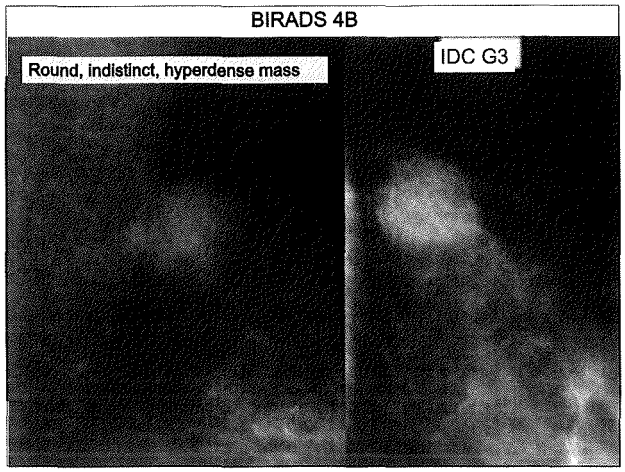
Not recommended!!!!!

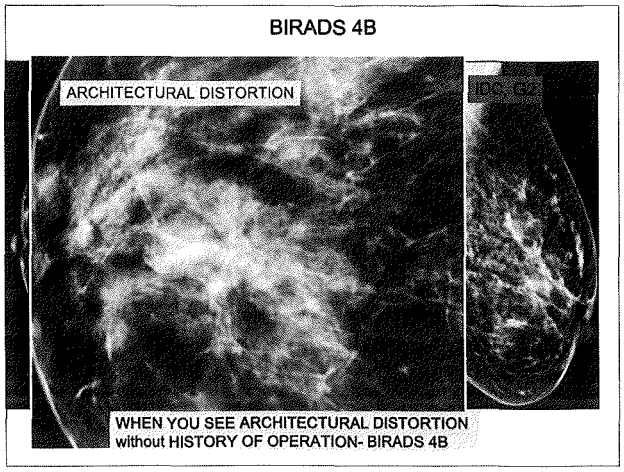

BI-RADS 4
PPV 2-10%
PPV 11-50%
PPV 51-95%
Intermediate probability of cancer
- for biopsy


BIRADS 4A MASS
SHAPE
round
oval
lobular
irregular
MARGIN
circumscribed
micro lobulated
indistinct
spiculate
DENSITY
fat-containing
equal
low
high

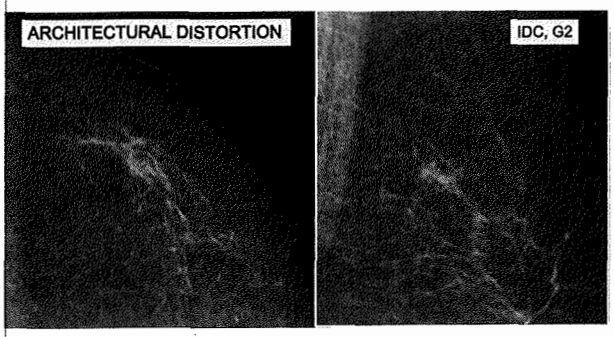

BIRADS 4a
Round,obscured isodense mass


BIRADS 4B MASS
SHAPE
round
oval
lobular
irregular
MARGIN
circumscribed
micro lobulated
obscured
spiculate
DENSITY
fat-containing
equal
low
high

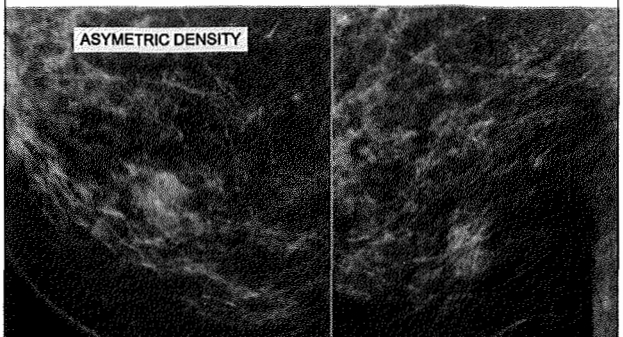

BIRADS 4B
Round, indistinct, hyperdense mass
IDC G3


BIRADS 4B
ARCHITECTURAL DISTORTION
IDC G2
WHEN YOU SEE ARCHITECTURAL DISTORTION
without HISTORY OF OPERATION- BIRADS 4B

BIRADS 4B



BIRADS 4B

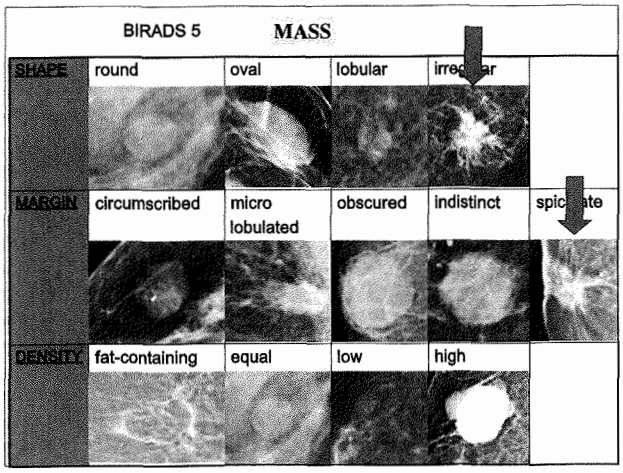


BI-RADS **5**

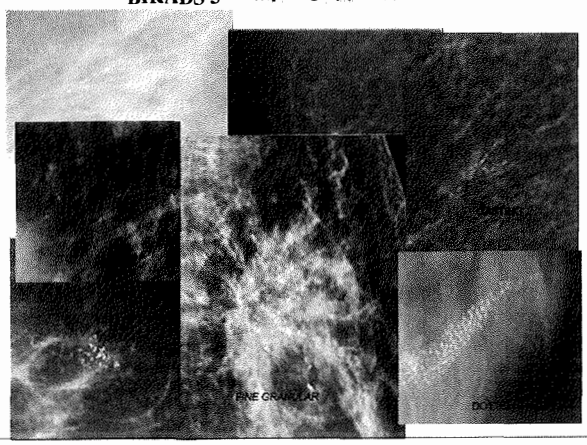
PPV>95%

High probability of cancer - for biopsy

BIRADS 5 MASS



BIRADS 5 MICROCALCINATION



BI-RADS **6**

Appropriate action should be taken.

BI-RADS ASSESSMENT CATEGORIES

[redacted]

REPORT ORGANISATION

Indication:

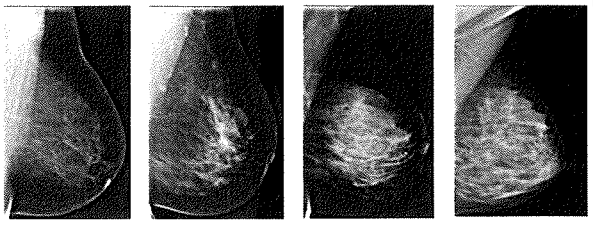
Breast composition:

Findings:

Comperison to previous study:

[redacted]

Mammographic Breast Composition



ACR 1 <25%

ACR 2 25-50%

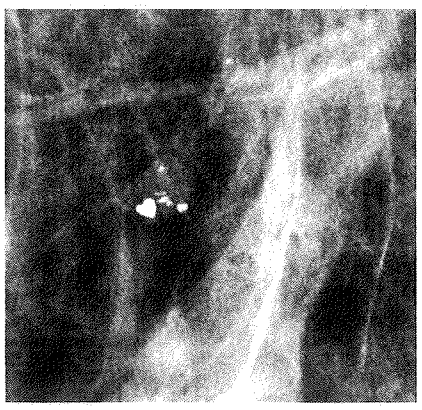
ACR 3 50-75%

ACR 4 >75%

In conclusion

[redacted]

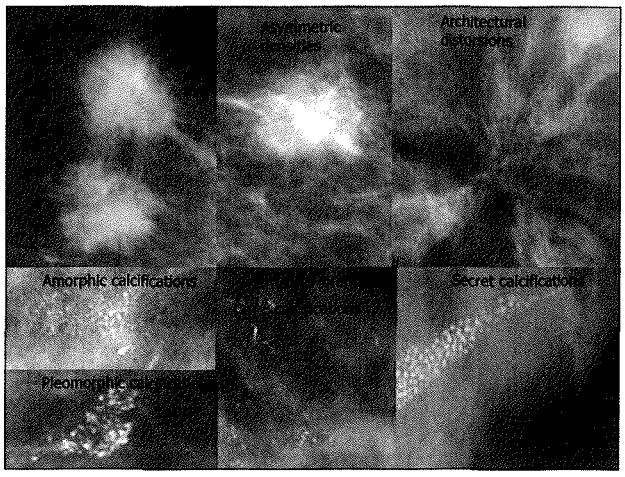
Thank you



5th international mammography school
Ljubljana, 29th – 31st March 2012

Microcalcifications

Margrit Reichel
Screening Reference team



What emphasis is laid on microcalcifications compared with masses?

Challenge for the radiologist

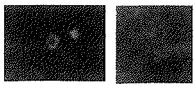
	Detection	Differentiation
micro-calcifications	E	D
masses	E	D

Historical overwiew

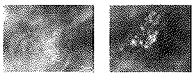
- 1913 First representation by Salomon
- 1934 Plasma cell mastitis by Finsterbusch and Groß
- 1951 und 1980
  Egan (1964) – Menges (1973) - LeGal et al.(1976) Moskowitz (1979)
- 1951 Leborgne found 30 % of the malignant tumors associated with calcifications

Description of Microcalcifications today

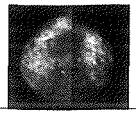
<u>Shape of the calcifications:</u>
rund, oval, linear



<u>Clusters of calcifications:</u>
amorphic, pleomorphic



<u>Distribution:</u>
single, clusters, scattered



The stop period ended with

examinations of Lanyi 1983 - 1985

The accurate comparison with the

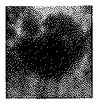
histopathologic-radiologic analysis

of the false negativ and false positive cases

leads to the possibility to differatiate

benign from malignant calcifications

Microcalcifications

in the lobules 

or

in den ducts 

or

outside of lobules and ducts

Microcalcifications

which do not need further assessment both

in

screening

and

diagnostic

Benign calcifications
outside of lobules and ducts

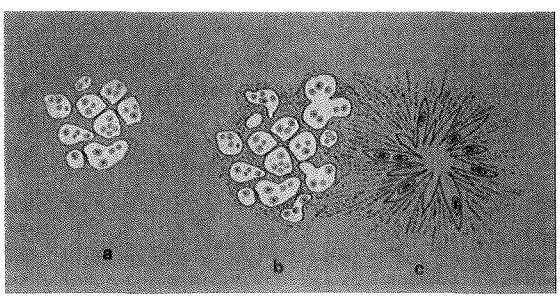
1. Calcified arteries
2. Plasma cell mastitis type
3. Fibroadenomas
4. Calcified cyst wall
5. Calcified sebaceous glands
6. Egg shell like calcifications
7. Fat necrosis
8. Oil cysts

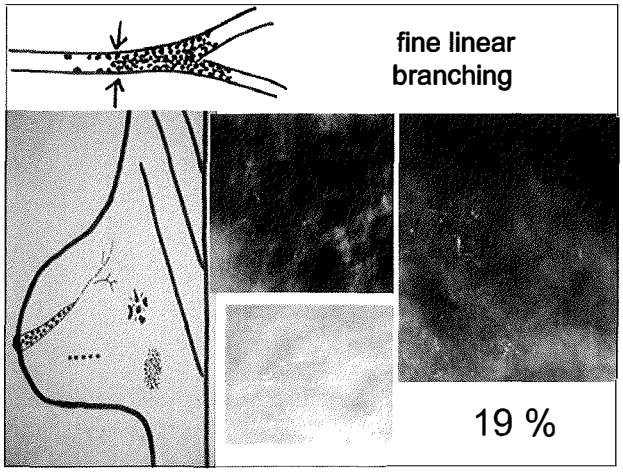
Benign calcifications localized within lobules

Fibrocystic change

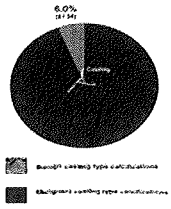
1. Blunt-duct-Adenosis
2. Adenosis
3. Milk of calcium

Sklerosing Adenosis
Lanyi

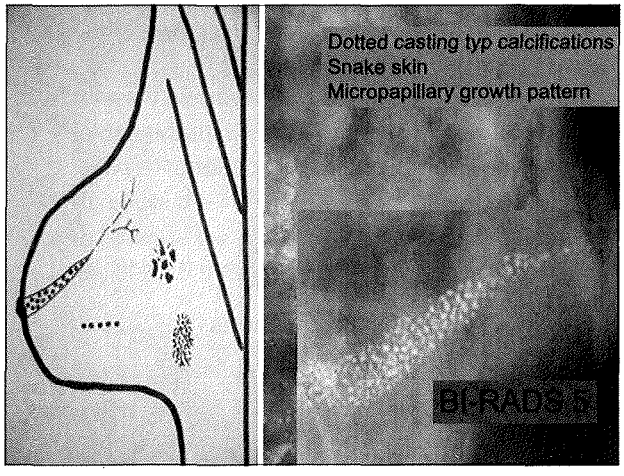




Kopparberg County, Schweden

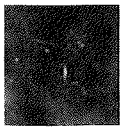


BI-RADS 5

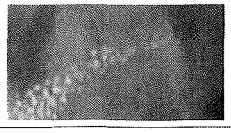


BI-RADS 5

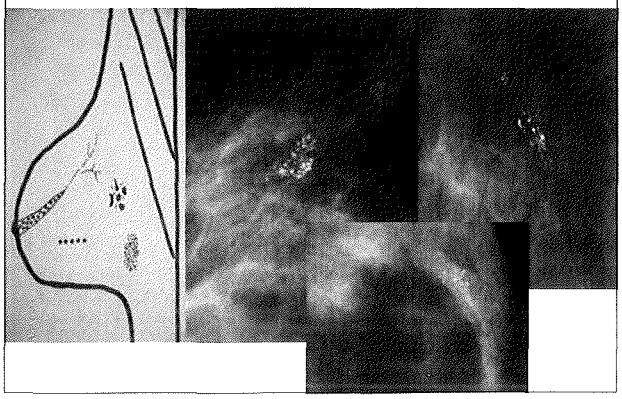
- Linear branching



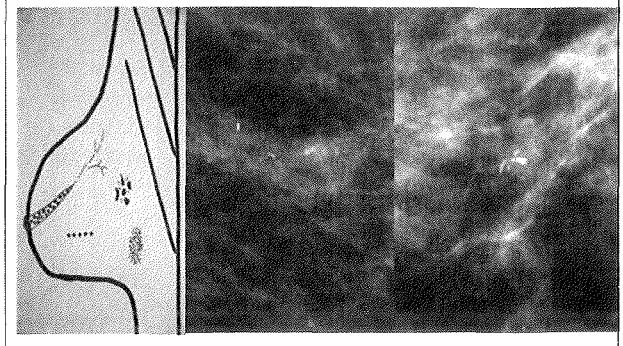
- Dotted casting type calcifications



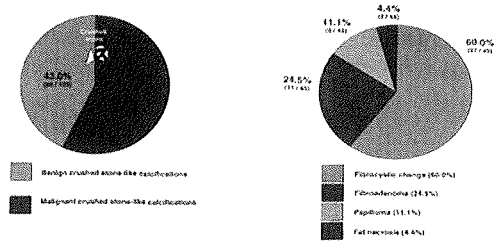
Cluster of pleomorphic calcifications



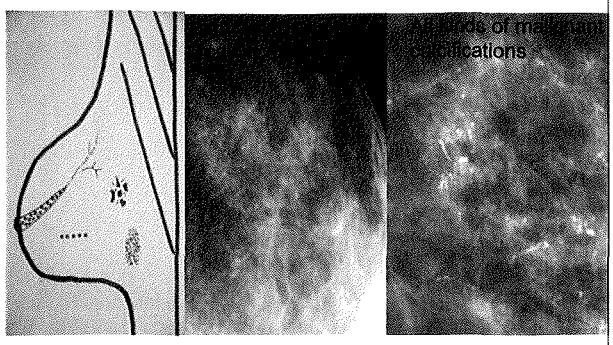
Question mark Needle tip



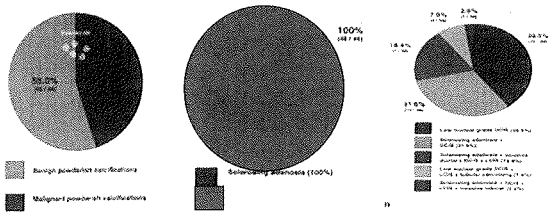
Kopparberg County, Schweden



BI-RADS 4 - 4a - 4b



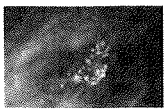
Kopperberg County, Schweden



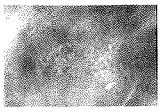
BI-RADS 4 - 4a - 4b

BI-RADS 4 – 4a – 4b

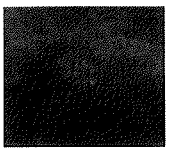
- Pleomorphic calcifications

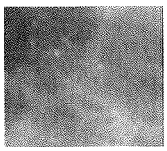


- Amorphic calcifications



- Clustered calcifications demand a biopsy undependend of the shape of the single calcifications





- Exception: Blunt duct Adenosis

US of axilla

Maja Music, MD, PhD
Inst. of Oncolgy
Ljubljana

Breast cancer - lymph node status

- ✓the most important prognostic factor
- ✓important in planning of surgical procedures
- ✓ or preoperative treatment (neoadjuvant chemoteraphy)

Sentinel lymph node Biopsy – SNLB

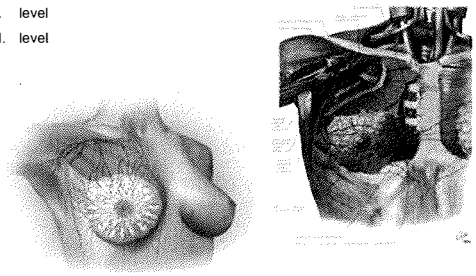
SLN: first node that a tumor drains in

Preoperative US of the axilla

- ✓clinically negative axilla
- ✓to detect patients with lymph node metastasis at initial imaging
- ✓to reduce the number SLNB
- ✓to optimise the treatment in patients with non-palpable LN metastasis

Lymphatic drainage of the breast

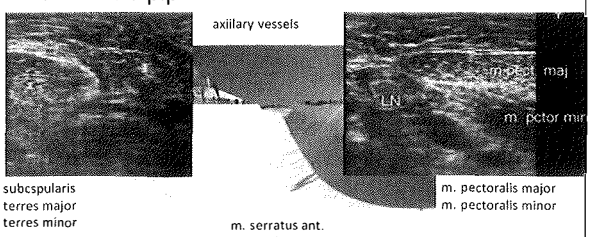
I. level
II. level
III. level



Netter: Atlas of human Anatomy

Preoperative axilla – the technique

- ✓linear probe (at least 10-12 MHz)
- ✓level I "half-pipe"



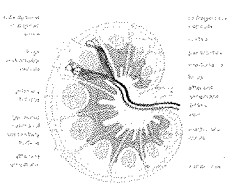
Preoperative axilla – where to look

- ✓ SLN mainly in the low axilla - in level I
- ✓ in 75% SLN is the lowest identifiable LN

LN, identified to be SLN

Britton P. et all: Clin Radiol 2010

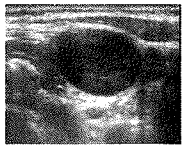
Normal lymph node

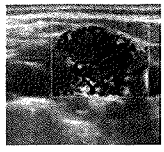


Roit: Immunology 2000

oval shape
hypoehoic, thin cortex
hyperehoic hilum
hillar type vascularisation

1.infiltration of subcapsular and cortical sinuses
2. buldging of the outer contour
3. displacement of hilum
4. rounded shape
5. periferal vascularisation





Cortex is the key

- ✓Cortex Appearance
  - ✓Even/foccaly thickened
  - ✓isoehoic/ hypoechoic
- ✓Cortical thickness measurement

  Less than 3 mm unlikely to be malignant
  - ✓ 88% sensitivity
  - ✓ 75% specificity

Egen et all: Eur Rad 05
Deurloo et all: EJC 03
Choi YJ. Breast 2009

Results of axillary ultrasonography

Non-palpable nodes only / Morphology

Study	n	Sensivity (%)	Specificity (%)
Van Rijk et al. 2006	732	35	82
Bedrosian et al. 2003	208	26	91
Deurloo et al. 2003	268	41	88
Bonnema et al. 1997	150	35	96
Alvarez et al. 2006	Meta	26-76	88-98

Moderate sensitivity and high specificity to detect lymph node metastases can be obtained using morphologic criteria only

Combination of axillary US and FNAB

Results for non-palpable nodes that underwent FNA

Study	n	Sensitivity (%)	Specificity (%)	Reduction in SLNB (%)
Van Rijk et al. 2006	176	62	99	24
Bedrosian et al. 2003	22	25	100	
Deurloo et al. 2003	66	76	100	25
Bonnema et al. 1997	81	80	100	
Podkrajsek et al. 2005	165	84	91	30
Alvarez et al. 2006	Meta	44-95	97-100	

Sensitivity and specificity can be increased by combining ultrasonography with FNA

Reduction of SNB up to 30%

Preoperative US of the axilla

- ✓normal US of the axilla – 28% of pos SLN
- ✓ suspitious US/ neg FNAB – 26-29% of positive SLN

Glissen et all, EJSO 2008
Jain et all, Ann Surg oncol 2008

FNAB/ Core Needle Biopsy

	sensitivity	specificity
FNAB	75%	100%
Core needle biopsy	82%	100%

The current data **do not** support the rutine use of CNB over FNAB for preoperative axillary staging in breast cancer patients with clinically negative axillas.

Rao et all; Ann Surg Oncol, 2009

Does using CE- US help?

- ✓i.v. application – no benefit
  Podkrajšek M. Coll Antropol. 2011
- ✓peritumoral admision of microbubbles for visualisation of breast lymphatics and SLN
- ✓visualisation of SLN in 40% of patients with US negative axilla, followed by biopsy

Server AR et all, Clin Rad 2012, in press

Take home message

- ✓US evaluation of the axilla with biopsy is valuable component in multidisciplinary approach to treatment of patients with breast cancer
- ✓Look for the lowest LN in axilla
- ✓Cortex thickness ≥ 3 mm

5th International School of Breast Imaging
Ljubljana, 29th – 31 March 2012

Breast Ultrasound

Harald Rott
GP Rott & Schön
Spezielle Ultraschalldiagnostik
Köln

www.ultraschall-frauenheilkunde.de

The History of Breast Ultrasound

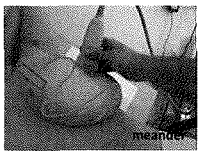
J Ultrasound Med. 2004 ; 23 ; 887-894

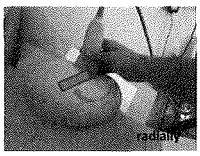
In the fifties: A-Mode (Wild a. o.)
End of the fifties: 2D-US, just black & white
End of the sixties: grey scale , B-Mode, „brightness modulation" (Kossoff a. o.)
In the seventies: first breast-ultrasound-machines (waterbathscanner)
In the eighties: hand-held real-time-scanner

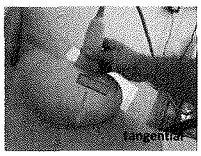
Examination technique

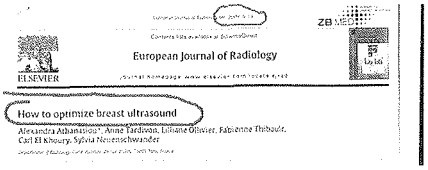
- **Supine position**
- **Raised arm**
- **Slightly inclined position**

A system is important !!



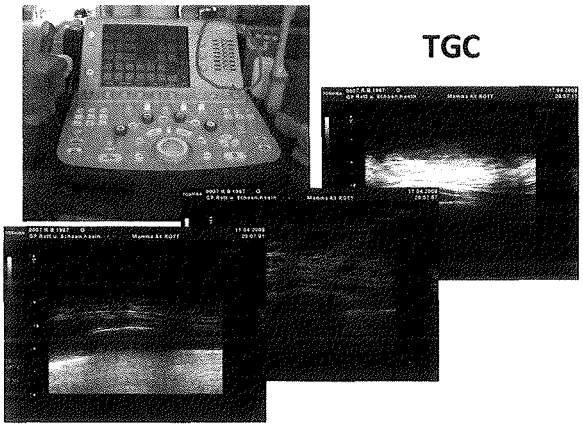




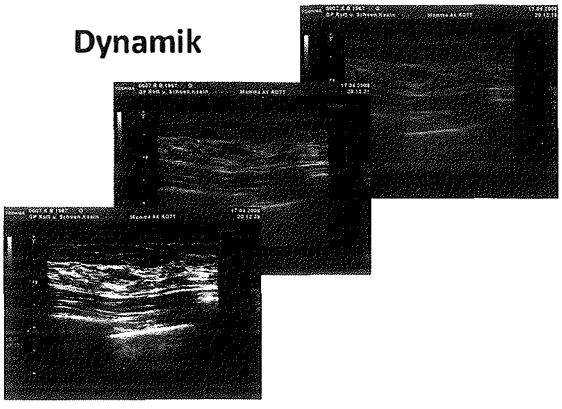


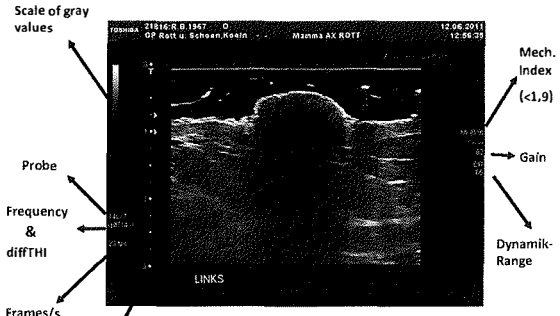
B-Mode grey-scale
Harmonic imaging
Compound imaging
Color doppler and Power doppler
Elastography
3D-Ultrasound
Computed aided diagnosis (CAD)

TGC

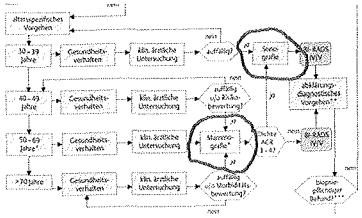


Dynamik



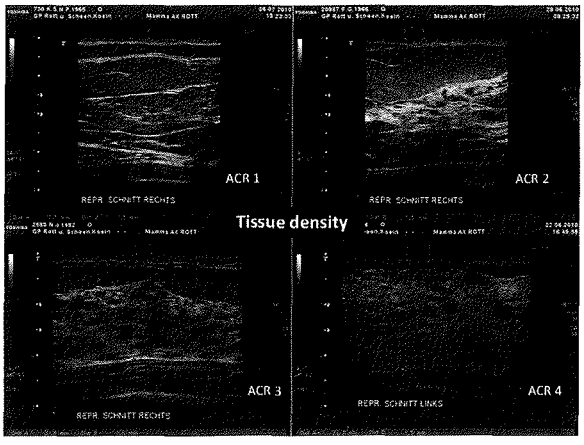


Device settings



S3-Guidelines 2008

Albert, U. et al, Senologie 2008, 5:39-49



Palpable nodule /

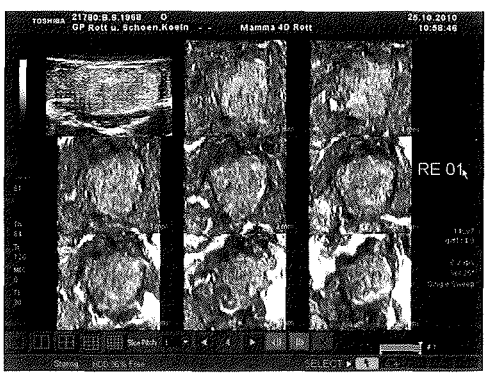
Indication: Palpable nodule

BI-RADS-similar DEGUM-criteria of ultrasound findings of the brest –
A Consensus of the working group „breast ultrasound", DEGUM

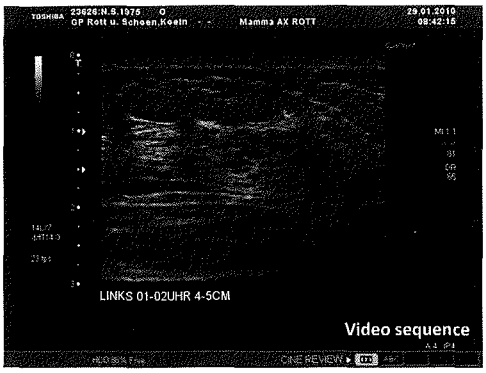
Lokalization	Side, Watchface, Nipple- and Skin distance
Tumor size	3 perpendicular axes & maximal diameter
Shape	Round shape, oval, irregular
Axis	Horizontally, vertikal, indifferent, not measurable
Margin	Plain, lobed, microlobulated, andrismet, spiculated,
Hyperechoic hem	Existing, not existing
Echogenicity	Anechone, hypo- , iso-, hyperechoic, complex
Sound transmission	Weakened, indifferent, reinforced, mixed
Calcifications	Macro- (>0,5 mm), Microcalcifications, in lesion,
Compressibility	Fine, little, not compressible
Movability	Fine, little, not displaceble
Environment change	Architectural distortions, Edema, Cooper-Lig.,
3D-Criteria	Compression pattern, Retraction pattern
Blood flow	Lokalization, Quantity, Vascular pattern
Ducts	Proper, dilated, irregular, anechoic, inclines
Lymph nodes	Region, unsuspicious, suspicious, size
Special cases	Botryoidal Microcysts, compl. cysts, LN...

Madjar et al., Ultraschall in Med. 2006; 27: 374 - 379

Palpable nodule /



Palpable nodule /



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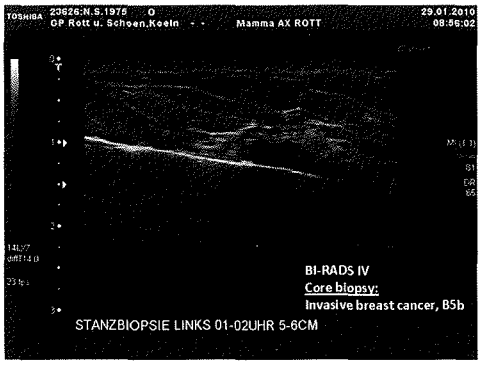
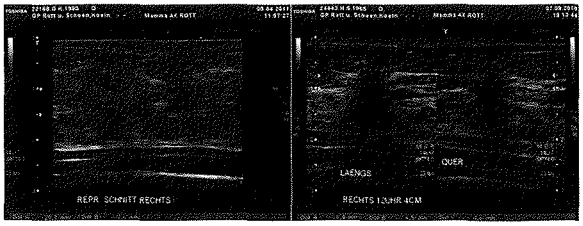
Madjar et al., Ultraschall in Med. 2006; 27: 374 - 379

Palpable nodule / Intervention /



Palpable nodule / intervention / mammography /

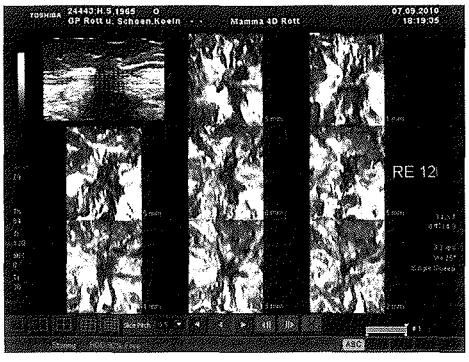


ACR 3 & 4

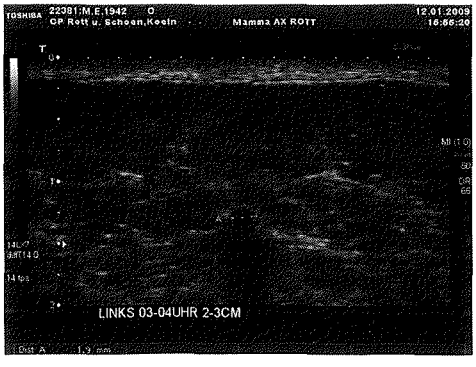
BI-RADS 0, 3, 4, 5

Indication: Dense breasts / Suspicious mammography

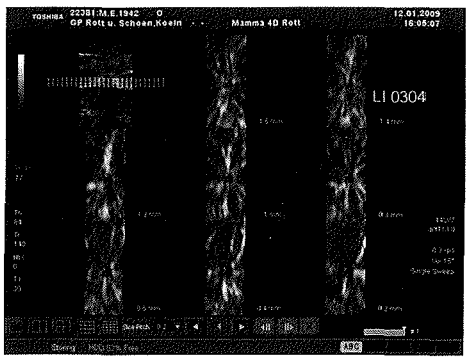
Palpable nodule / intervention / mammography /

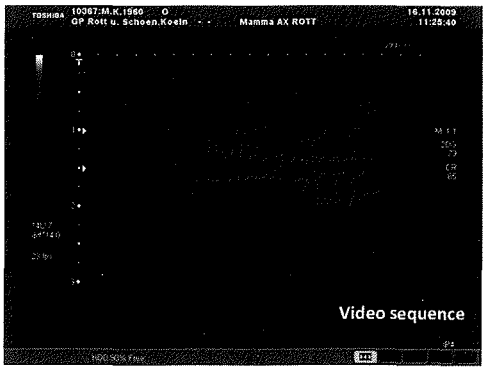


Palpable nodule / intervention / mammography /



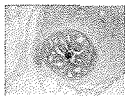
Palpable nodule / intervention / mammography /





Sensitivity of Mammography and Ultrasonography on Detecting Abnormal Findings of Ductal Carcinoma *in Situ*

D. Boonjunwetwatmd et al ; J Med Assoc Thai 2007 Mar ;90(3) : 539-45



Original Article

Ultrasound Demonstration of Mammographically Detected Microcalcifications in Patients with Ductal Carcinoma *in situ* of the Breast

Nagashima T et al. ; Breast Cancer 2005;12(3):216-20

Microcalcification Detection
in
3-D Breast Ultrasound

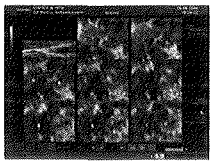
R.F. Chang et al ; Conf Proc IEEE Eng Med Biol Soc 2005 ; 6 : 6297-300

Reducing Motion Artifacts in 3-D Breast Ultrasound Using Non-linear Registration

MICCAI 2008, Part II, LNCS 5242, pp.998-1005
Springer-Verlag, Heidelberg

- Hand-held 3D-US: cone-shaped image volumes
- Automated full-field breast US-Scanner
- Computer-aided detection systems

- Transducer-Sweep induced artifacts
- Tissue deformation



US-Guided Vacuum-Assisted Biopsy of Microcalcifications in Breast Lesions and Long-Term Follow-Up Results

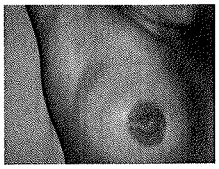
Korean J Radiol 9(6), December 2008, 503-509

02/2002 – 02/2006, 62 breast lesions
Philips HDI 5000, 12-MHz-probe
No false-negative after > 2 years Mammo-Follow-up
2 of 27 in-situ-lesions upgrade to invasive after tumor removal
1 of 3 ADH upgrade to DCIS after tumor removal

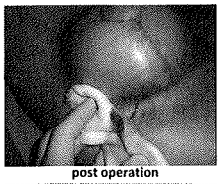
Quantity compared (microcalcifications): No differences

Conclusion: US-guided vacuum-assisted biopsy can be an effective alternative to stereotactic management in cases where microcalcifications are visble with the use of high-resolution US.

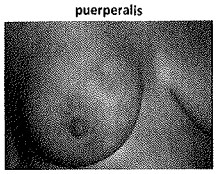
Palpable nodule / intervention / mammography / mastitis /



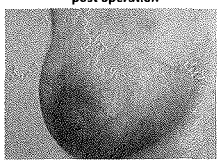
puerperalis



post operation



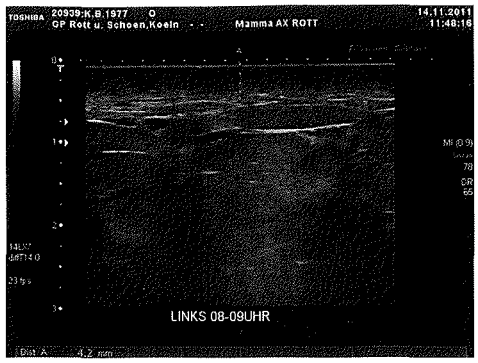
non-puerperalis



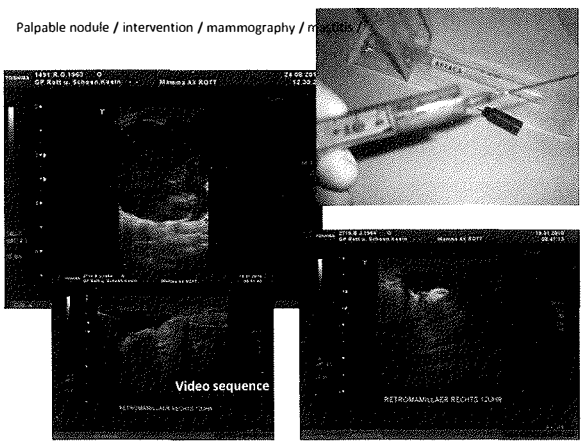
malignant

Indication: Mastitis

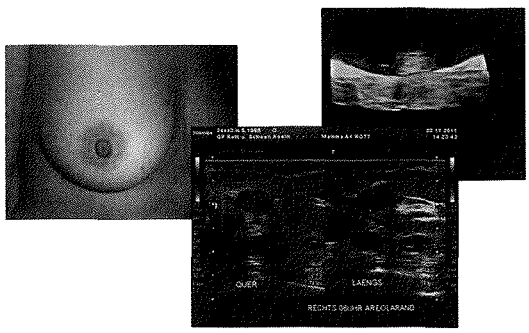
Palpable nodule / intervention / mammography / mastitis /



Palpable nodule / intervention / mammography / m

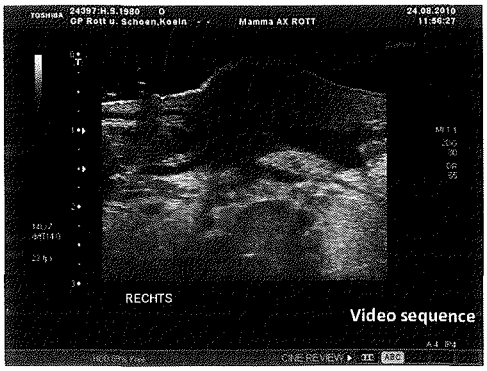


Palpable nodule / intervention / mammography / mastitis / nipple secretions /

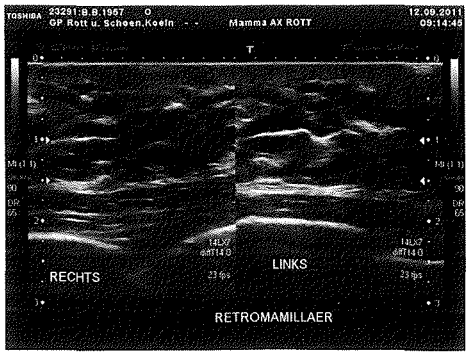


Indication: Nipple secretions

Palpable nodule / intervention / mammography / mastitis / nipple secretions /



Palpable nodule / intervention / mammography / mastitis / nipple secretions /



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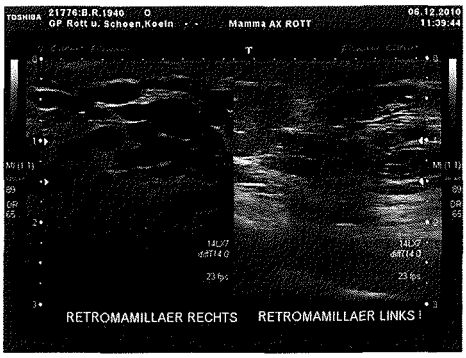

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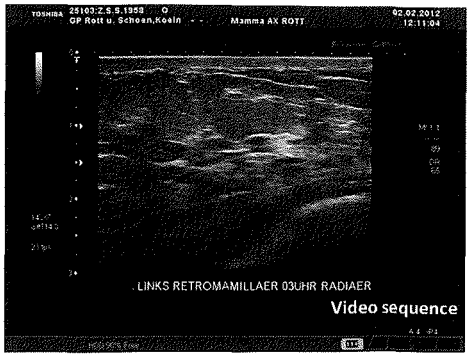
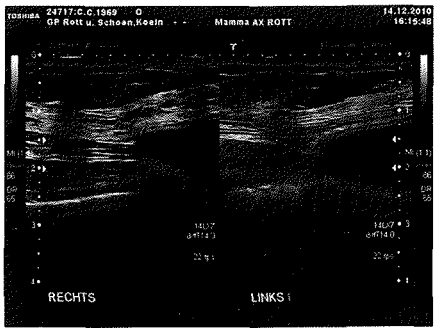
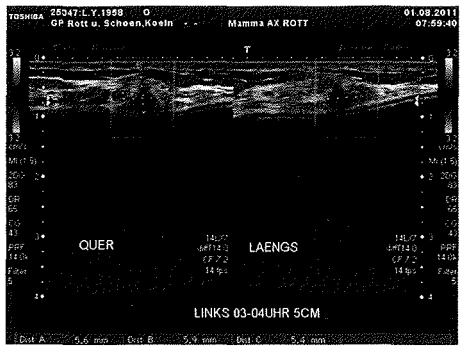


Palpable nodule / intervention / mammography / mastitis / nipple secretions /
Augmentation & reconstruction /



Indication: Augmentation / Reconstruction

Palpable nodule / intervention / mammography / mastitis / nipple secretions /
Augmentation & reconstruction /

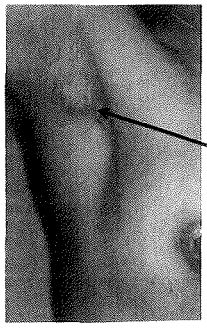


Invasive lobular breast cancer pT1b

Palpable nodule / intervention / mammography / mastitis / nipple secretions /
Augmentation & reconstruction /

Latissimus dorsi flap

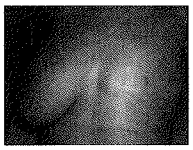
Palpable nodule / intervention / mammography / mastitis / nipple secretions
/Augmentation & reconstruction / Axilla /



Axilla-Ultrasound

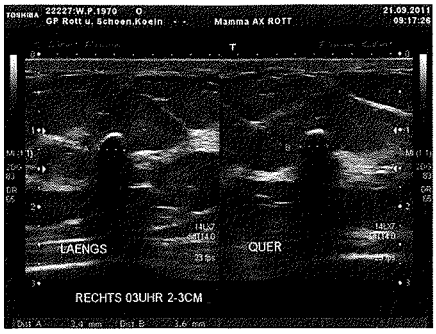
Special other lecture !

Palpable nodule / intervention / mammography / mastitis / nipple secretions /Augmentation & reconstruction / Axilla / Cancer folow-up /

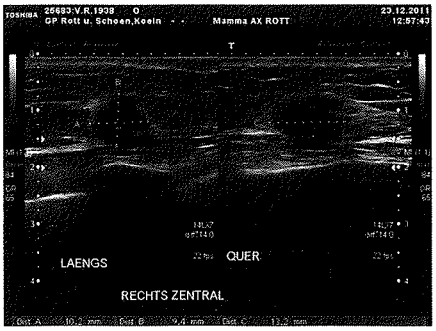


Indication: Cancer follow-up

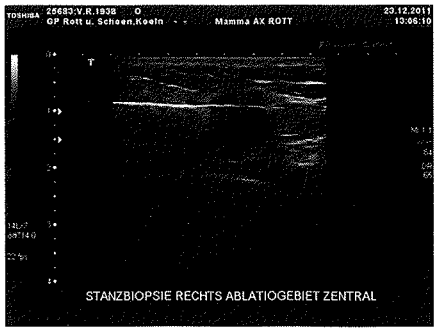
Palpable nodule / intervention / mammography / mastitis / nipple secretions /Augmentation & reconstruction / Axilla / Cancer folow-up /



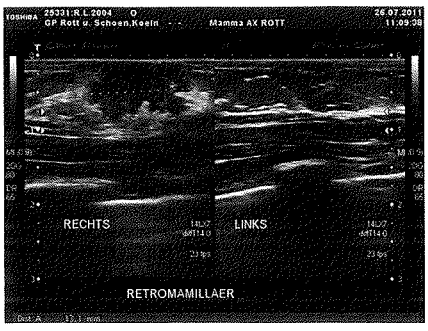
Palpable nodule / intervention / mammography / mastitis / nipple secretions /Augmentation & reconstruction / Axilla / Cancer folow-up /



Palpable nodule / intervention / mammography / mastitis / nipple secretions /Augmentation & reconstruction / Axilla / Cancer folow-up /

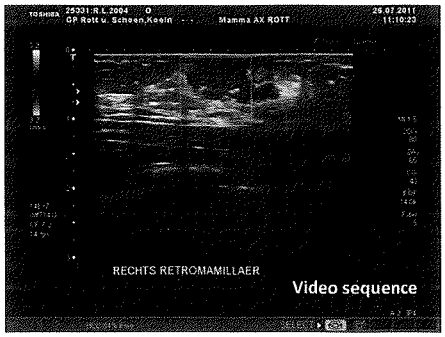


Palpable nodule / intervention / mammography / mastitis / nipple secretions /Augmentation & reconstruction / Axilla / Cancer folow-up / men & children



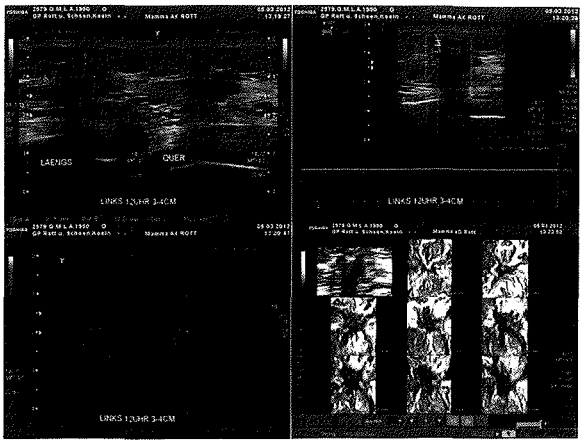
Indication: Men & children

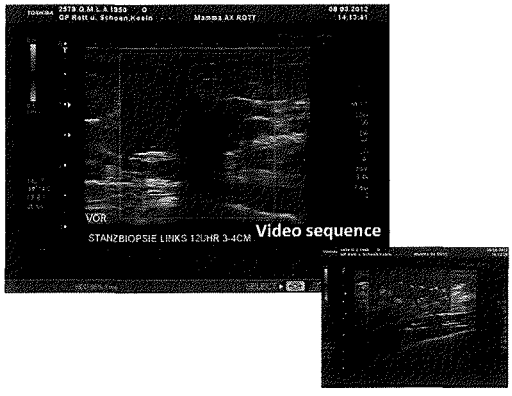
Palpable nodule / intervention / mammography / mastitis / nipple secretions /Augmentation & reconstruction / Axilla / Cancer folow-up / men & children

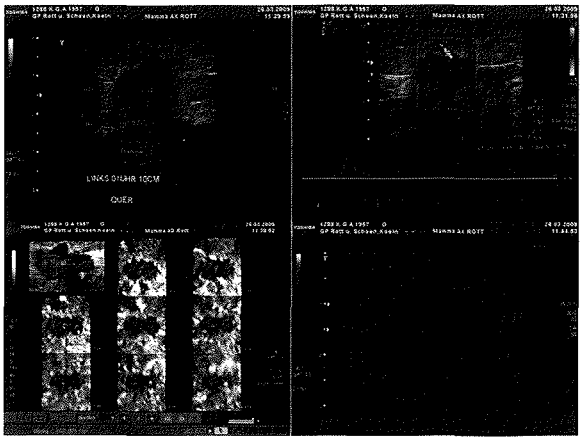


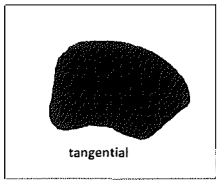
Palpable nodule / intervention / mammography / mastitis / nipple secretions /Augmentation & reconstruction / Axilla / Cancer folow-up / men & children / familiar high-risk /

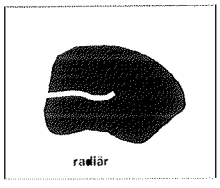
Indication: Familiar high-risk (screening)

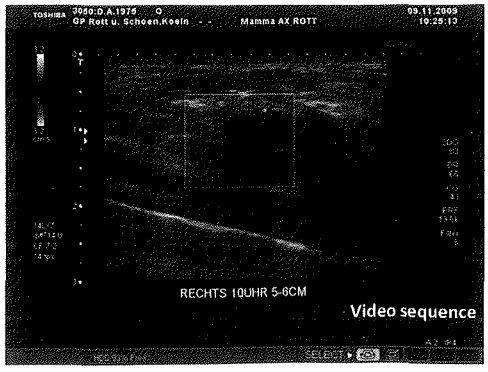


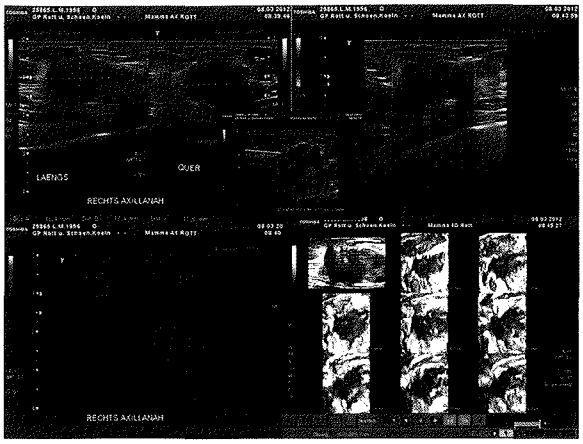


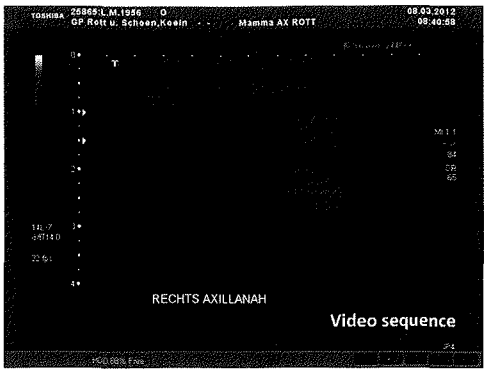


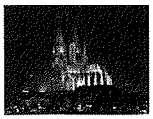




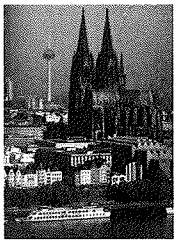








Thank you
for your attention



Harald Rott, Cologne

INTERVENTION PROCEDURES IN BREAST AND NON-PALPABLE BREAST LESIONS LOCALIZATIONS

KADIVEC Maksimiljan
HERTL Kristijana
Institute of Oncology Ljubljana
SLOVENIA

5th International School of Breast Imaging,
29th – 31st of March 2012
Ljubljana,SLOVENIA

Procedures, Image guided

1. US - Guided Fine Needle Aspiration Biopsy – NOT USED IN SCREENING !!!
2. US - Guided Core Biopsy
3. US - Guided Vacuum – Assisted Biopsy
4. Sterotactic Biopsy, Prone
5. Sterotactic Biopsy, Upright
6. MRI - Guided Vacuum – Assisted Biopsy
7. Pre –Op Lesion Localisation, Mammo (wire, isotop)
8. Pre –Op Lesion Localisation, US (wire, isotop)
9. Pre –Op Lesion Localisation, MRI (wire, isotop)
10. Imaging Guided Ablation (RFA)

US - Guided Fine Needle Aspiration Biopsy FNAB (ABTI)

Unacceptably high insufficient sampling rate for breast masses

	US		STEREOTACTIC	
	FNAB	CB	FNAB	CB
N =	2.673	1.851	5.895	6.689
Sensitivity	83,1	96,7	62,4	90,5
Specifity	84,0	98,7	86,9	98,3

Fine Needle Aspiration or Core Biopsy ?Britton PD. The Breast 1999;8:1-5

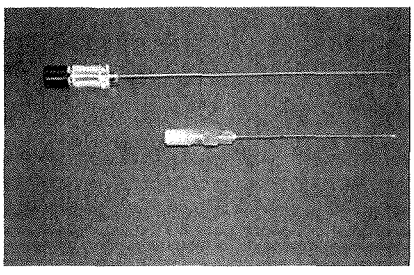
US - Guided Fine Needle Aspiration Biopsy FNAB (ABTI - aspiracijska biopsija s tanko iglo)

INDICATIONS:
1. Suspected axillary nodal metastasis
2. Suspicious palpable mass , core biopsy problematic or not available
   - Anticoagulant therapy
   - Probable complicated cyst (most commonly smal mass, smaller than 8 mm, aspirated under US)

CONTRAINDICATIONS:
1. Lack of adequately trained cytopatologist
2. Calcifications without a mass

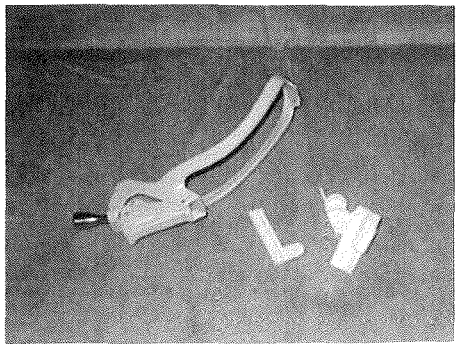
US - Guided Fine Needle Aspiration Biopsy FNAB (ABTI)

- needle 20 and 22 – gauge (0,9 mm and 0,7 mm)

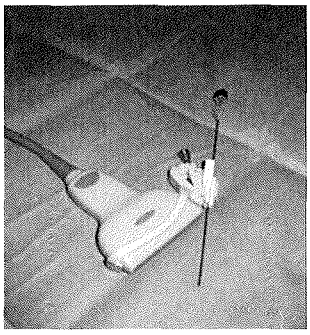


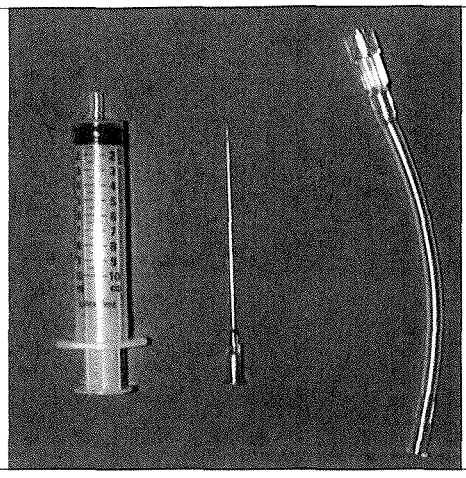
US - Guided Fine Needle Aspiration Biopsy FNAB (ABTI)

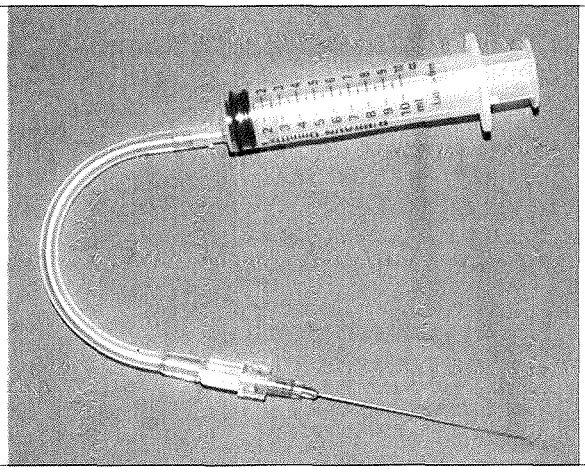
Puncture adapter



US - Guided Fine Needle Aspiration Biopsy
FNAB (ABTI)







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7. Pre –Op Lesion Localisation, Mammo, US, MRI (wire, isotope)
8. Imaging Guided Ablation (RFA)

US - Guided Core Biopsy
DIB –debeloigelna biopsija

INDICATIONS:
1. Confirmation of axillary node metastais
2. US visible mass - screening
3. Confirmation of clinically evident malignancy
   - Prior to surgery
   - Prior to neoadjuvant chemotherapy or radiotherapy

CONTRAINDICATIONS:
1. Lesion poorly seen on US
   - Ca++ without a mass
2. Anticoagulants (relative)

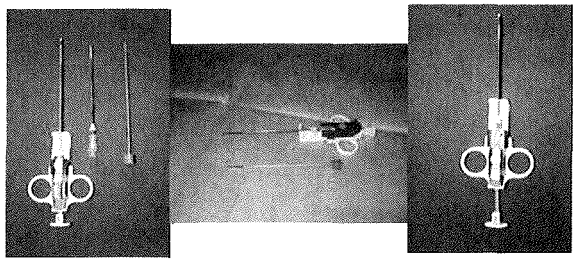
US - Guided Core Biopsy DIB

PROCEDURE:

- Lidocaine, (scalpel blade), sharp introducer
- High frequency linear array probe
- Real time 3D improve biopsy accuracy
- 14-g needle
- Semi automated biopsy system (" fire in place " type) - Precisa
- Automated biopsy gun system ("fire forward" type) - Bard

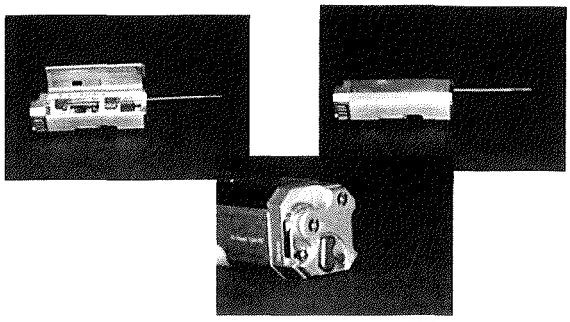
US - Guided Core Biopsy DIB

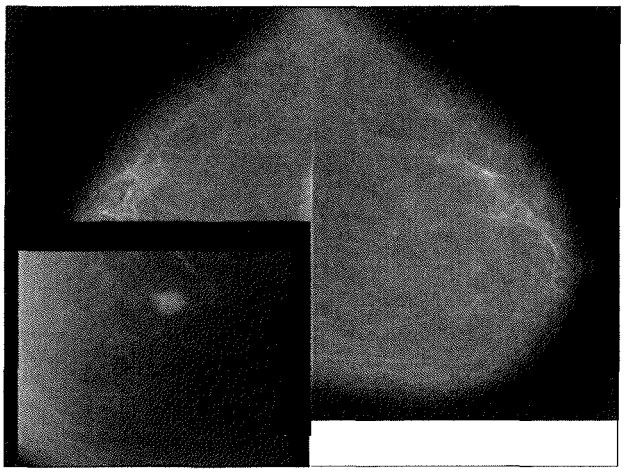
Semi automated biopsy system (" fire in place " type) - Precisa

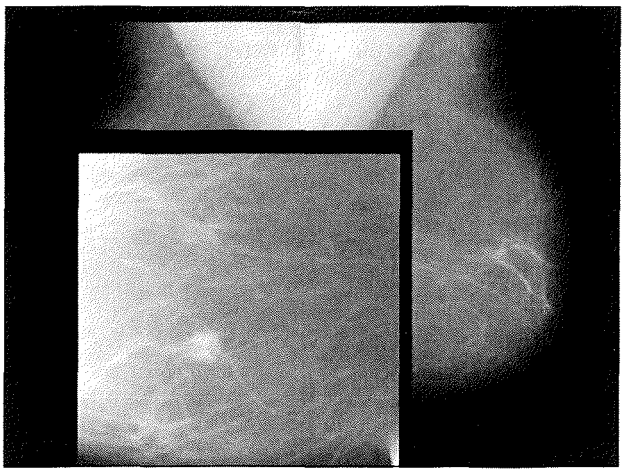


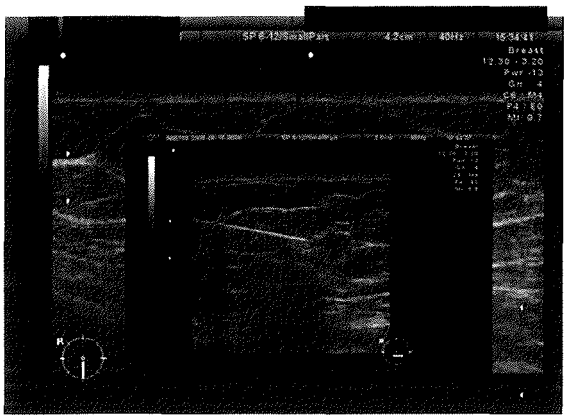
US - Guided Core Biopsy DIB

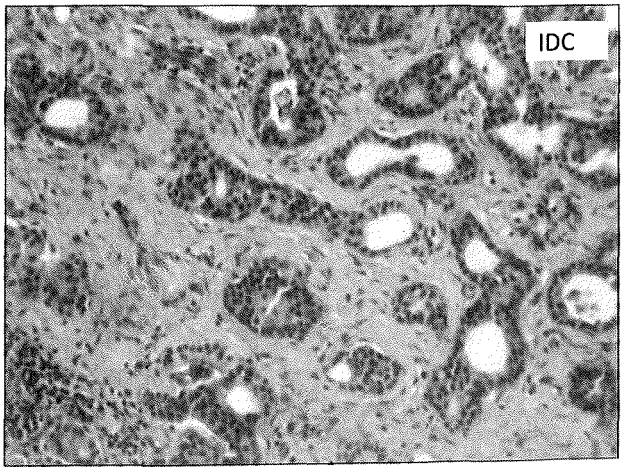
Automated biopsy gun system ("fire forward" type) - Bard











US - Guided Vacuum – Assisted Biopsy

UZ VDIB - vakumska debelo igelna biopsija dojke

INDICATIONS
Suspicious Ca++ visible on US
Very small lesions less than 1,5 cm to less than 5 mm
No proven diagnostic benefit for masses compared to 14-g core !!!

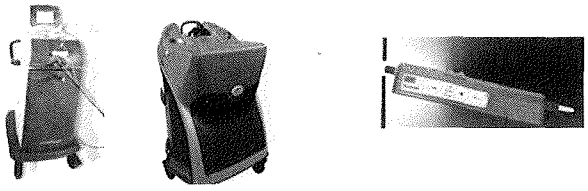
CONTRAINDICATIONS
Anticoagulants
Bleeding disorders
Subcutaneous lesions
Lesions immediately adjacent to implants

Vacuum – Assisted Biopsy

VDIB

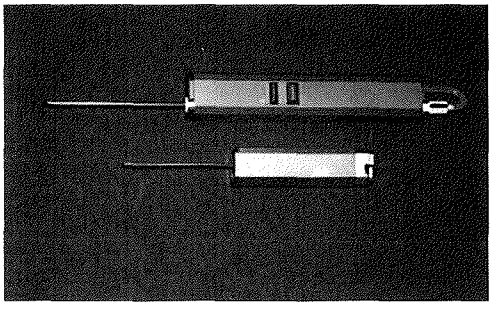
Four types of Vacuum – Assisted Biopsy

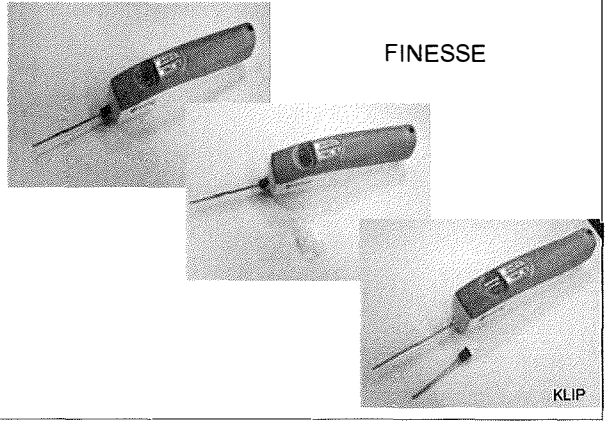
1. Mammotome (semi – automated, not for MRI)
2. ATEC (Automated Tissue Excision and Collection) (automated, MRI)
3. Vacora (semi – automated, small, user friendly)
4. Finessa (Automated Tissue Excision) – only for US



US - Guided Vacuum – Assisted Biopsy

UZ VDIB





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8. Imaging Guided Ablation (RFA)

Sterotactic Biopsy, Prone

- Dedicated prone biopsy table
- Sterotactic vacuum – assisted biopsy (14 to 8 gauge)
- Stereotactic core needle biopsy (automated 14-g)
- Localisations
- Use of mammografic images (+15° and -15°)
- Speciemen radiograph to verify Ca++ lesion retrieval
- Titanium clip placed via hollow probe

INDICATIONS
- Nonpalpable lesions, mamographically BI-RADS 4 or 5 (Ca++)
- Desirable to sample extremes of suspicious area (wide excision:mastectomy)
- Masses not seen on US

Sterotactic Biopsy, Prone

CONTRAINDICATIONS

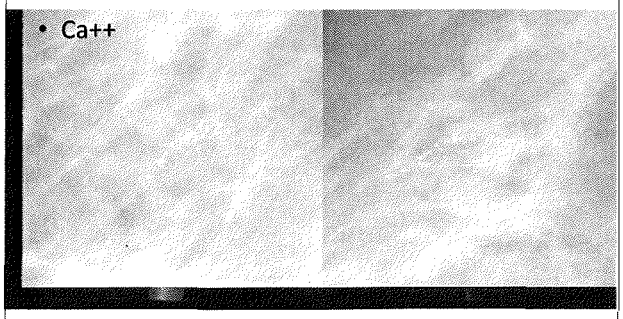
- Patient inability to lie prone or at least 30 minutes
- Thin breast (less than 3 cm)
- Deep lesions
- Superficial lesions
- Lesion unable to target (extreme posterior location)
- Subareolar lesion (relative – breast thickness)
- Architectural distortion (relative) – reasonable to excise possible radial scars directly
- Large area of suspicious Ca++ (relative): Difficult to target specific Ca++
- *Anticoagulants (aspirin one week)*

ATEC

Sterotactic Biopsy, Prone (movie)

Sterotactic Biopsy, Prone

- Ca++



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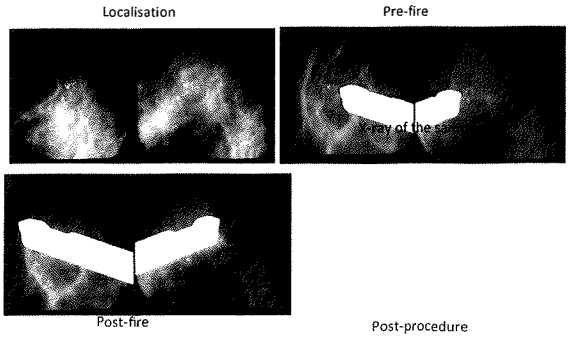
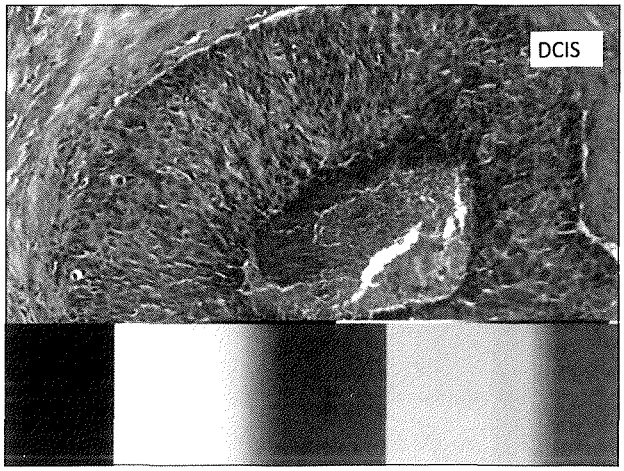
Sterotactic Biopsy, Prone



Titanium marker

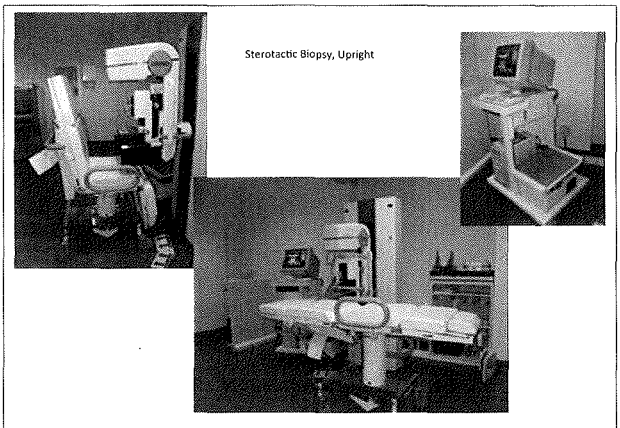


Procedures, Image guided

1. US - Guided Fine Needle Aspiration Biopsy
2. US - Guided Core Biopsy
3. US - Guided Vacuum – Assisted Biopsy
4. Sterotactic Biopsy, Prone
5. Sterotactic Biopsy, Upright
6. MRI - Guided Vacuum – Assisted Biopsy
7. Pre –Op Lesion Localisation, Mammo, US, MRI (wire, isotope)
8. Imaging Guided Ablation (RFA)

Sterotactic Biopsy, Upright

- Mammographicaly guided needle biopsy using conventional mammogram unit and stereotactic attachment (analog or digital)
- Cor needle biopsy or vacuum – assisted biopsy
- Localisations
- Old patients, wheel chair patients



Sterotactic Biopsy, Upright

Procedures, Image guided

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2. US - Guided Core Biopsy
3. US - Guided Vacuum – Assisted Biopsy
4. Sterotactic Biopsy, Prone
5. Sterotactic Biopsy, Upright
6. MRI - Guided Vacuum – Assisted Biopsy
7. Pre –Op Lesion Localisation, Mammo, US, MRI (wire, isotope)
8. Imaging Guided Ablation (RFA)

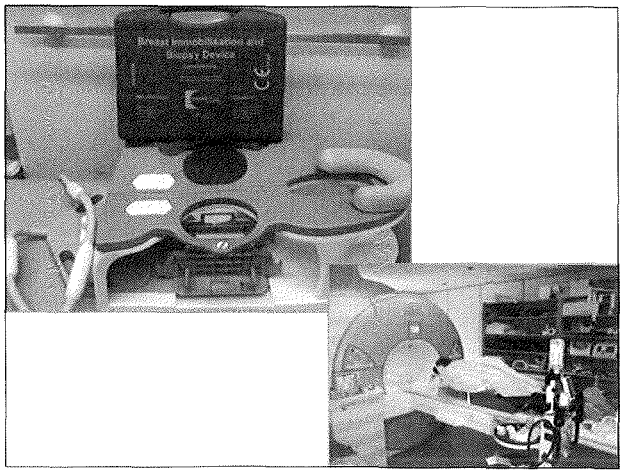
MRI - Guided Vacuum – Assisted Biopsy

INDICATIONS

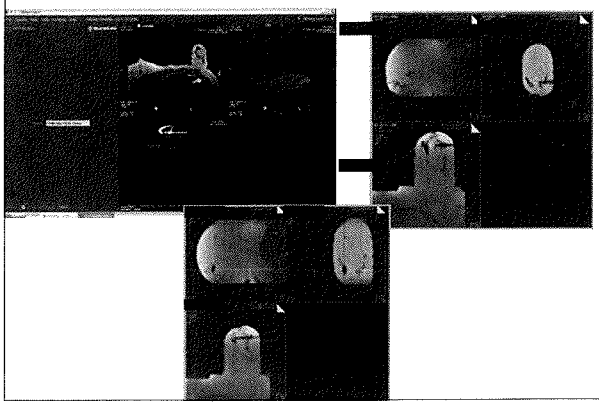
- Suspicious lesion detected on MR
- Lesion seen only on MR

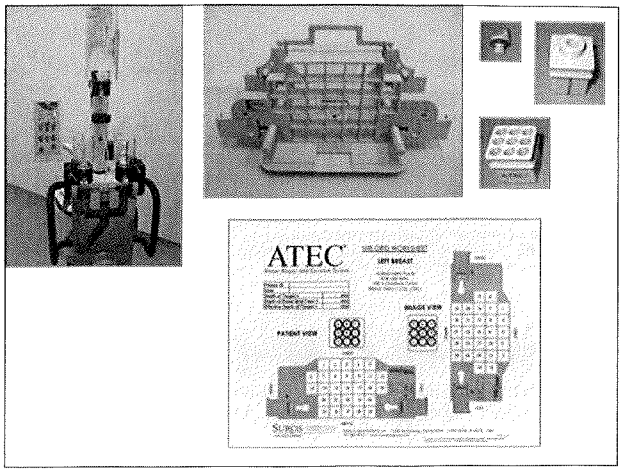
CONTRAINDICATIONS

- Same as for general MR
- Breast implants (relative) – distance to the lesion
- Extreme posterior lesion
- Very large breast – limit access to anterior lesion
- Very thin breast – less than 3 cm
- Very small lesion, less than 5 mm in diameter (only 3% of malignancy, technical success may be reduced)



NORAS - CADstream





LOCALISATIONS

Procedures, Image guided

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8. Imaging Guided Ablation (RFA)

Pre – Op Lesion Localisation

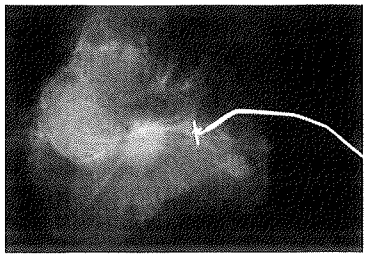
- Image guided localisation of breast lesion, using one or two wires or isotope
- Mammographic, US, MR guidance

INDICATIONS
- Known cancer, nonpalpable
- Malignant Ca++
- Architectural distorsion

CONTRAINDICATIONS
- Lesion not clearly visible by mammography (follow US or MR)
- Clearly benign lesion

Pre – Op Lesion Localisation

WIRE



Pre – Op Lesion Localisation

ISOTOPE (Technetium 94)

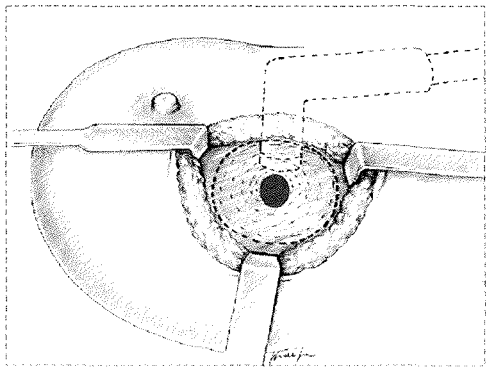
- OI Ljubljana: Replace wire localisation since 2001
- Wire:
  - the lesion is very hard and movable
  - isotope flow in the ducts
  - two lesions close together (isotope and wire)

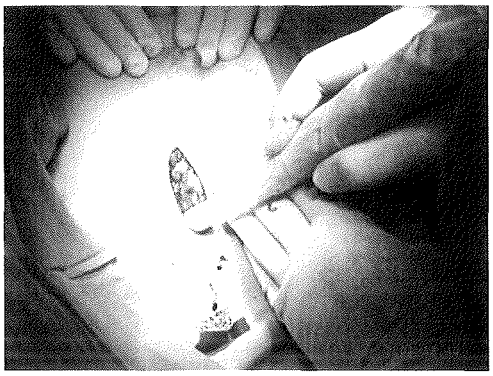
ROLL (radioguided occult lesion localisation)

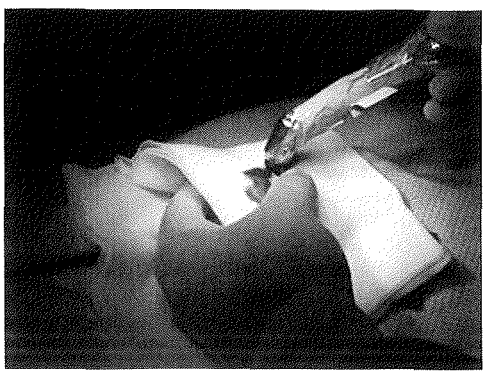
- Isotope is binding – on the **makroglobulin**
(rest in the place of the injection)
- Gama probe
- No movment of the wire

•SNOLL (sentinel node and occult lesion localisation)

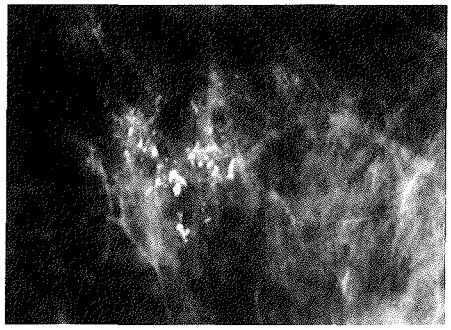
- Isotope is binding – on the **smaller globulin**
(move through limf vessels from tumor to the sentinel limf node)
- Remove tumor and sentinel limf node at the same time, operation
- Gama probe
- No movment of the wire



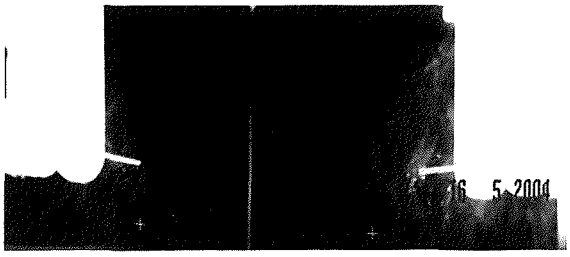




Malignant Ca++



Localisation of the Ca++ sterotacticaly



Control mammogram after aplication of the isotope and the contrast agent

Procedures, Image guided

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7. Pre –Op Lesion Localisation, Mammo, US, MRI (wire, isotope)
8. Imaging Guided Ablation

Imaging Guided Ablation

- RFA (radoifrequency ablation, electromagnetic field, 0,4-8 MHz)
- FUS (focused ultrasound, focal heating, acoustic energy 1-2 MHz)
- CRYOABLATION (rapid cooling, -40°C)
- LITT (laser interstitial thermal therapy, percutaneus optical fiber)
- MICROWAVE (1 GHz with interstitial antennae)

Imaging Guided Ablation

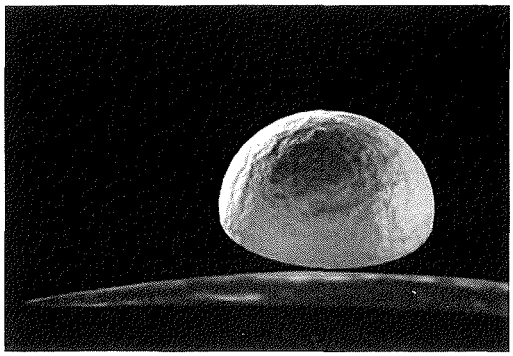
LIMITATIONS AND DISADVANTAGES

- Margin status cannot be assessed due to lack of patologic speciemen
- Radiologic assessment must replace histopatology

ADVANTAGES

- Inoperable old patients because of heartsick
- Greater cosmesis, patient comfort, reduced hospital stays, cost savings
- Reduced risk for hemorrhage, infection, scarring, disfigurement

RFA



Breast symptoms:
clinical point of view and what surgeon needs to know

Janez Žgajnar
Institute of Oncology Ljubljana

Which information does the surgeon need?

- Age, family history (mutations?), prior diseases and treatments
- Clinical presentation (if any!)
- Imaging information about the size, multifocality / multicentricity or bilaterality of the disease and regional or systemic dissemination
- Biological characteristics of the disease
- Patient whish

I will talk about

- Clinical presentations
- Diagnostics (very briefly)
- Surgery
- Basic information about multidisciplinary treatment

Clinical presentation

(a typical one)

- Hard lump
- Irregular edges
- Limited mobility of the lump
- Not painful !!!
- Retracted skin !!!
- Nipple changes
- Asymmetry

Some rare clinical presentations

- Paget disease
- Inflammatory cancer
- Nipple discharge

Therefore....

- Triple assessment is mandatory
  - Clinical examination
  - Imaging techniques
  - Biopsy
    - Fine Needle Aspiration Biopsy (FNAB)
    - Core biopsy
    - Surgical biopsy (not recommended as a first step)

Imaging techniques

- Mammography
- Ultrasound
- MRI

FINE NEEDLE ASPIRATION BIOPSY

- Fine needle (19-23G)
- Cytological specimen
- Easy, fast,cheap, specific
- Trained personnel needed
- Invasiveness of the disease not determined
- Inadequate in nonpalpable lesions or prior to neoadjuvant chemotherapy

Core biopsy

- Wide needle (14-20 G)
- Histopathological report
- Trained personnel needed
- 5-10 more costly compared to the FNAB
- Obligatory in nonpalpable lesions or prior to neoadjuvant chemotherapy

decision on first treatment based on :

- Clinical presentation
- Diagnostic work-up of the tumor
- Stage of the disease

Aim of the surgery in BC

- To achieve the local control of the disease
- To obtain material for the diagnosis and prognosis
- To cure the patient (in selected cases)

..with minimal side effects !

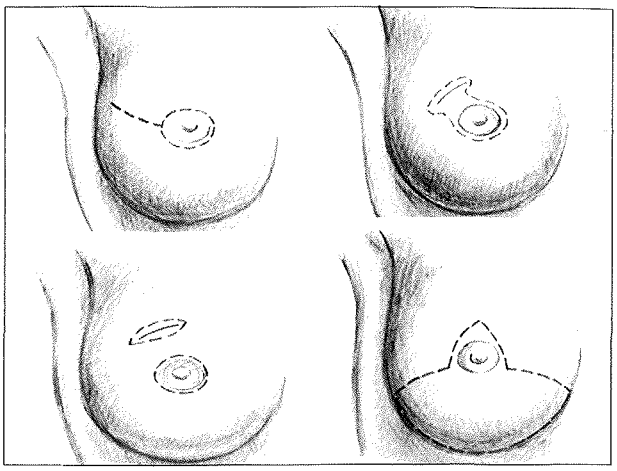
Cancer has to be radically excised

- The aim is to achieve 1 cm clear surgical margins
- Technique
  - Mastectomy
  - Breast conserving treatment (BCT)

reconstruction

- Immediate
- Delayed

- With implant
- Natural tissue from body (autologous)
  - Free flap
  - Pedicle flap
- combined



NIPPLE-SPARING MASTECTOMY INDICATIONS

1. BC TREATMENT
- T < 2cm AND
- Distance from NAC > 2,5 cm AND
- No AND
- Unicentric tumors

BCT candidates who opt for mastectomy

2. "RISK-REDUCING" MASTEKTOMY

?

*Garcia-Etienne CA, Borgen PI. *J Support Oncol* 2006.

Review

British Journal of Surgery 2010; 97: 305–316

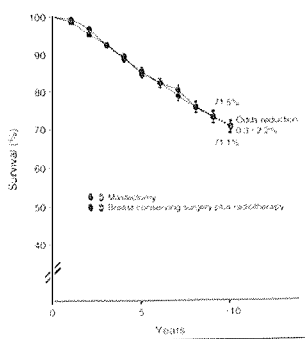
Nipple-sparing mastectomy

J. F. Rusby[1], B. L. Smith[2] and G. P. H. Gui[1]

- Local recurrence <5%
- Cancer incidenec in risk reducind surgery <1%
- Nipple necrosis 8-16%

Is it always necessary to do the mastectomy?

EBCTCG meta analysis



Tumour size : breast size

is crucial

What to do?

- Quadrantectomy
- Wide local excision
- Lumpectomy
- Tumourectomy
- Segmental excision
- Partial mastectomy

margins dilemma

- Aim to achieve 1 cm
- In most cases 1-2 mm acceptable
- Local reccurence rate depends on tumor caracteristics
  (Nguyen et al., JCO, 2008)
  - luminal A 0,8% (5y)
  - Luminal B 1,5%
  - Basal like 7,1%

"it is time to abandon the holy grale of a single margin width that is appropriate for all patients..."

Morrow M, Expert Rev Anticancer Ther., 2008

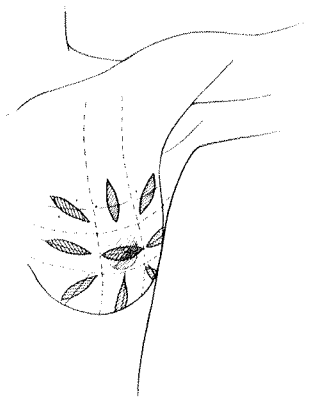


FIGURE 2-4. Recommended resection for partial breast excision.

BCT and neoadjuvant treatment

- Indications
  - Tumors too large for BCT
- Mandatory
  - Core biopsy before CT
  - Mammograpfy /MRI after CT
- Surgery
  - tricky

Noninvasive breast cancer (DCIS)

general strategy .. multidisciplinary approach

DCIS in the past

- Rare, mostly clinically diagnosed
  - as a palpable mass
  - Paget disease
  - Nipple discharge
- Treatment ALLWAYS mastectomy- results excellent

DCIS today

- Common
  (20-30 % of mammographically detected cancers is DCIS)
  (Ernster et al.:JAMA 1996)
- Usually no clinical presentation

  mammographically detected as microcalcifications in 90%
  (Stomper PC et al.:Radiology 1989)

Indications for mastectomy

(Consensus Conference on the Treatment of DCIS, Cancer 2000)

- indications
  - large areas of DCIS (>3cm microcalc.)
  - poor cosmesis after excision
  - multicentricity
  - inability to undergo radiation
- surgical technique
  - immediate reconstruction +/-

DCIS treatment today

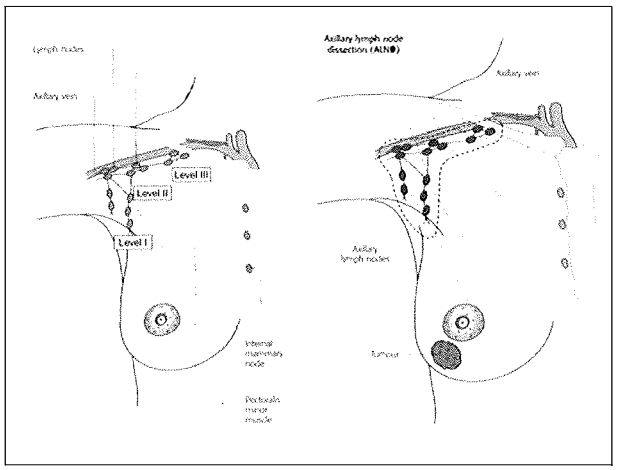
Mastectomy

or

BCT + radiotherapy

Axillary surgery

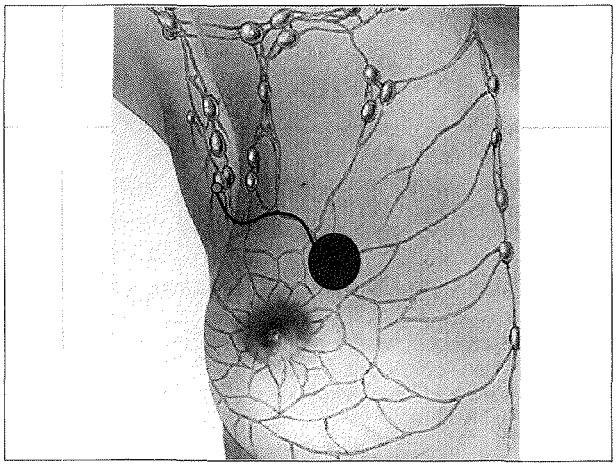
- Axillary lymphnode dissection
- Sentinel node biopsy



Side effects od the ALND

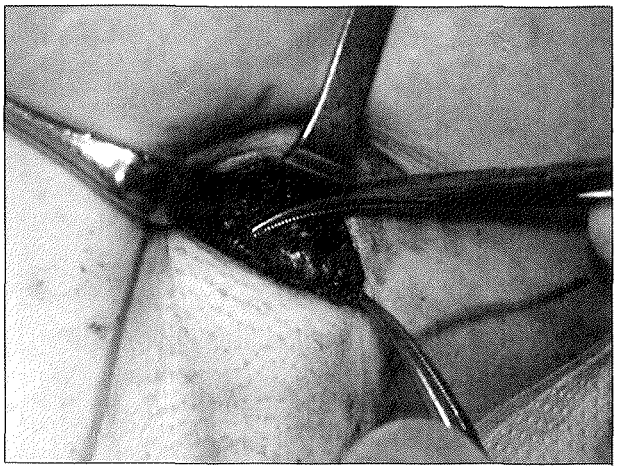
- Lymphedema
- Impaired shoulder movements
- Cutaneous sensitory disturbances in the axillary region
- More limb infections

Can we avoid the ALND?



indications

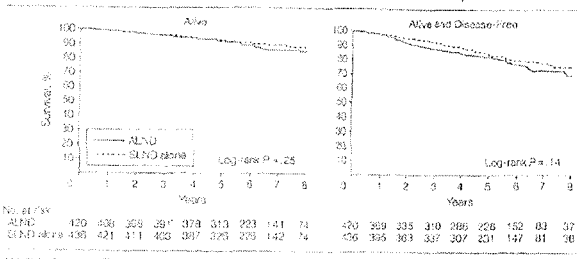
- The only absolute <u>contraindication</u>
  - metastatic disease in the lymphnodes
- DCIS
  - if mastectomy
  - if palpable, high grade
- Profilactic mastectomy



Acosog Z 11

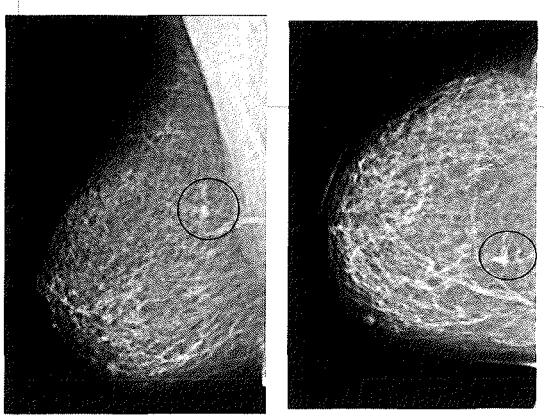
Giuliano AE et al, JAMA, 2011

Figure 2. Survival of the ALND Group Compared With SLND-Alone Group



ALND indicates axillary lymph node dissection; SLND, sentinel lymph node dissection.

Nonpalpable lesions



Some important facts

- Most of screening detected breast lesions (>50%) today are nonpalpable
- Multidisciplinary approach
  - Image diagnostics
  - Pathology
  - Nuclear medicine
  - Surgery

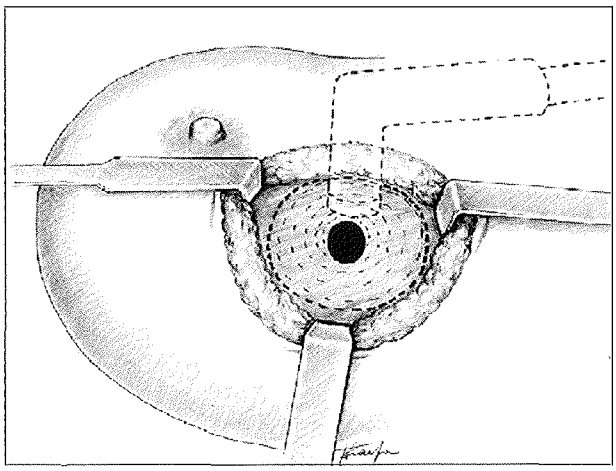
Indications for surgery

- diagnostic
- therapeutic

ROLL

Radioguided Occult Lesion Localization
(Luini A et al., BJS, 1999)

- Into the center of the nonpalpable lesion
  human serum albumin, labeled with 3,7 MBq ^{99}Tc
  in 2ml of saline is injected
- colloid size 10 – 150μm
- Followed by injection of 0,1 ml of contrast



Available online at www.sciencedirect.com
ScienceDirect
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ELSEVIER

Review

Systematic review of radioguided surgery for non-palpable breast cancer☆

P.J. Lovrics [a,b], S.D. Cornacchi [a], R. Vora [a], C.H. Goldsmith [a,b,c], K. Kahnamoui [a]

Abstract

Multidisciplinary meetings

- Breast tumor board
  - Multimodal therapy discussed
    Surgeon, radiotherapist, medical oncologist, pathologist
- Nonpalpable lesions
  - From screening after needle biopsies
  - After surgery of the nonpalpable lesions
    Surgeon, pathologist, citologist, radiologist
- Meeting for reconstructions
  Surgeon, reconstructive surgeon

Radiotherapy

- Allways after BCS (?)
- After mastectomy
  - 3+ positive lnn
  - inflammatory carcinoma
  - T3 tumors

~ 1 of 4 prevented local reccurences saves life
Punglia, NEJM, 2007

Systemic treatment

- Chemotherapy
  - New drugs i.e. PARP inhibitors
- Hormonal treatment
  - Tamoxifen
  - LHRH analogue +tamoxifen
  - Aromatase inhibitors
- Targeted treatment

Treatment decision (today) based on:

- Type of surgery, margins
- Tumor type
- Size
- Grade, LVI
- ER,PR, HER-2
- Lymphnode status
- Patient caracteristics

future

- Individualized risk assesment
- Individualized screening approaches
- Minimized surgery
- Individualized radiotherapy approach
- Individualized systemic treatment

- Health professionals?

Comprehensive MDT aproach in Breast reconstruction

Ljubljana experience

Prof. **Uros Ahcan**, MD, PhD
Consultant general surgeon
Consultant plastic, reconstructive and aesthetic surgeon
Department of Plastic Surgery & Burns
University Medical Center Ljubljana

"We repair and fix body parts that were given by nature but taken away by fate"

Gaspare Tagliacozzi (1545-1599) founder of modern plastic surgery.

From Tagliacozzi's description of nasal repair, 1597

However, comunity regarded his nasal operations as ilegal and crime against nature.

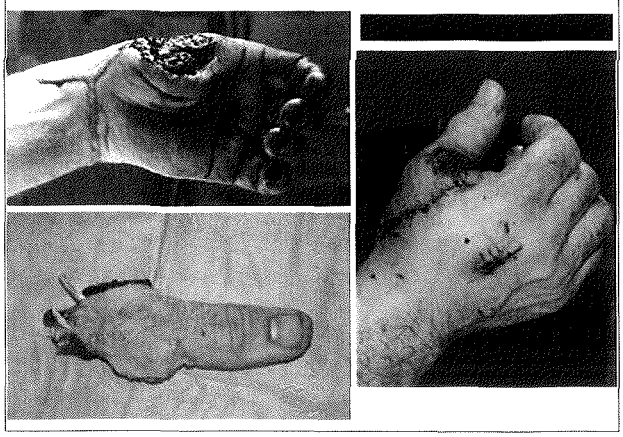
He was eventually buried in unconsecrated ground.

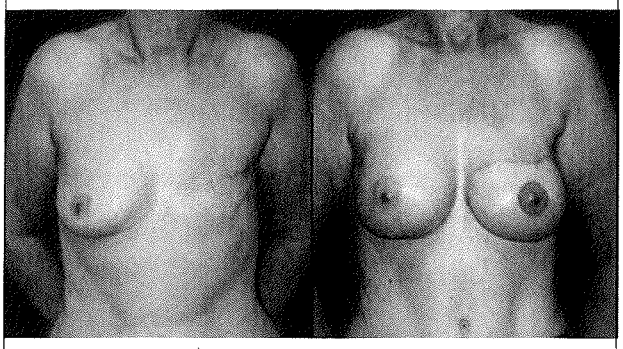
modern plastic surgery

reconstruct composite tissue defect

Modern plastic surgery

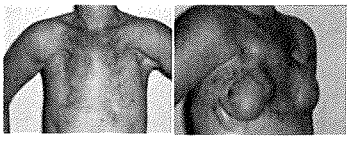
With different techniques, materials, instruments...





Modern plastic surgery

Breast reconstruction



History

- The resistance to breast reconstruction in the past was a function of the techniques available for reconstructive surgery as well as oncological considerations.

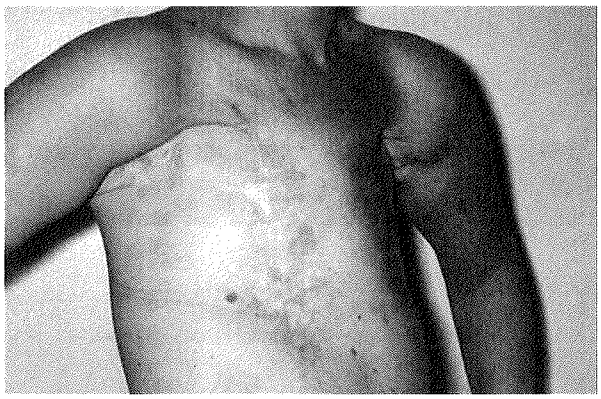
- Initial attempts at breast reconstruction were sporadic and can be found in the literature in the form of case reports.

Later half of the 19th century

- a difficult time to initiate a reconstructive practice with Halsted`s philosophical concerns against any surgical closure of the chest that it

"*might conceal tumor recurrence and increase the chance of tumor dissemination*"

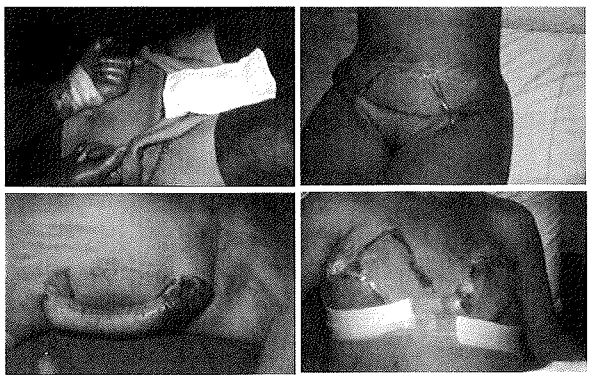
Halstead 1894



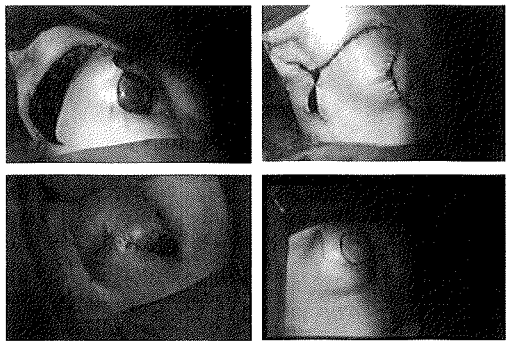
Before 1987

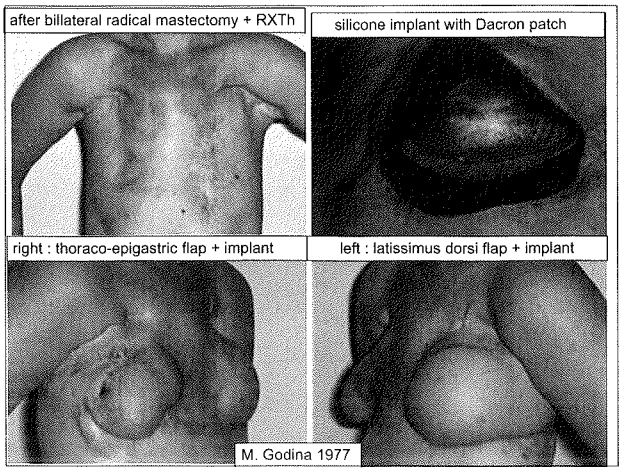
- Breast reconstruction following HALSTEDT radical mastectomy
- Techniques used:
  - Reconstruction with inguinal tubes
  - Thoracic flap with implant
  - Latissimus dorsi flap

Reconstruction with inguinal tubes

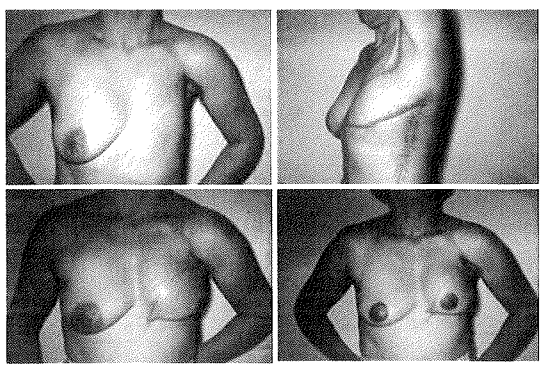


Thoracic flap with implant

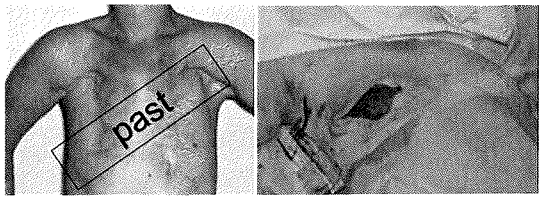




Latissimus dorsi flap



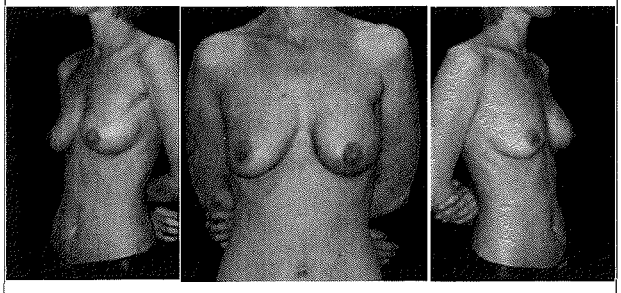
- Mastectomy modifications became popular in Europe at the turn of the century and were though to minimize morbidity while introducing the concept of reconstructing the defect.

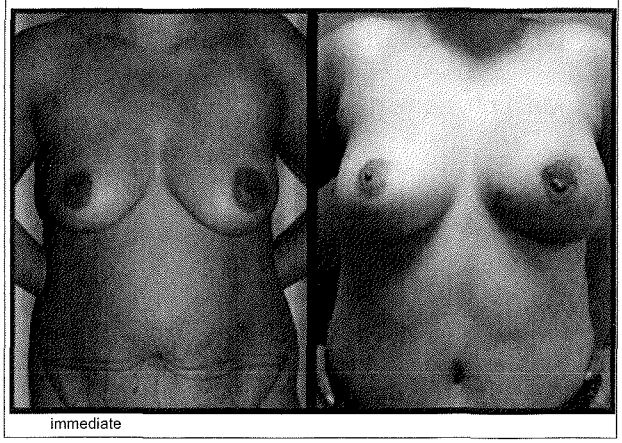


Reconstructive techniques

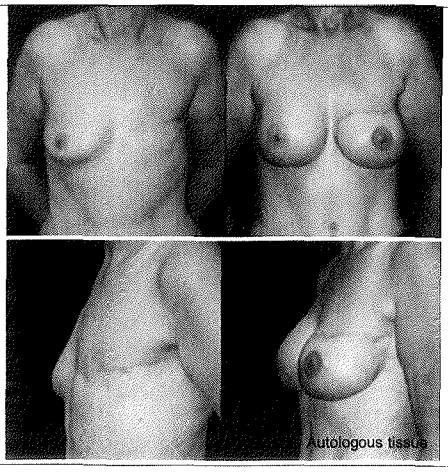
today

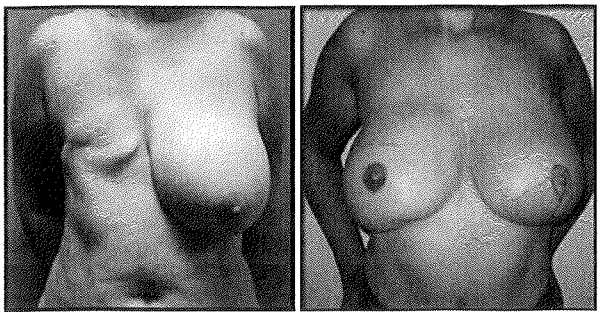
We are able to reconstruct the breast with implants





immediate





delayed

New knowledge – new possibilities

- Much more is now known about breast cancer and its treatment.
- New kinds of treatment as well as improved reconstructive surgery mean that women who have breast cancer today have better choices ??

Problem outline

Suboptimal breast cancer treatment

Breast reconstruction strategy

- Main problem: patient with breast cancer

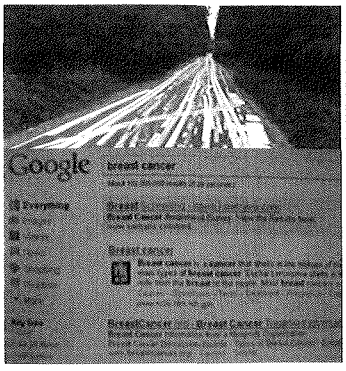
What she needs?

Breast reconstruction strategy

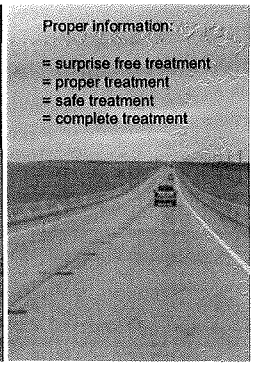
What she needs?

- Proper information
- Skilled surgeons
- All possible methods
- Best material (expanders & implants)
- Best pre & post operative care
- Psychological support

The most important clear, objective information...



internet

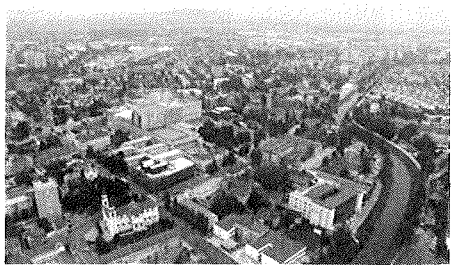


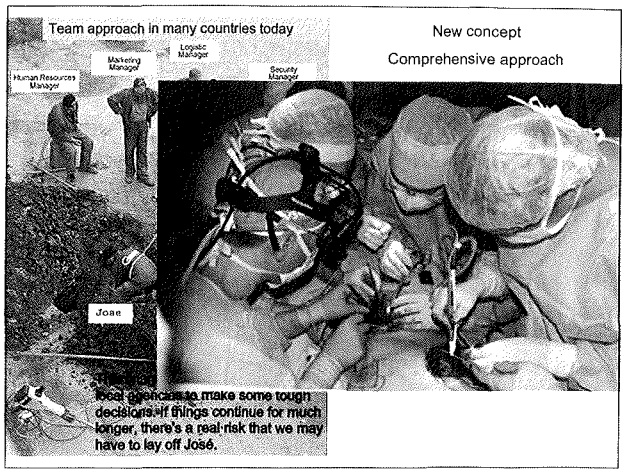
Brochure

MDT – multidisciplinary teamworks

MDT & breast cancer

LJUBLJANA experience





MDT

Multidisciplinary teams are groups of specialists in different fields linked together around a patient to provide comprehensive assessment and consultation and the best possible treatment under specific circumstances.

MDT & breast cancer

- to provide optimal care to women with breast cancer,
- disseminate examples of good practice,
- guarantee women an equal standard of care
- assuring a better treatment outcome and quality of life

MDT & breast cancer

- Oncology core team
- Reconstructive core team
- Other (optional) team members

Oncology core team

Medical oncologist

Breast surgeon

Clinical geneticist

Reconstructive core team

- Reconstructive surgeon
- Breast care nurse
- Nurse educator

Other (optional) team members

- Psychiatrist
- Psychologist

MDT & breast cancer

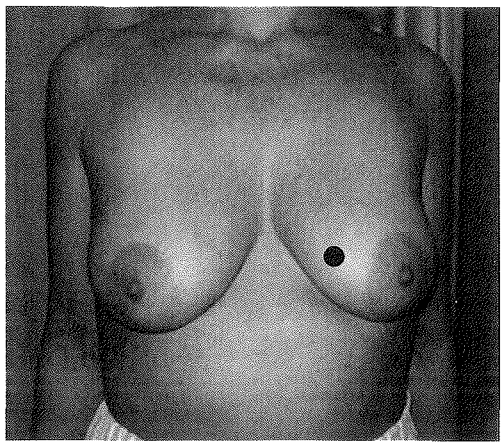
Step-by-step guide for the patient, optimal treatment options and end-results

MDT & breast cancer

Multidisciplinary Case Management Meetings

Multidisciplinary Case Management Meetings

- An MDM is a consultation of two or more physicians concerning the diagnosis and treatment of a patient.
- Check all data in the protocol, and discuss all treatment options.



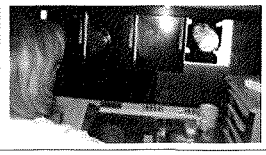
Oncology core team

- establish the diagnosis,
- determine the stage of the disease,
- decide for surgical and adjuvant therapy.

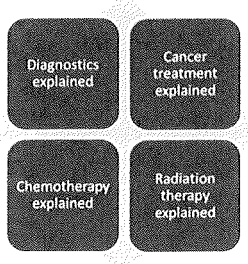
A key role in the treatment of breast cancer is played by the team of oncologists

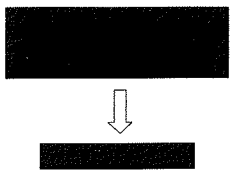
Multidisciplinary meetings (onco)

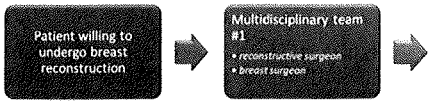
- Breast tumor board
  - Multimodal therapy discussed
    Breast Surgeon, radiotherapist, medical oncologist, pathologist
- Nonpalpable lesions
  - From screening after needle biopsies
  - After surgery of the nonpalpable lesions
    Breast Surgeon, pathologist, citologist, radiologist

Step 1 – oncological treatment







Team 2

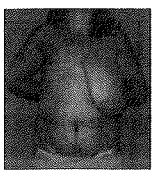
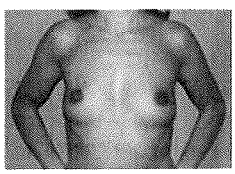
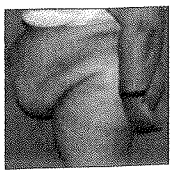
Breast surgeon

Onco treatment plan:

Neoadjuvant therapy, surgery radiotherapy

Patient - clinical factors

(age, body weight, tissue quality and quantity, glandular characteristics, breast ptosis, pectoralis muscle characteristics, scars, aging, obesitas, general health condition)

Reconstruction decision tree

Timeframe

Immediate

Delayed

Type

Autologous

DIEP

msTRAM

LD

Nonautologous

Expander and prosthesis

Explander and autologous tissue

Step 2 – breast reconstruction

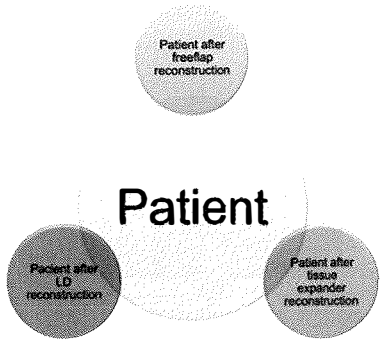
patient

The final decision regarding the oncologic treatment and type of breast reconstruction is made by the patient after consultation.

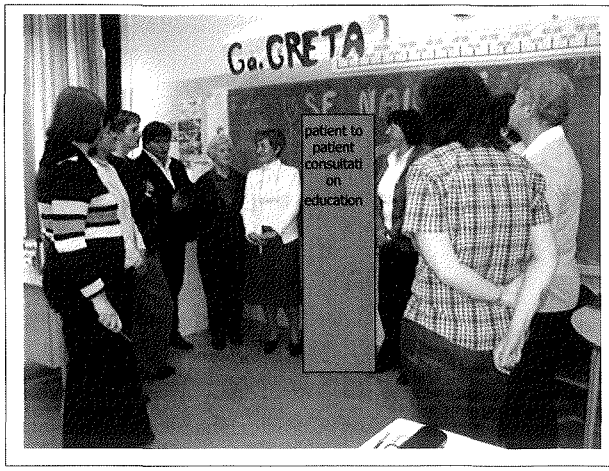
Patient – subjective opinions

patient can talk with other women from Breast cancer support groups who have had mastectomies & reconstruction, about personal experience,

subjective feelings.

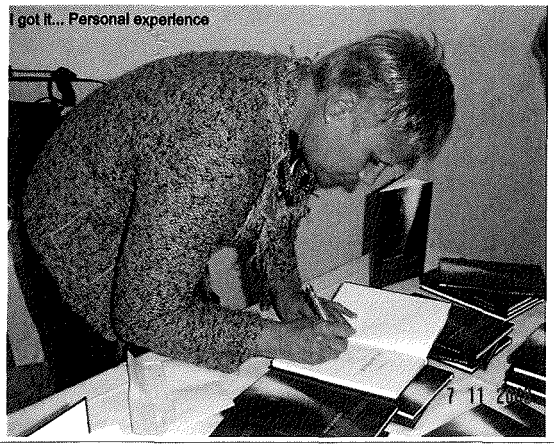


Association of patients after breast reconstruction – priceless promotors



After reconstruction with 2 different methods.

I got it... Personal experience

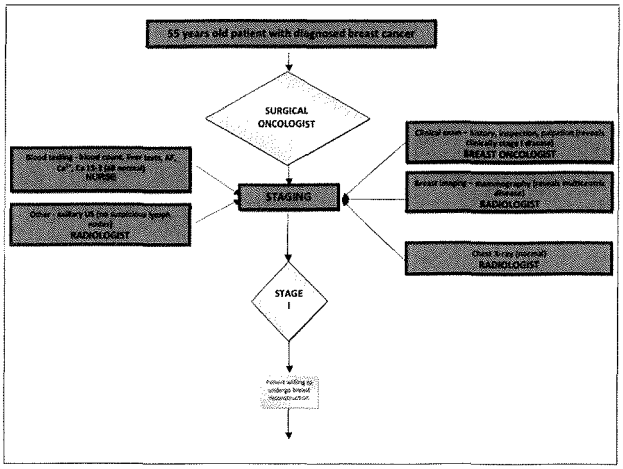


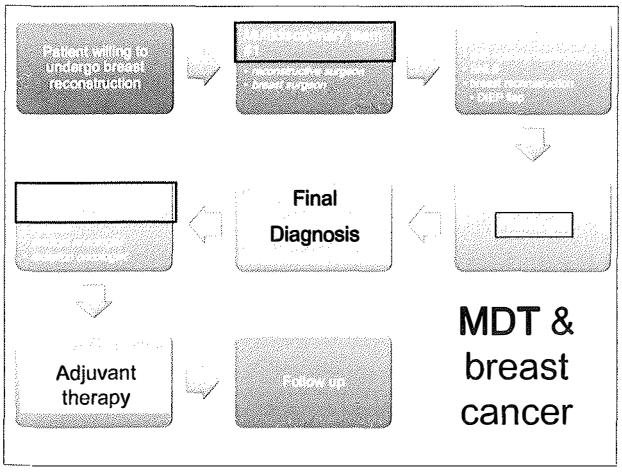
Typical case

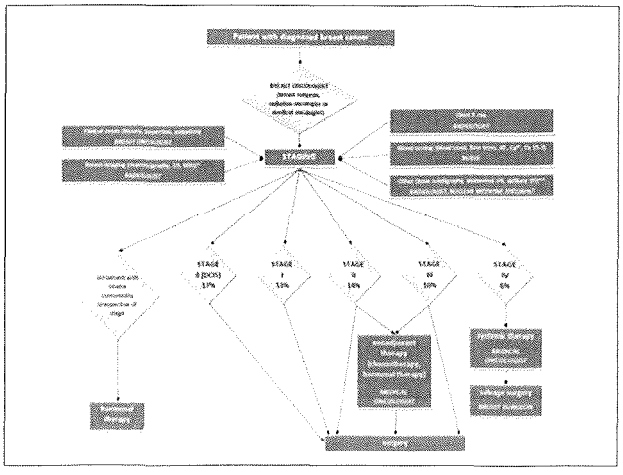
70% of cases

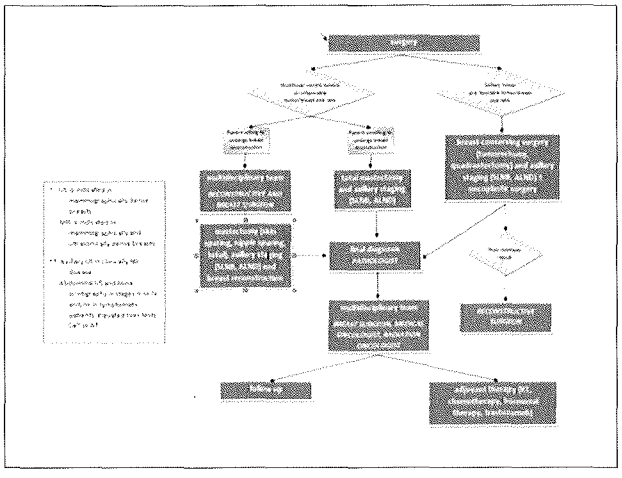
55 y old patient

Stage 0 or 1









Recon. surgeon

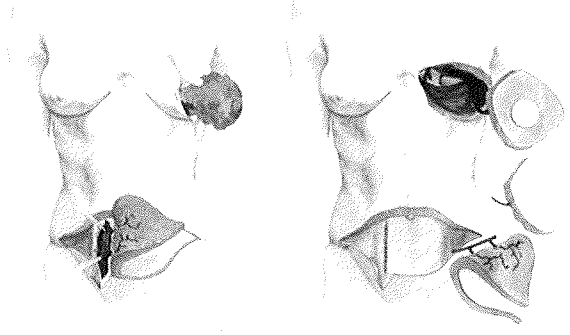
Reconstructive techniques

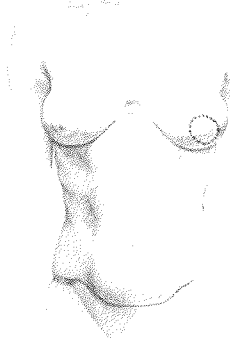
Autologous tissue
Expanders – prosthesis combination
Oncoplastic surgery

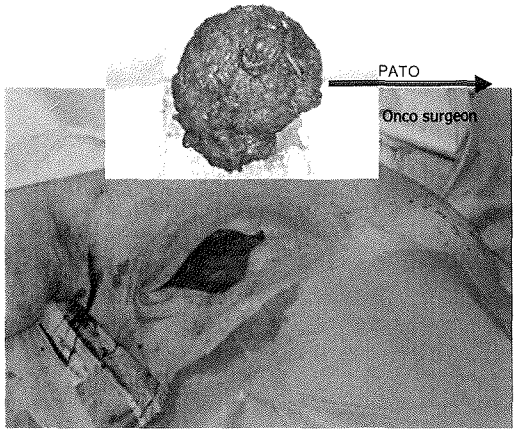
Reconstructive techniques

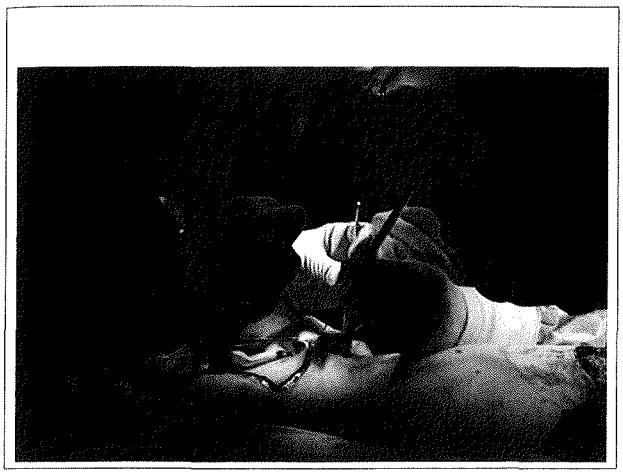
Autologous tissue

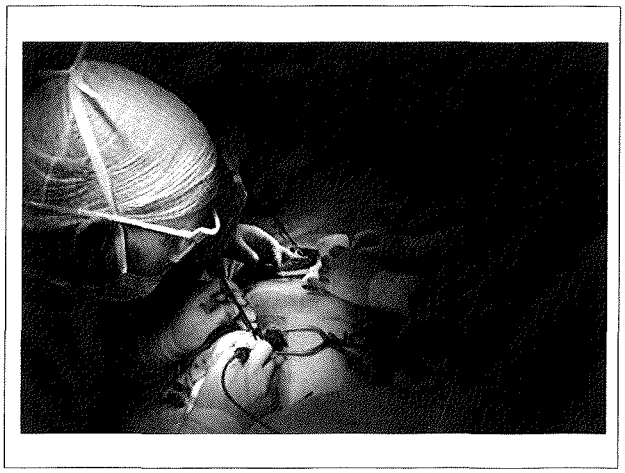
DIEP – working horse in breast reconstruction

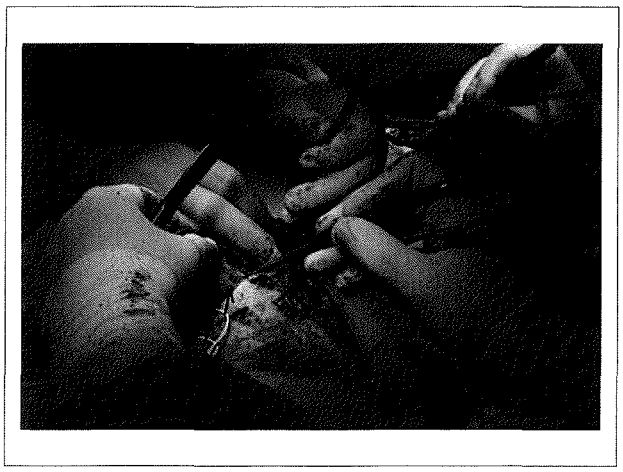


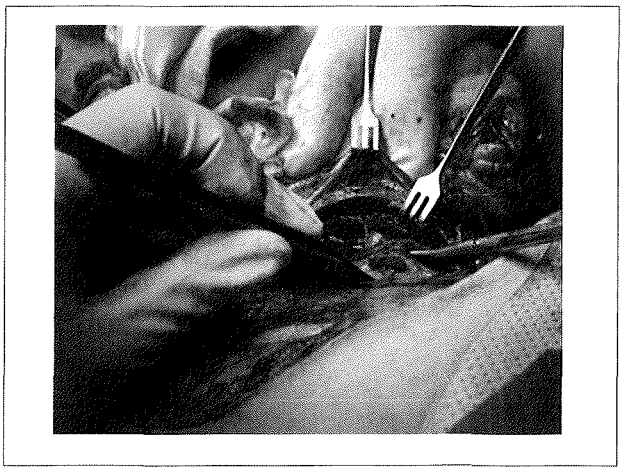


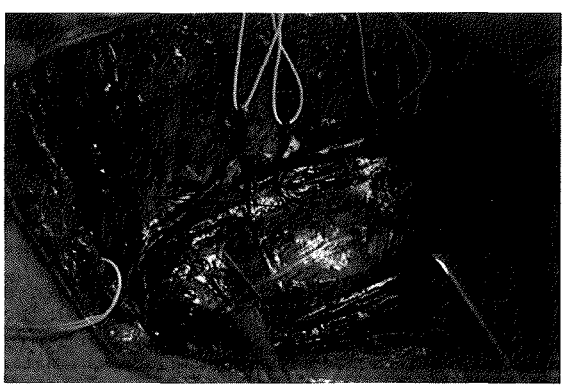


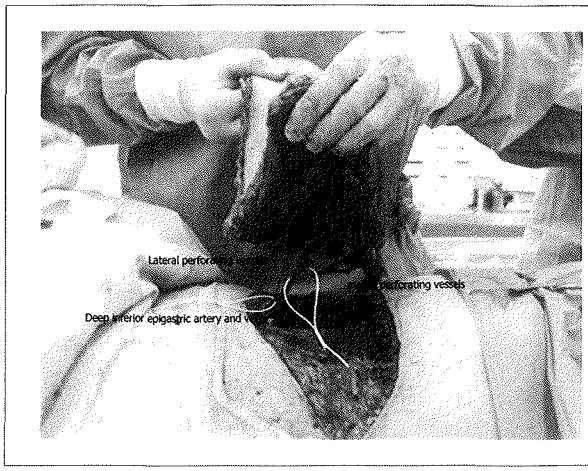


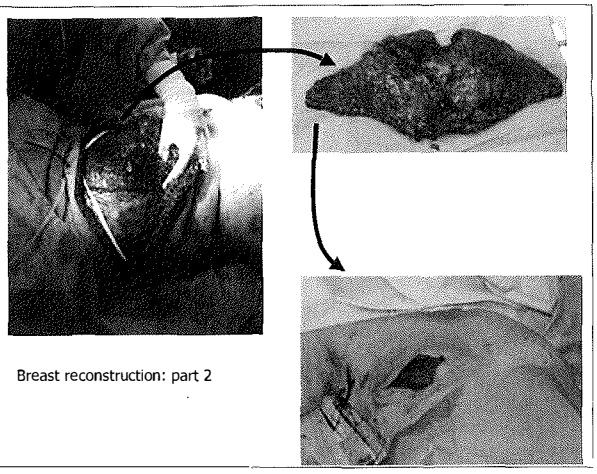






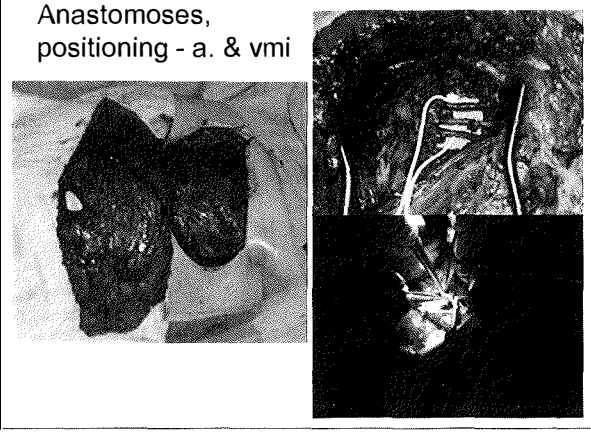



Lateral perforating vessels
Deep inferior epigastric artery and

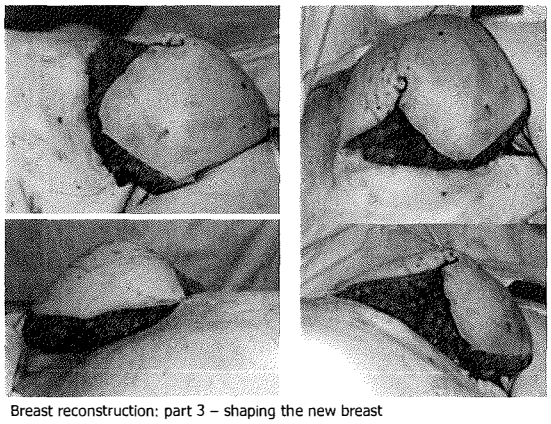


Breast reconstruction: part 2

Anastomoses, positioning - a. & vmi

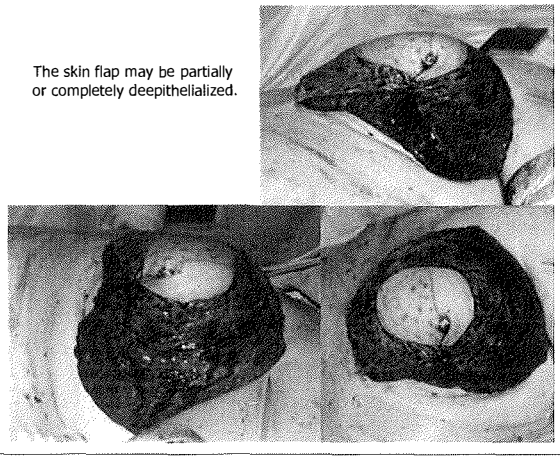


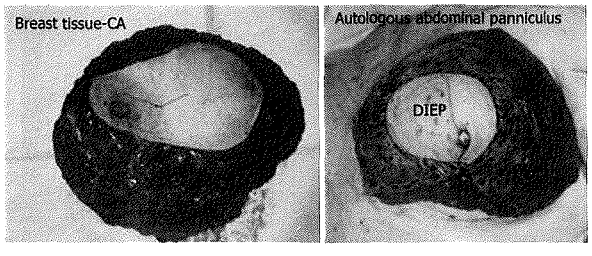
Anastomoses, positioning of the flap



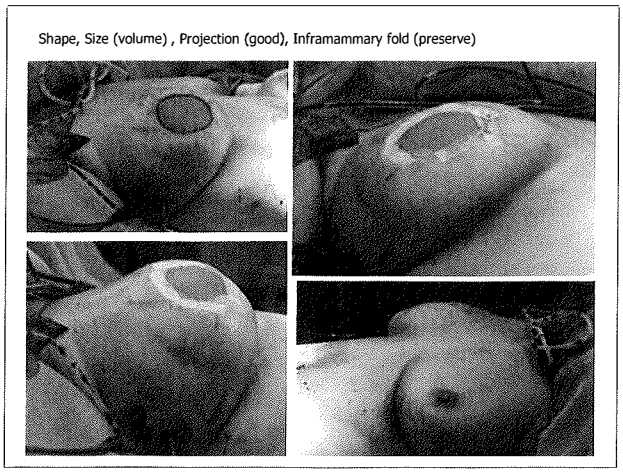
Breast reconstruction: part 3 – shaping the new breast

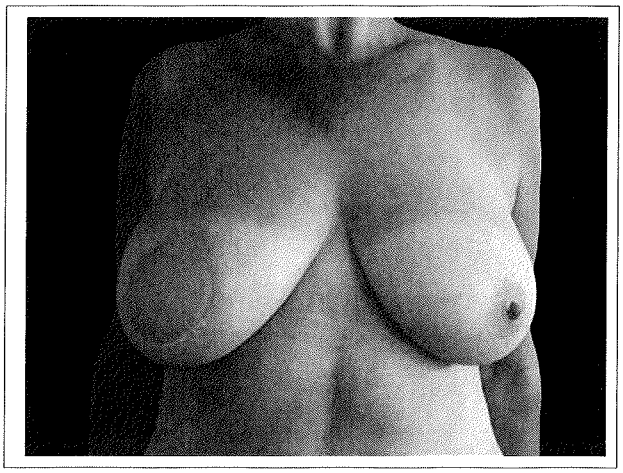
The skin flap may be partially or completely deepithelialized.

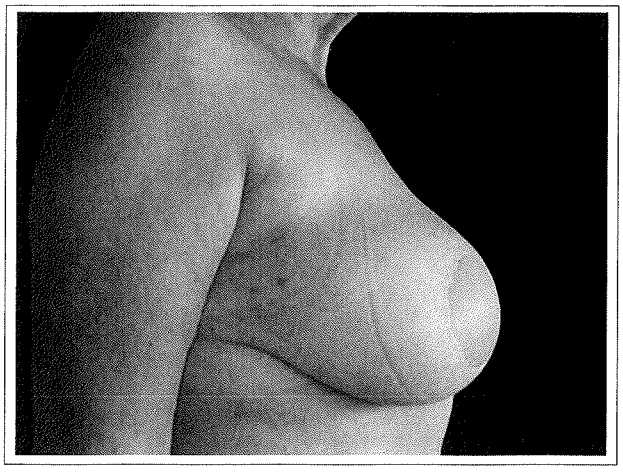


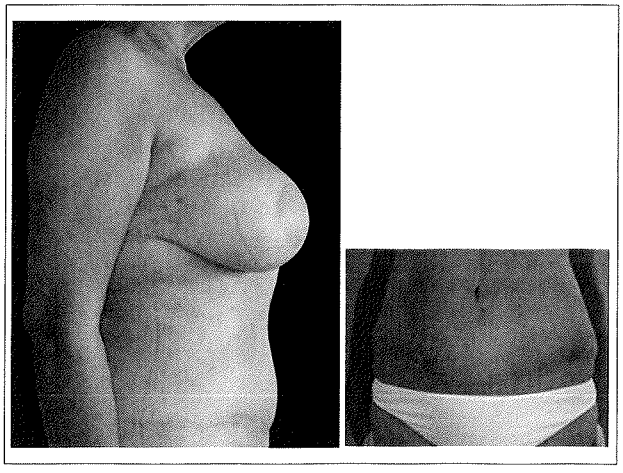


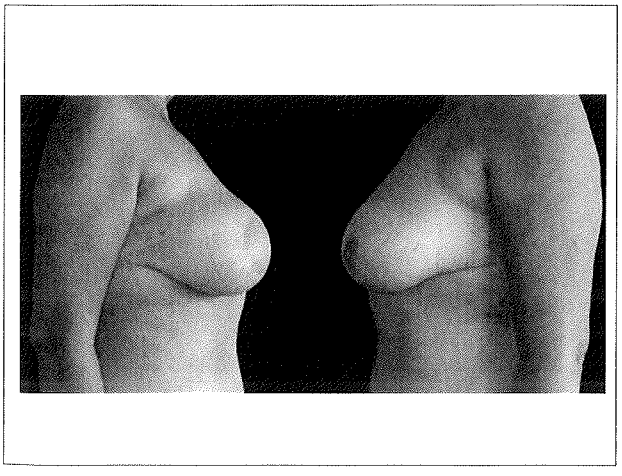
Shape
Size (volume)
Placement (right place)
Projection (good)
Inframammary fold (preserve)











Reconstructive techniques

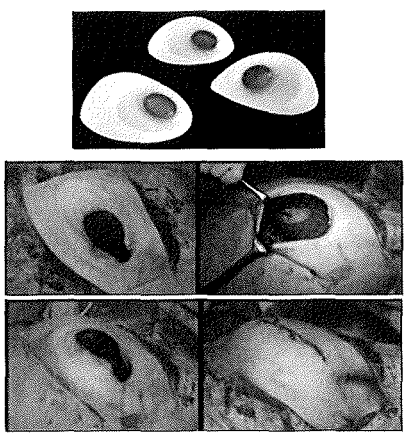
Autologous tissue

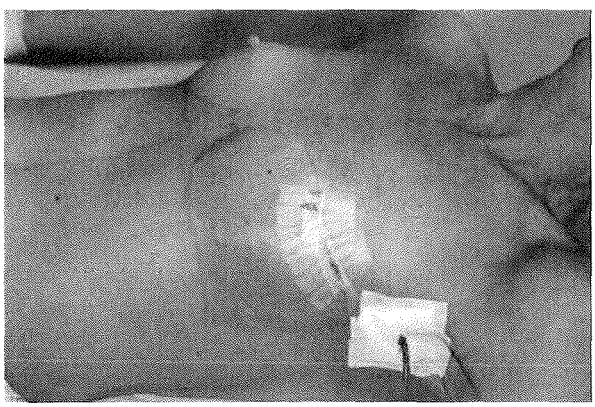
Expanders – prosthesis

combination

Patients appropriate for implant reconstruction

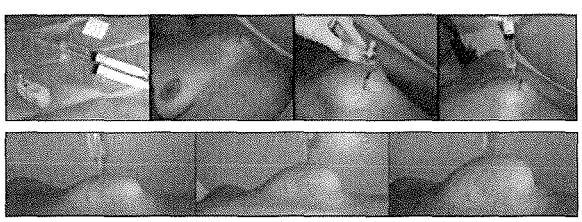
- Patient who are not suitable for autologous reconstruction
- Patient who do not want additional donor scars
- Patient who preffer a speedier recovery
- Ideal for small-breasted women

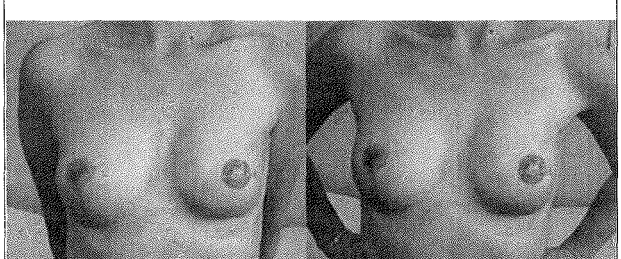


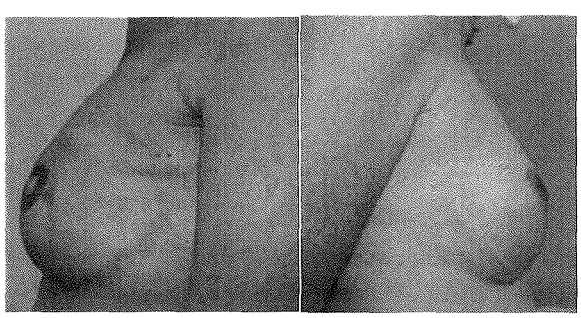


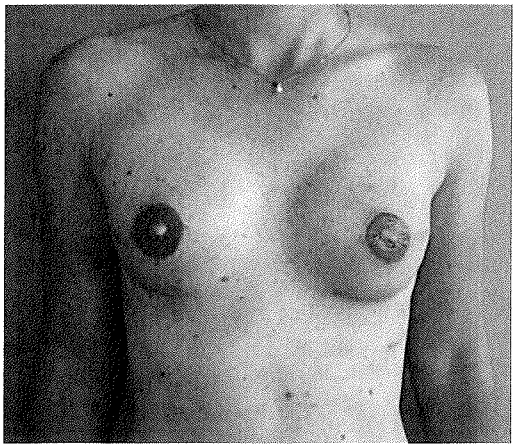
Tissue expansion in breast reconstruction

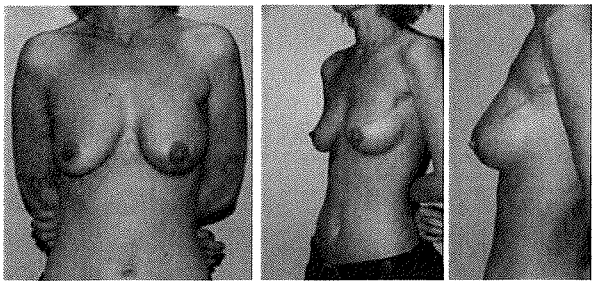
- Same skin colour, texture
- No additional scars / donor sites
- Faster recovery



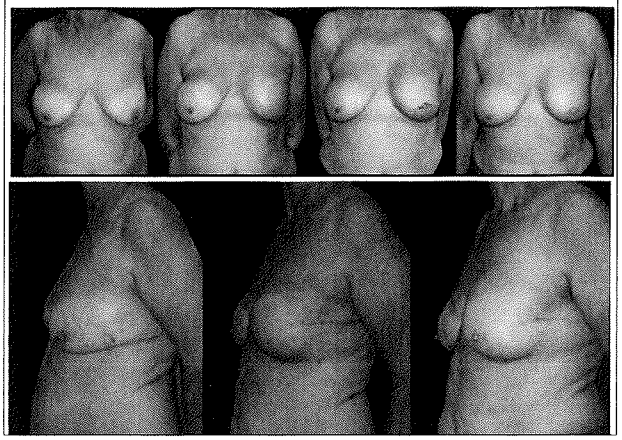


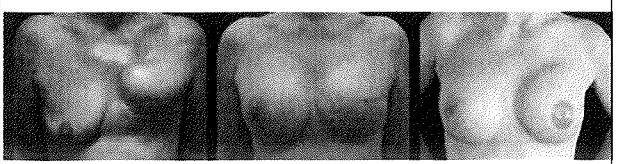


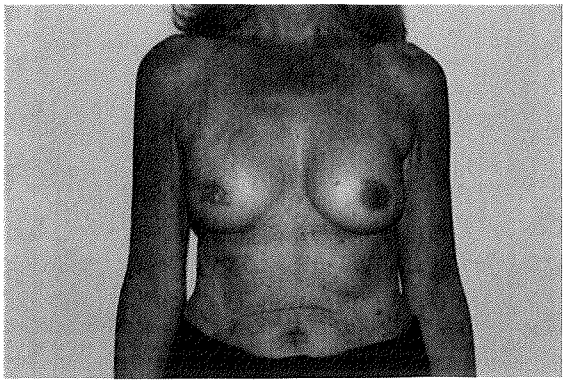




Old patient with comorbidities

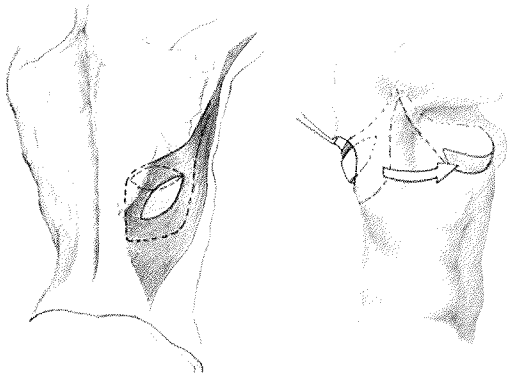


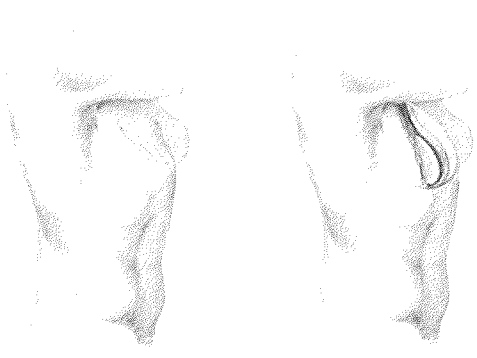


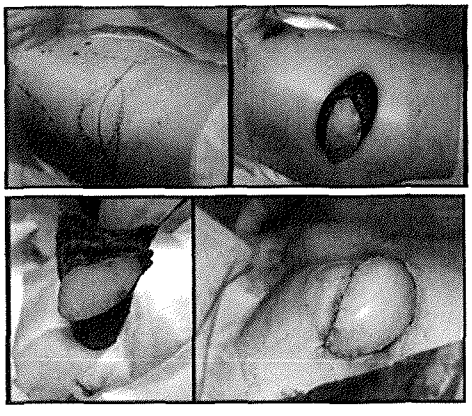


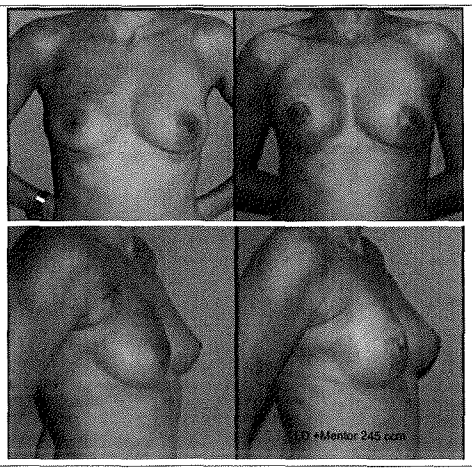
Reconstructive techniques

Autologous tissue
Expanders – prosthesis
combination



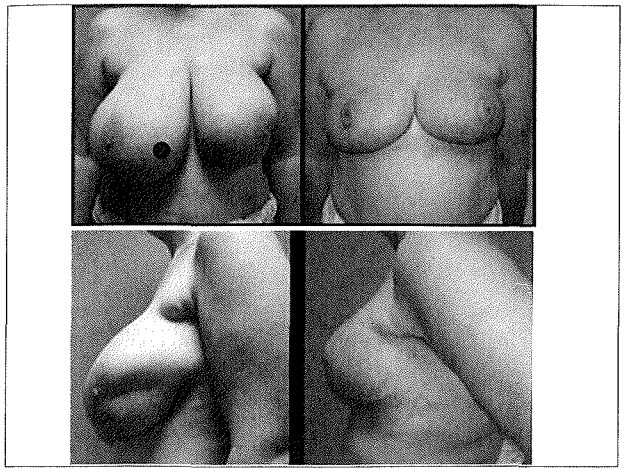


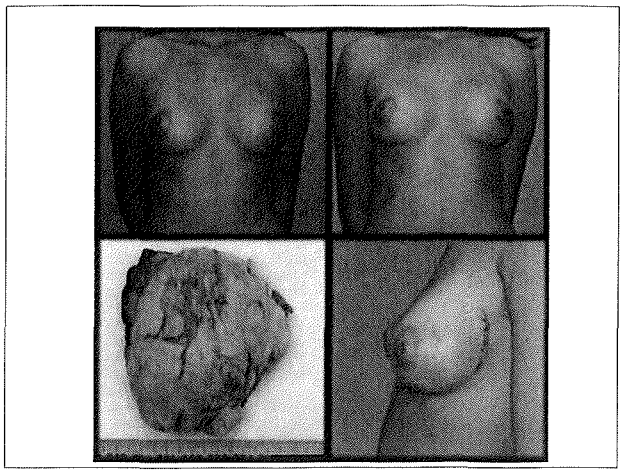




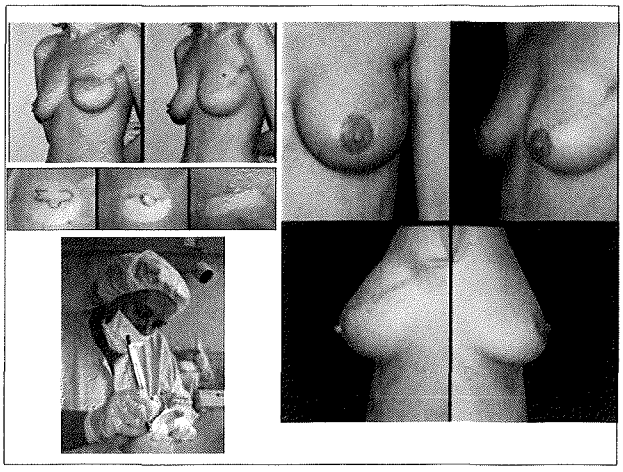
Reconstructive techniques

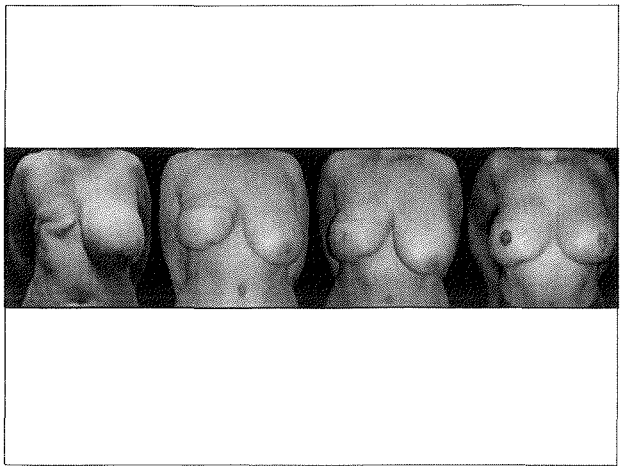
oncoplastics

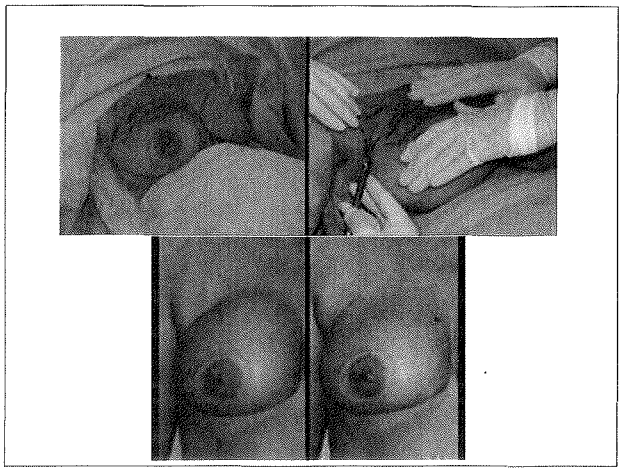


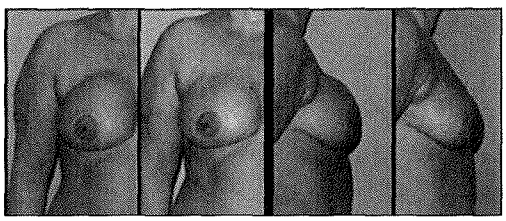


Additional procedures for symmetry

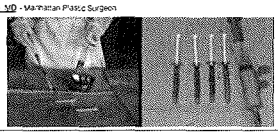


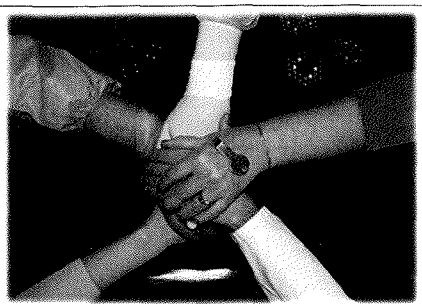






Fat transfer is not the primary technique in breast recostruction, but we often use it to add **finesse and a more natural** look AROUND the main reconstruction. The main breast reconstruction is done with an implant or a flap. But there can be hollows or defects from the mastectomy around the implant or the flap. This is where filling in with fat injections can turn a good result into a great result. Gabriel J. Banda, MD - Manhattan Plastic Surgeon



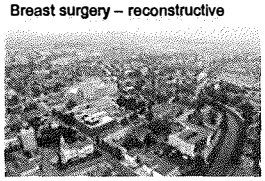


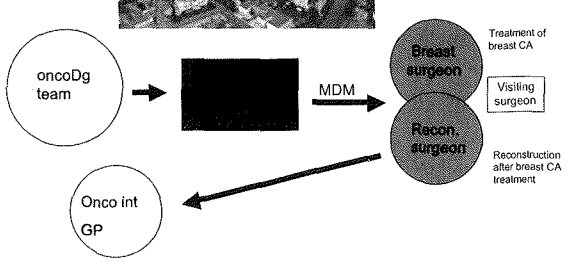
MDT – multidisciplinary teamworks LJUBLJANA

How to implement

- in a short time and without additional investment in buildings, equipment and personnel…
- link together the existing staff and infrastructure and individual experts working in different locations
- to use modern technology

Breast surgery – reconstructive

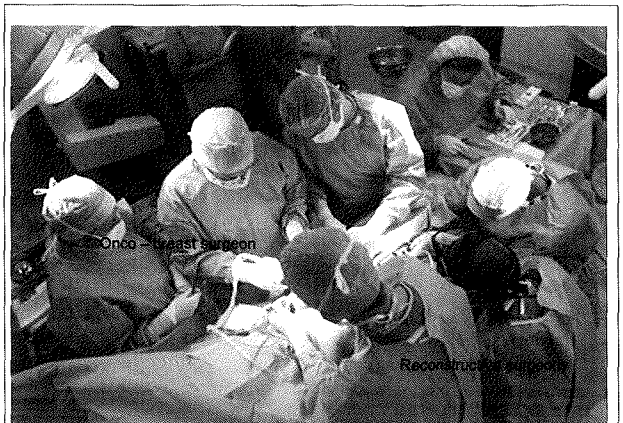




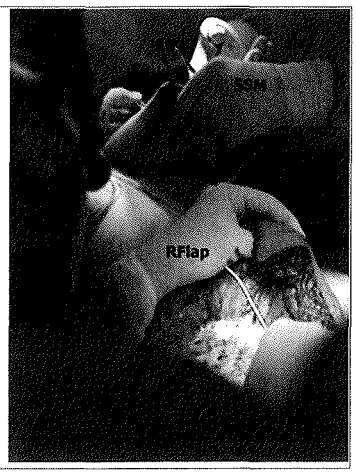
ms TRAM/DIEP flap breast reconstruction

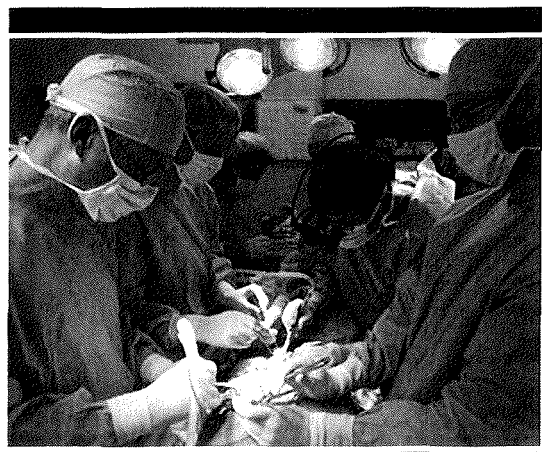
MDT ...to share new ideas

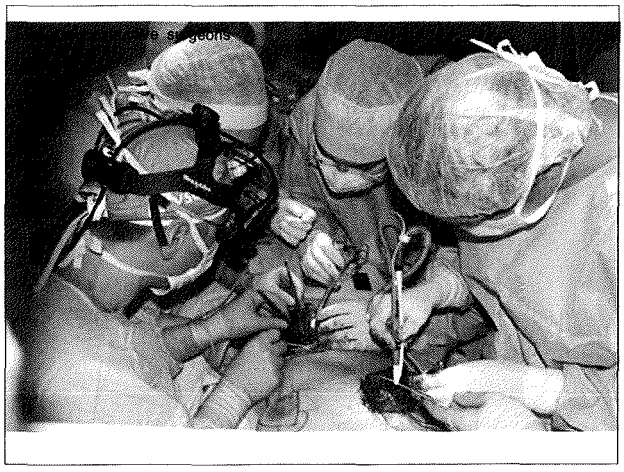
- Two team approach

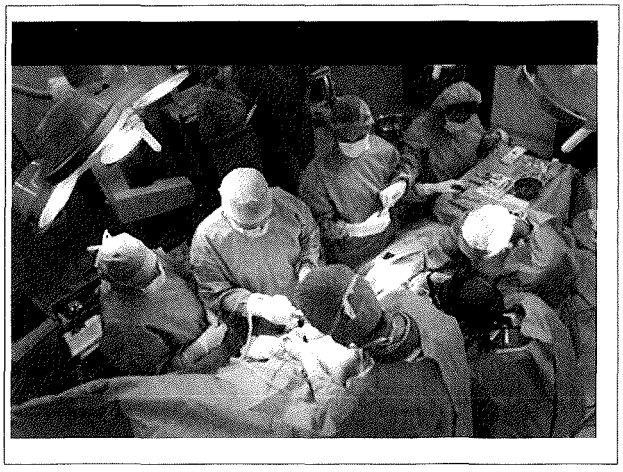


ms TRAM/DIEP
breast reconstruction

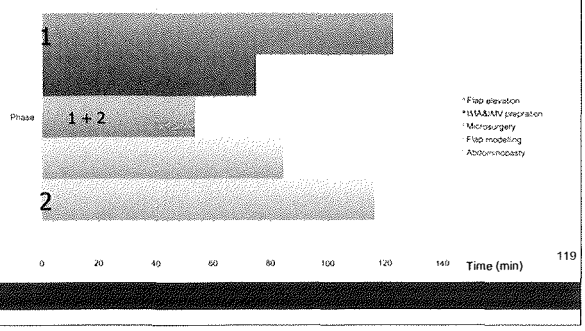








Two team approach



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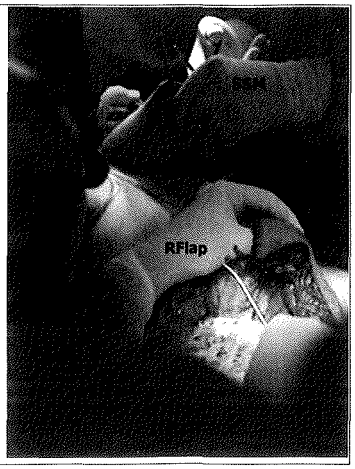
ms TRAM/DIEP
breast reconstruction

- Min 175 min (2,9 h)
- Max 435 min (7,25 h in billateral)
- Average 287 min **(4,7 h)**

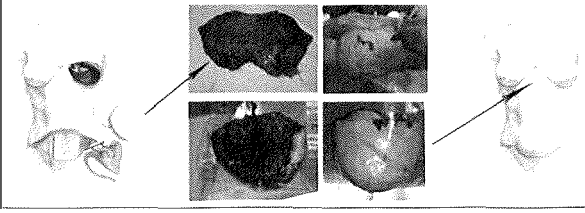


ms TRAM/DIEP flap breast reconstruction

MDT ...to share new ideas

- Two team approach
- the use of reverse engineering technology

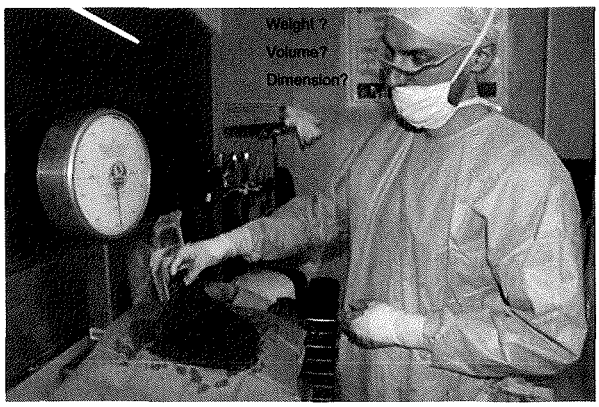
Recreating an aesthetically pleasing breast is a combination of good measurement, artistic insight and the experience of the surgeon, that are very abstract and ill-defined elements (Brandel et al, PRS 2008)

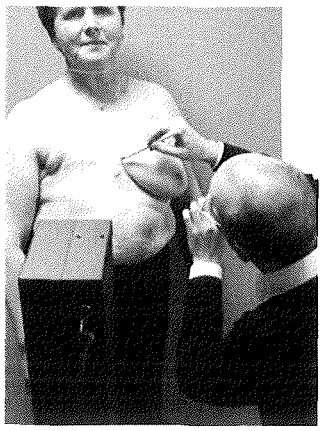


ms TRAM/DIEP breast reconstruction

optimization of autologous 2nd breast reconstruction in Ljubljana MC

In order to achieve better breast symmetry in secondary breast recontruction where the footprint, conus, and envelope have been damaged dramatically, reverse engineering technology is used.

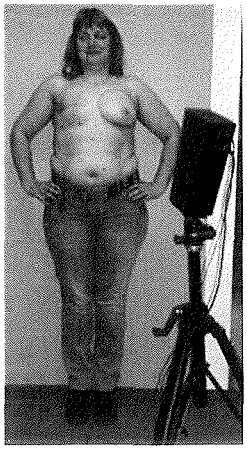




[redacted]

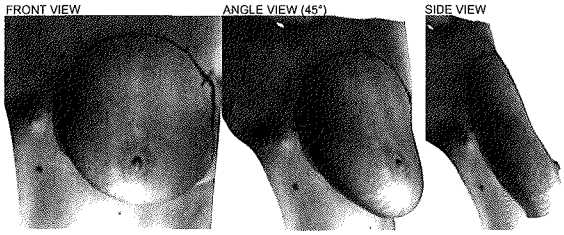
3D image of the remaining breast is taken according to the instruction from the plastic surgeon with 3D scanner by mechanical engineer.

Faculty of mechanical engineering



and processed by custom-made software for breast shape modeling and cast production.

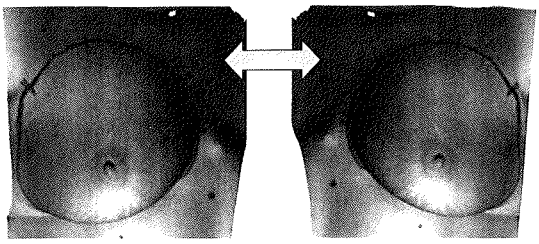
BREAST 3D IMAGE



THREE-DIMENSIONAL SHAPE of contralateral breast

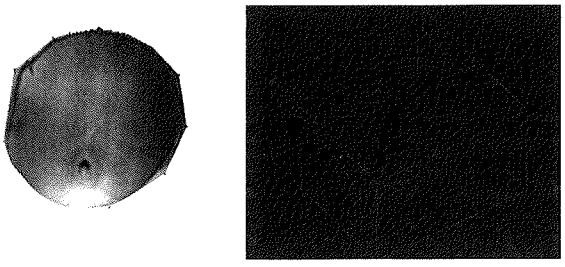
3D IMAGE PROCESSING

(1) MIRROR - replica



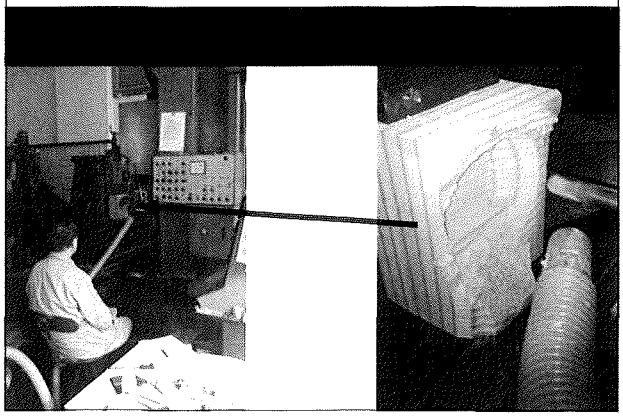
The 3D image is mirrored around the vertical axis = replica of contralateral breast

3D IMAGE PROCESSING

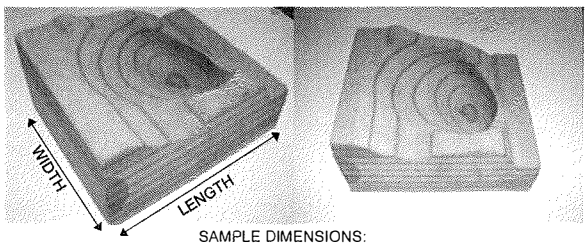


The shape is positioned in a mold coordinate system.

MILLING ON A COMPUTER CONTROLLED MACHINE TOOL



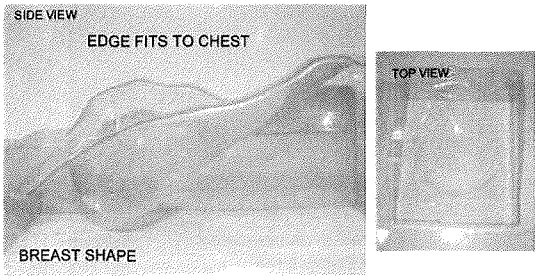
MOLD is used FOR PLASTIC VACUUM FORMING



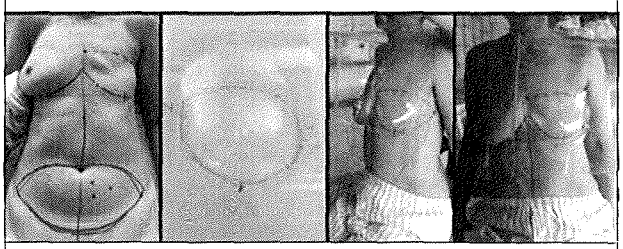
SAMPLE DIMENSIONS:
LENGTH: 300 mm
WIDTH: 250 mm
HEIGHT: 150 mm

MATERIAL: MEDIAPAN

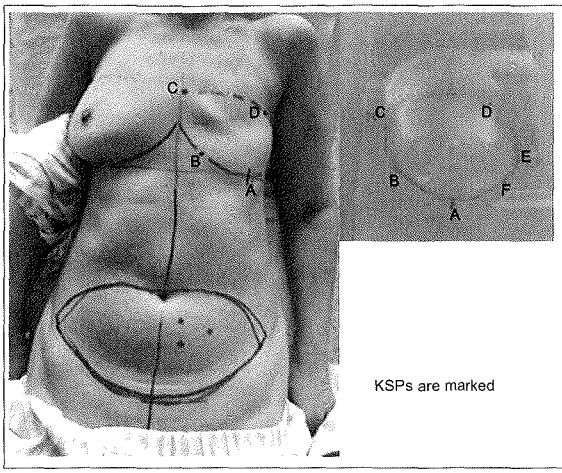
PLASTIC MOLD



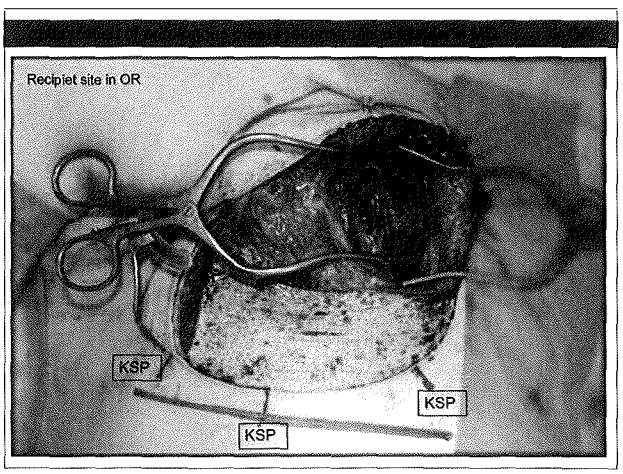
- Transparent
- Rectangular shape
- Self standing
- Rigid (tissue can be put inside)

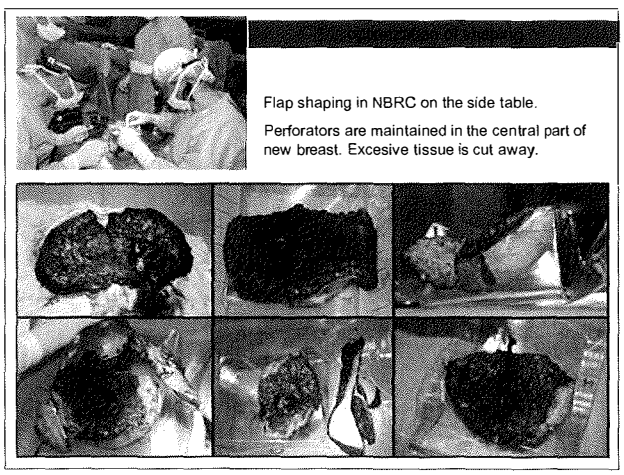


The mold has negative geometry of the contralateral breast and is used for tissue shaping during surgery.



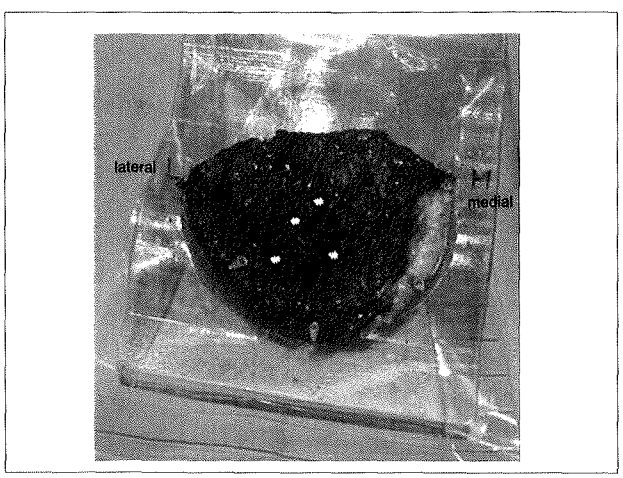
KSPs are marked

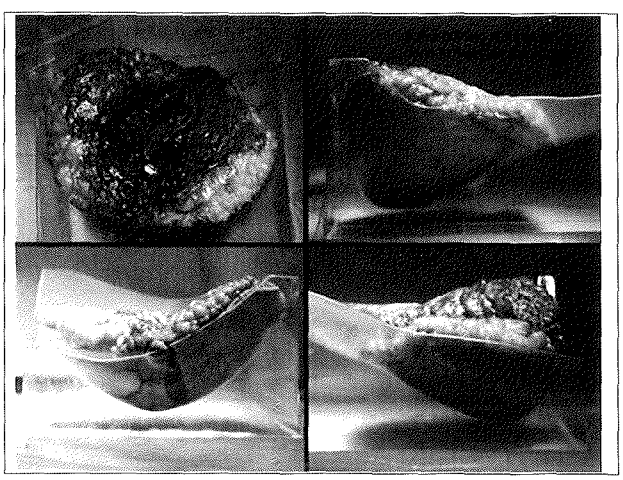


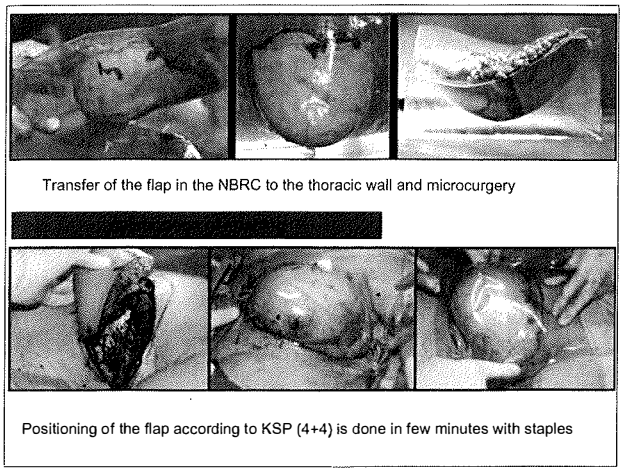


Flap shaping in NBRC on the side table.

Perforators are maintained in the central part of new breast. Excesive tissue is cut away.

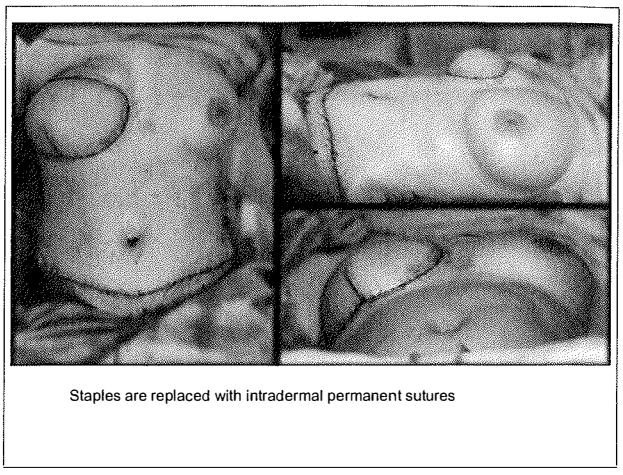






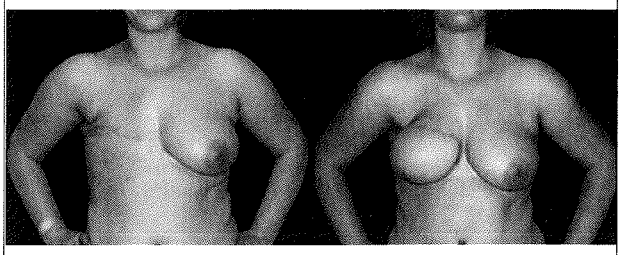
Transfer of the flap in the NBRC to the thoracic wall and microcurgery

Positioning of the flap according to KSP (4+4) is done in few minutes with staples

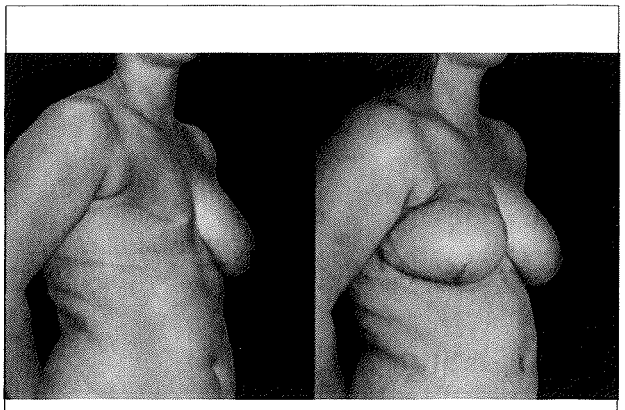


Staples are replaced with intradermal permanent sutures

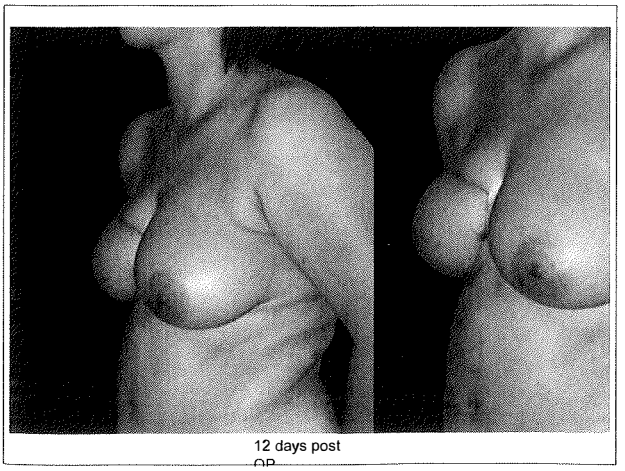
7 days post OP



12 days post
OP

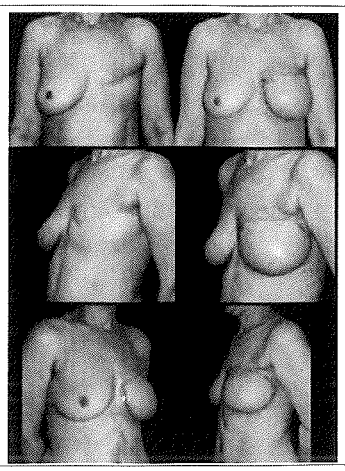


12 days post
OP



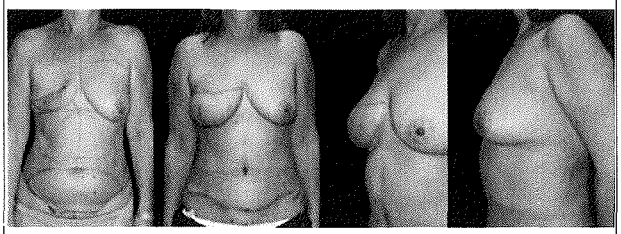
12 days post
OP

Patient 1



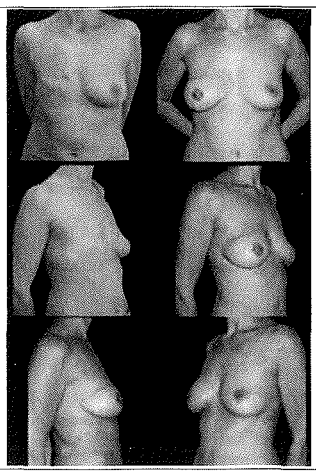
14 days post
OP

patient 2



14 days post OP

Patient 3

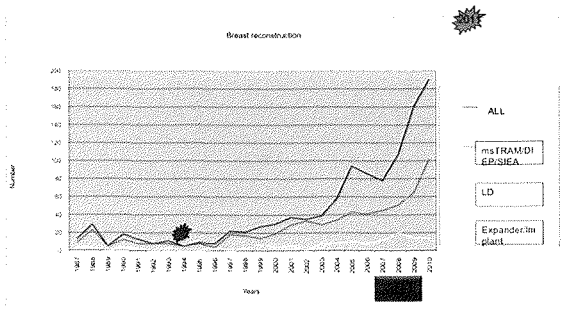


1 year post OP

- The greatest success stories were created by people who recognized a problem and turned it into an opportunity.

Joseph Sugarman

Reconstruction trends



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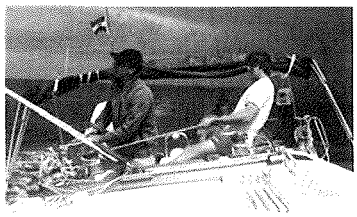
Team building

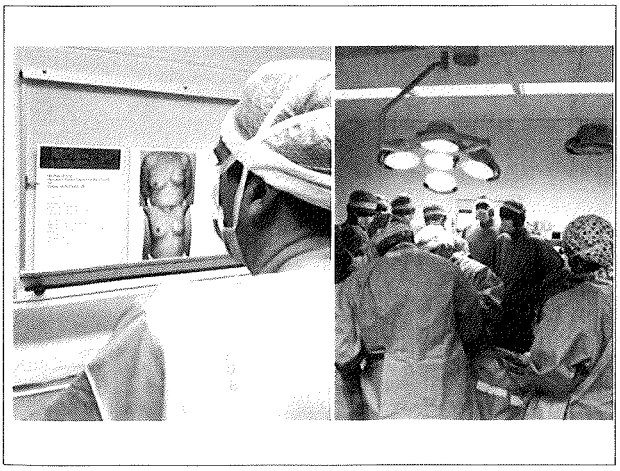
- **GREAT** people talk about **IDEAS**
- AVERAGE people talk about things
- Small people talk about other people



Media & press

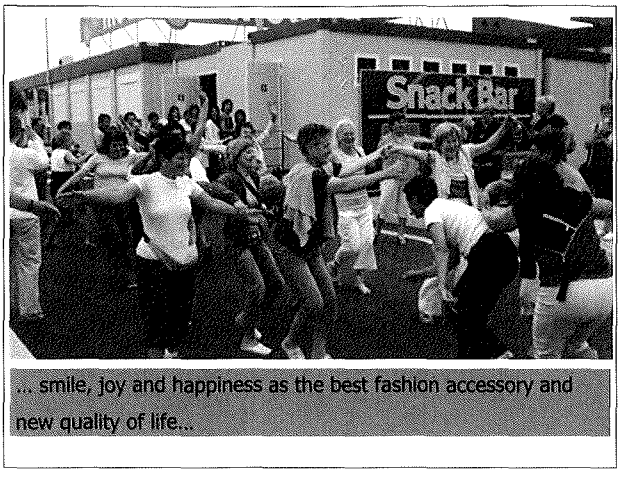
workshops

- National
- International
  - Ljubljana
    - Zagreb, Sarajevo, Beograd...

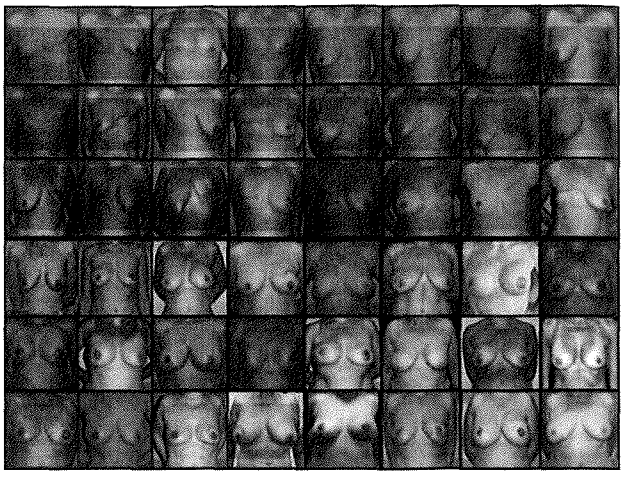


Treating breast cancer patients

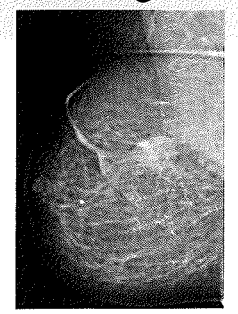
- Is a "project" which should involves large groups of people. If they work in a co-ordinated manner, with dedication and professionalism, the treatment can represent nothing more than unpleasant transitional period…
- When completed it brings relief…



... smile, joy and happiness as the best fashion accessory and new quality of life...



Postsurgical breast imaging



Hertl Kristijana
Institute of Oncology

Postoperative breast changes

[redacted]

- Percutaneous biopsy
- Excisional breast biopsy- EBB
- Breast conservation surgery- BCS (qudractectomy or lumpectomy)
- Cosmetric surgery (reduction,augumentation, reconstruktion)

Acute changes (weeks-months)

Chronic changes (months-years)

[redacted]

BENIGN

Postoperative changes

MALIGNANT

Recurrence
Primary cancer

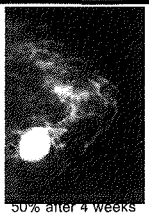
CHANGES IN POSTOPERATIVE PERIOD

[redacted] +

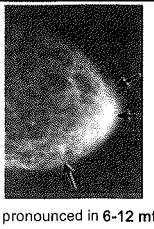
ACUTE PERIOD

Seroma/hematoma
Local skin thickness
at surgical site

Edema
(trabecular and skin thickness, hyperdensity)



Demage of lymph vessels



50% after 4 weeks
25% after 6 months

most pronounced in **6-12 mt** after RT

CHANGES IN POSTOPERATIVE PERIOD

[redacted] +

ACUTE PERIOD

Seroma/hematoma
Local skin thickness
at surgical site

Demage of lymph vessels

Edema
(trabecular and skin thickness,hyperdensity)

Resorbtion
Fibrotic healing

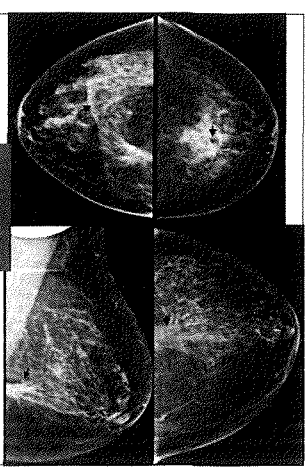
Fibrosis (scar):
- Spiculated mass
- Architectural distortion
- Microcalcification
- Local deformity/ skin thickening

Generalized **skin thickening** and **trabecular thickening**

Imaging of **postoperative chronic changes** (month-years)

1. Architectural distortion
2. Spiculated lesion
3. Local skin deformity
4. Late postirradiation changes (diffuse skin and trabecular thickness)
5. microcalcification

[redacted]



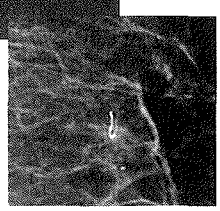
Imaging of **postiradiation chronic changes**
(month-years)

1. Architectural distortion
2. Local skin deformity
3. Spiculated lesion
4. Late postradiation changes (diffuse skin and trabecular thickness)
5. Microcalcification

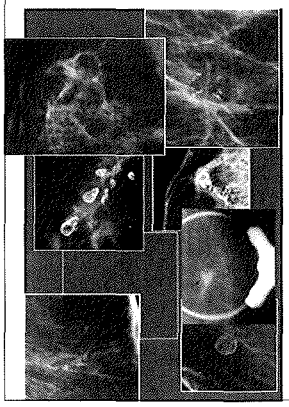
Imaging of **postoperative chronic changes**
(month-years)

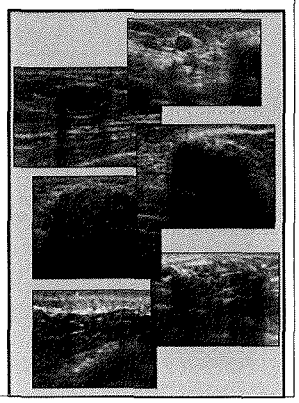
1. Architectural distortion
2. Spiculated lesion
3. Local skin deformity
4. PostRT residuals
5. Microcalcifications

Suture MK
Distrophic MK
Fat necrosis MK

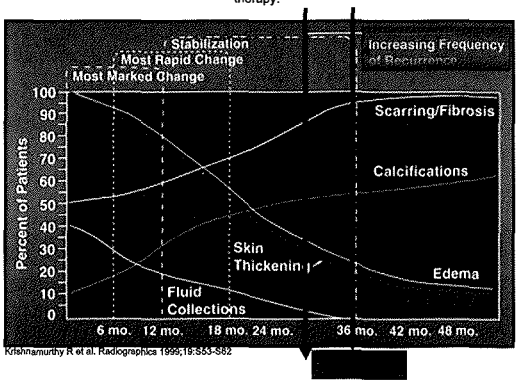


FAT NECROSIS- one diagnosis, many faces





Characteristic mammographic findings in 6- and 12-month intervals after breast conservation therapy.



Krishnamurthy R et al. Radiographics 1999;19:S53-S62

RadioGraphics

TUMOR RECURRENCE **1%/per year**

EARLY recurrence: → [redacted] → <5-6 y. local recurrence

LATE recurrence: → elsewhere in breast → >6 y. second primary tumor

[redacted]

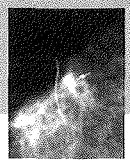
STABILIZATION of mmg changes 2-3 y. after OP →

Signs of recurrence:
- increased size/density of scar
- Increased skin thickening
- development of mlg MK
- new solid mass near the scar

DIAGNOSTIC WORKUP

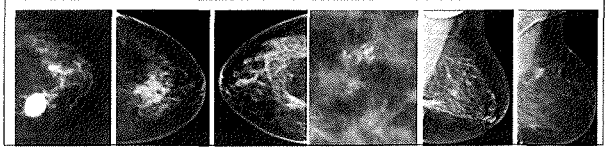
OP → 3-6w. → RT (5w) → 1st mmg 6-12 mt after th → every year control

- mammographic evaluation + correlation with history, pathol
- scar markers are helpful
- additional mammographic projections
- valueable PRIVIOUS FILMS
- US, MR, needle biopsy



Take home message

- Surgery and RT can produce permanent changes in the breast
- These changes are: skin and trabecular thickening, scar (architectural distortion,spiculated lesion), calcifications, fat necrosis
- They must be differentiated from tumor recurrence
- Previous films are extremly helpful
- First mammogram obtained 6-12 month after op
- Changes due to surgery stabilized in 2-3 years.



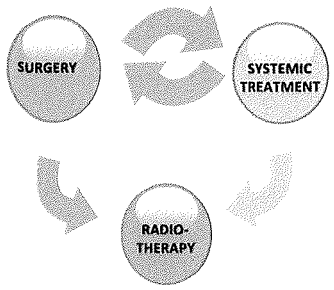
THANK YOU

Systemic treatment of breast cancer

Simona Borštnar
Division of Medical Oncology
Institute of Oncology Ljubljana

Ljubljana, March 2012

Management of Breast Cancer



Systemic Treatment of Breast Cancer

EARLY BREAST CANCER

DIAGNOSIS (biopsy) → SURGERY → TUMOR CHARACTE-RISTICS → ADJUVANT SYSTEMIC TREATMENT +/- RT

LOCALY ADVANCED BREAST CANCER

COR BIOPSY → TUMOR CHARACTE-RISTICS → NEOADJUVANT CHEMO-THERAPY → SURGERY → ADJUVANT SYSTEMIC TREATMENT +RT

METASTATIC BREAST CANCER

BIOPSY OF MERASTASIS — ST 1 — ST 2 — ST 3 — ST 4 — ST 5

ST= systemic tretment

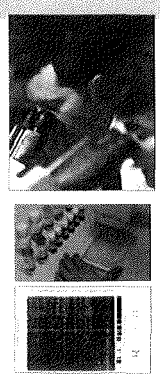
Adjuvant Therapy of Early Breast Cancer

Adjuvant therapy is based on the principle that breast cancer is a systemic disease at the time of diagnosis with undetectable dormant micrometastases which may develop into clinically relevant metastases years after primary diagnosis.

Systemic therapies aim to prevent or delay distant metastases.

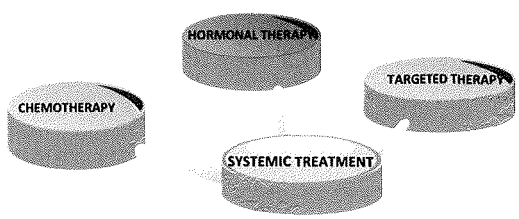
Tumor Characteristics

1. Tumor size
2. Nodal status
3. Histological grade
4. Limpho-vascular invasion
5. Hormone receptors (ER, PR)
6. HER-2 status
7. KI67 (MIB-1)
8. uPA, PAI-1
9. Gene signature

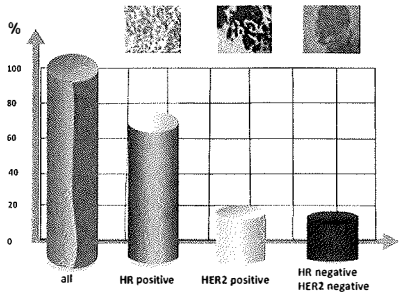


ER=estrogen receptors,
PR=progesterone receptors
HER-2=Human Epidermal Growth Factor Receptor 2
uPA=urokinase-type plasminogen activator
PAI-1=Plasminogen activator inhibitor-1

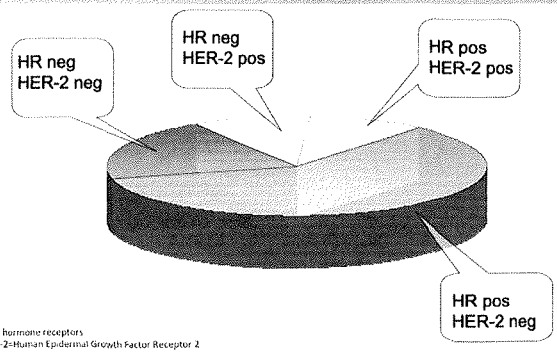
Systemic Treatment of Breast Cancer



Distribution of HR and HER2

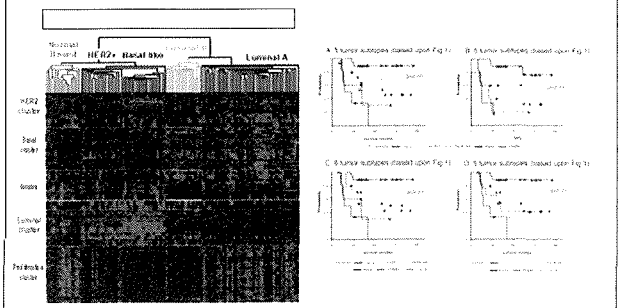


Distribution of Hormone Receptor and HER-2 Receptor status



HR= hormone receptors
HER-2=Human Epidermal Growth Factor Receptor 2

Molecular Classification of Breast Cancer



Perou CM et al. Molecular portraits of human breast tumours. Nature 406:747–752, 2000
Sorlie T, Perou CM et al. Gene expression patterns of breast carcinomas distinguish tumor subclasses with clinical implications. Proc Natl Acad Sci USA 2001, 98:10869-10874.

Surrogate Definitions of Intrinsic Subtypes of Breast Cancer

INTRINSIC SUBTYPE	CLINICO-PATHOLOGY DEFINITION	
LUMINAL A	**Luminal A**	ER and/or PR positive HER-2 negative Ki-67 low
LUMINAL B	**Luminal B (HER-2 negative)**	ER and/or PR positive HER-2 negative Ki-67 high
	Luminal B (HER-2 positive)	ER and/or PR positive HER-2 positive Ki-67 any
HER2 OVEREXPRESSION	**HER-2 positive (non luminal)**	HER-2 over-expressed or amplified ER and PR absent
BASAL -LIKE	**Triple negative (ductal)**	ER and PR absent HER-2 negative

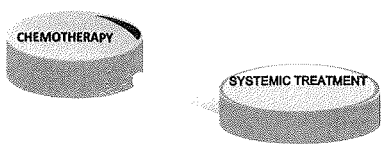
ER=estrogen receptors,
PR=progesteronereceptors
HER-2=Human Epidermal Growth Factor Receptor 2

Treatment Options

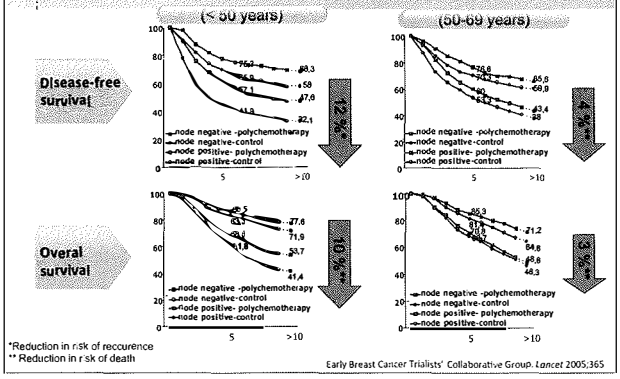
Triple negative (ductal)	Luminal B (HER2 negative)	Luminal B (HER2 positive)	HER2 positive (non luminal)	Luminal A
ChT	ChT + HT	ChT + Anti-HER2 therapy* + HT	ChT + Anti-HER2 therapy*	HT

ChT= chemotherapy
HT=hormonal therapy
*currently trastuzumab only

Systemic Treatment in Breast Cancer: Chemotherapy



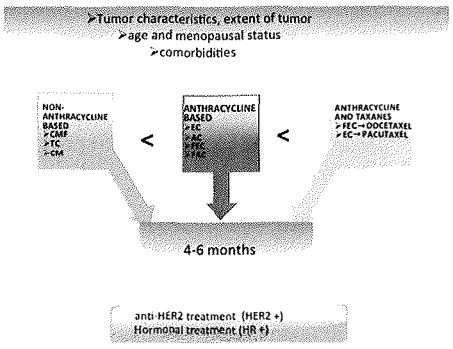
Effect of Adjuvant Chemotherapy on Breast Cancer Relapse



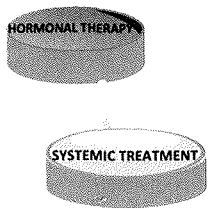
*Reduction in risk of reccurence
** Reduction in risk of death

Early Breast Cancer Trialists' Collaborative Group. *Lancet* 2005;365

Adjuvant Chemotherapy

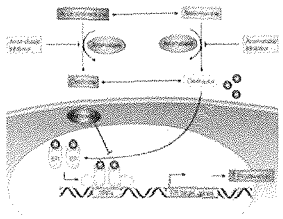


Systemic Treatment in Breast Cancer: Hormonal Therapy

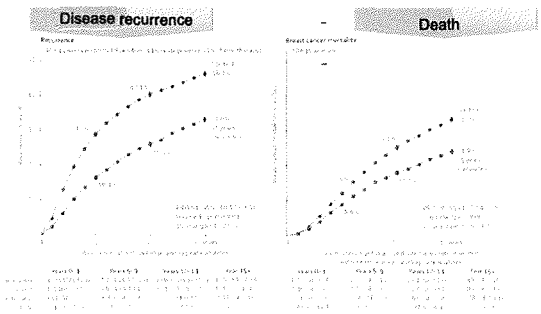


Hormonal Treatment

➢ For women with strongly estrogen and/or progesterone receptor-positive breast cancer, hormonal therapy is the mainstay of treatment



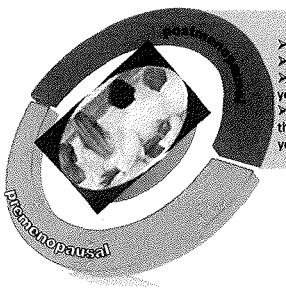
Effect of Adjuvant Hormonal Therapy on Breast Cancer Relapse and Death



Lancet. 2011 August 27; 378(9793): 771–784.

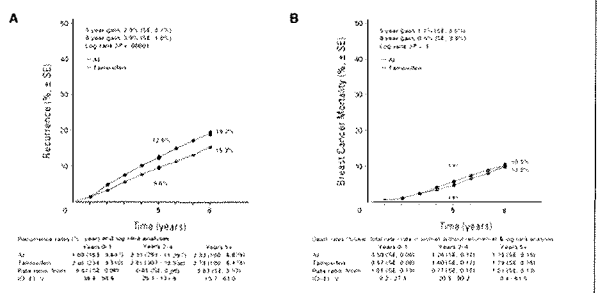
Adjuvant Hormonal Treatment in Premenopausal and Postmenopausal Breast Cancer Patients

➢Tamoxifen 5 years +/- ovarian supression/ ablation



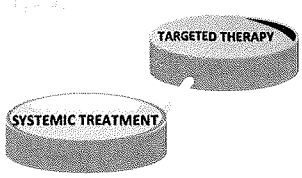
➢Tamoxifen for 5 years
➢AI for 5 years
➢Switch: AI started at 2–3 years after tamoxifen
➢extended adjuvant therapy – AI started after 5 years of tamoxifen

Meta-Analysis of Aromatase Inhibitors Versus Tamoxifen

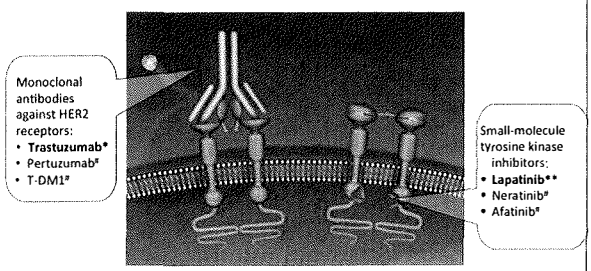


Dowsett, M. et al. J Clin Oncol; 28:509-518 2010

Systemic Treatment in Breast Cancer: Targeted Therapy



Strategies for HER2 Receptor Inhibition



* the only anti HER2 drug that is approved in adjuvantsetting
**approved in metastatic setting
not (yet) approved

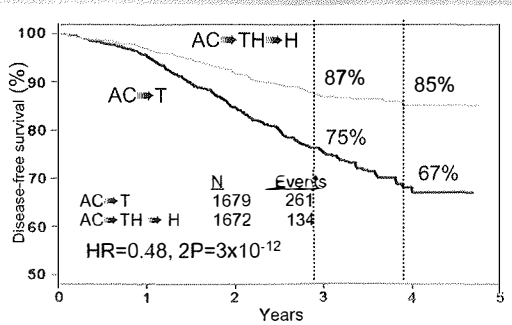
Adjuvant Trastuzumab Treatment

DFS	HR = 0,49	p = 0,001
OS	HR = 0,63	p < 0,004
DFS	HR = 0,64	p < 0,0001
OS	HR = 0,66	p < 0,0115
AC → TH		
DFS	HR = 0,61	p < 0,0001
OS	HR = 0,67	p < 0,004
TCH		
DFS	HR = 0,59	p = 0,0003
OS	HR = 0,66	P = 0,017
RFS	HR = 0,42	p = 0,01
OS	HR = 0,41	p = 0,07

5 clinical trials
> 13.000 patients

Slamon et al 2011;
Piccart et al 2007;
Perez al 2007;
Joensuu et al 2005

Joint Analysis (B31/N9831) Chemotherapy vs. Chemotherapy + Trastuzumab



B31/N9831

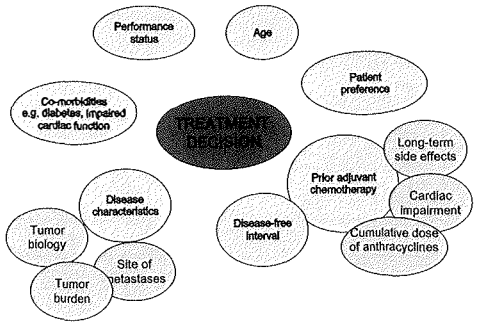
Management of Metastatic Breast Cancer (MBC)

- 6% of breast cancer patients are found to be metastatic at the time of diagnosis.
- Approximately 20-30% of patients diagnosed with early breast cancer will eventually develop metastatic disease.
- The most common sites of breast cancer metastasis are the bone, lungs, liver and brain.
- Metastatic breast cancer is increasingly a chronic and recurrent disease characterized by remission and relapses, the best predictor of outcome is previous response.
- The median survival for these patients is approximately two to three years.
- Approximately one-fifth MBC patients will survive 5 years.

The Primary Goals of Treatment in MBC Include:

- maximizing the quality of life (QoL)
- prevention and palliation of symptoms and
- prolongation of survival

Factors Influencing Chemotherapy Decisions in Advanced Breast Cancer



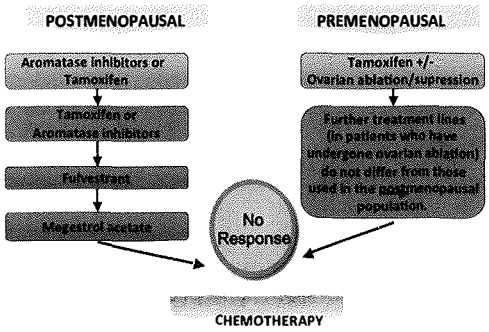
Prognostic Factors in Patients with Metastatic Breast Cancer

Prognostic factor	Favourable	Unfavourable
Performance status	Good	Poor
Sites of disease	Bone, soft tissue	Viscera, CNS
No. of sites of disease	Few	Multiple
Hormone receptor status	Positive	Negative
Her-2/*neu* status	Negative	Positive*
Disease-free interval	>2 years	<2 years
Prior adjuvant therapy	No	Yes
Prior therapy for MBC	No	Yes

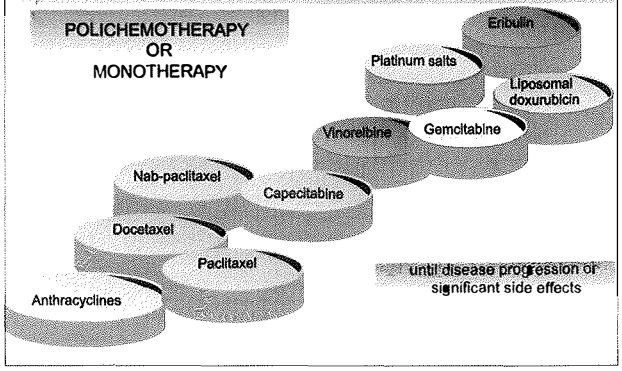
* (significance less clear in Her-2/*neu* inhibitors era

Beslija et al (CECOG). Ann Oncol. 2009;20(11

Treatment Sequence for Women With Hormonal Receptor Positive Metastatic Breast Cancer



Chemotherapy in Metastatic Breast Cancer



Management of Patients with HER 2 positive Metastatic Breast Cancer

Trastuzumab in combination with:

- Taxanes
- Capecitabine
- Vinorelbine
- Platinum compounds
- Gemcitabine
- Aromatase inhibitors in HR positive MBC only

Lapatinib in combination with:

- Capecitabine
- Aromatase inhibitors in HR positive MBC only

Response rate: 24-81%

Systemic Treatment of Bone Metastases

Bone metastases occur in over **70%** of patients with metastatic breast cancer. They are usually identified because of pain or during staging after metastatic disease has been identified at other sites.

Patients with symptomatic bone metastases should be treated with bone modifying agents to reduce the risk of skeletal-related events, such as:

- pathological fractures,
- spinal cord compression,
- bone pain requiring palliative radiotherapy and
- orthopaedic surgery.

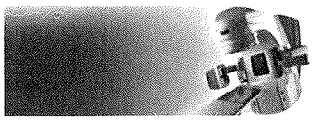
Conclusions: Early Breast Cancer

- Adjuvant hormonal treatment and chemotherapy reduces the risk of recurrence of breast cancer and improves survival.
- The absolute benefit for an individual woman depends on her initial risk.
- For women with strongly estrogen-receptor-positive breast cancer, endocrine treatment is the mainstay of treatment and the additional benefit of chemotherapy should be considered.
- Women with HER2- positive breast cancer should be offered anti-HER2-targeted therapy as part of standard adjuvant treatment.

Conclusions: Metastatic Breast Cancer (MBC)

- The goals of treatment in MBC are quality of life, prevention and palliation of symptoms and prolongation of survival.
- Tumor biology, site of recurrence, extent, time to recurrence and co-morbidities are critical determinants of prognosis and treatment of MBC.

RADIOTHERAPY IN BREAST CANCER TREATMENT



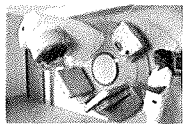
Tanja Marinko
Radiation Oncologist
Department of Radiation Oncology
Institute of Oncology Ljubljana
March 2012

Introduction

- Local treatment
- used for more than 100 yr
- Intent of the treatment radical /palliative → Radical RT
  Palliative RT

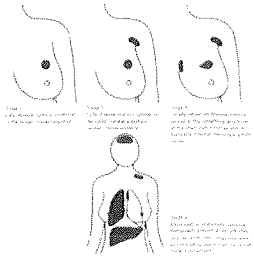
❑ **Radical RT:**
- we try to destroy all tumor cells in the irradiated area
- total doses are higer

❑ **Palliative RT:**
- for metastatic disease
- to relieve the symptoms of disease
- total doses are lower



Radical RT in breast cancer treatment

- used for nonmetastatic disease
- mostly adjuvant
- after mastectomy /breast conserving therapy



Adjuvant radiotherapy-

sequencing of multimodality treatment

RT: - after surgery or adjuvant CT
- concurrent with HT and/or trastuzumab

Adjuvant RT in early breast cancer

❑ EBCTCG analysis (Lancet 2005):

- Post-operative radiotherapy for breast cancer reduces the local recurrence rate by a factor of 3-4.
- One breast cancer death is avoided for every four local recurrences avoided- both after breast conserving therapy and modified radical mastectomy

General indications for adjuvant RT in breast cancer

❑ **RT after mastectomy:**

In case of :
- tumor > 5 cm → chest wall radiation
- 4 or more positive axillary nodes or T4 →
  chest wall + periclavicular (infracl.,supracl.) nodes
- 1-3 positive axillary nodes consider locoregional radiotherapy if: young age, risk factors for local recurrence

General indications for adjuvant RT in breast cancer

- **RT after breast conserving therapy: (DCIS and invasive cancer)**

- always in case of conservative surgery →whole breast RT
- tumorbed boost:
  - -in case of complete resection and ≤ 50 yr
  - -in case of complete resection > 50 yr and risk factors for LR

Prescription of the dose

- standard dose for breast/chest wall (postoperative RT): TD=25 x 2 Gy (5 weeks)
- hypofractionation : TD=16 x 2.67 Gy

- When comparing different schemes simple math is not applicable - we have to use the principles of radiobiology

- 25 x 2 Gy ≠ 20 X 2.5 Gy !!

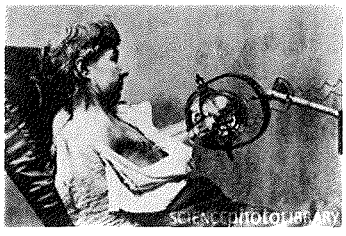
Tumor bed boost radiotherapy

- indication:
  after conservative surgery
  - all patients < 50 yr
  - all patients with close margins

- dose: 10-16 Gy (2 Gy/fr)
  - The closer the margin- the larger the dose

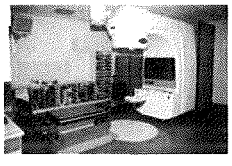
RT in breast cancer treatment in the past

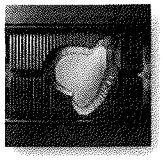
- yr 1903



Nowadays we use linear accelerators...

better equipment, better knowledge of radiobiology → better techniques for treatment planning and delivery → more protection of healthy tissues



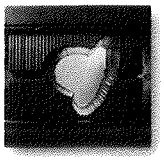


protection of healthy tissues with multiliefe collimators

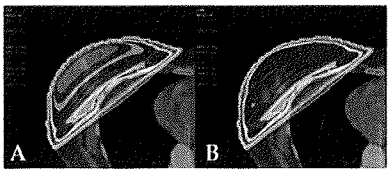
3D conformal radiation therapy

- modern technique, uses computer technology
- the beams of radiation used in treatment are shaped to match the tumor
  →target cancer while sparing healthy tissues

- radiation is focused precisely on the tumor, while avoiding the healthy surrounding tissue.

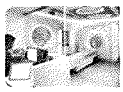


3D conformal radiation therapy



Result:
1. healthy tissues are protected from radiation to a much greater extent as was possible in the past
2. target volume (tumor cells) is covered with a more homogeneous dose

3D conformal radiation therapy
The whole procedure-basic steps



treatment planning:
- **Step 1: imaging for treatment planning**
- **Step 2: organ delineation**
- **Step 3: field set –up**
- **Step 4 : plan evaluation**

treatment delivery

Treatment planning

step 1: imaging for treatment planning

step 2: organ delineation

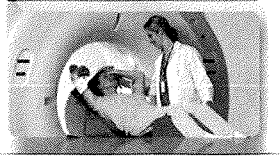
step 3: field set –up

step 4: plan evaluation

Step 1: imaging for treatment planning (simulation)

CT scan:

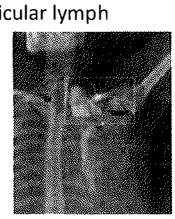
- CT scanning: standard for planning breast radiotherapy
- Image of the area of the body that needs to be irradiated
  (CT slices, 3-5 mm)



Step 2: organ delineation

- Based on CT image radiotherapist draws:

1. Target volume:
   - breast/chest wall
   - periclavicular lymph nodes



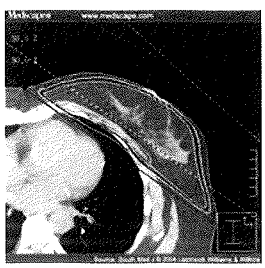
2. Organs at risk:
   - heart, lung
   - in the case of regional nodes irradiation: trachea, esophagus, medula

Step 3: field set-up

- treatment plan:

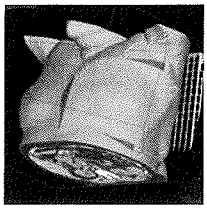
- main principle : two opposite tangential fields

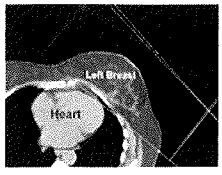
- displays :
  1. target tissue dose
  2. doses to healty tissues (heart, lung, ...)



- 3D RT- left breast – we have to be careful of the heart

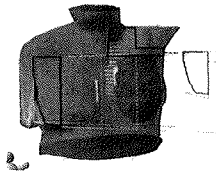
  Always capture in the field the smallest possible part of the heart- If necessary, adjust the target volume (breast, chest wall)

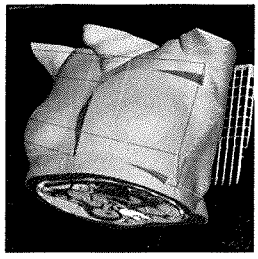




If more than 4 positive axilary nodes:

breast /chest wall + infraclavicular and supraclavicular nodes

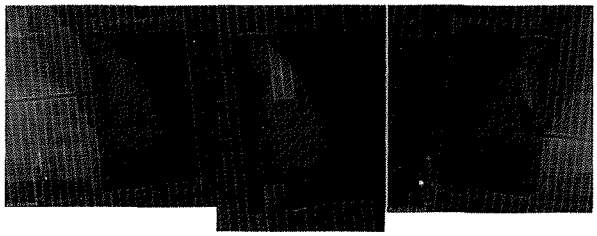




step 4: plan evaluation

Treatment delivery

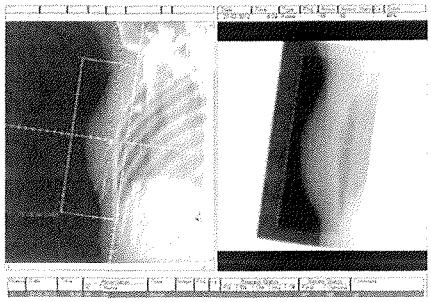
portal images- Beam's- eye-view



Patient Setup Error Assessment (Electronic Portal Image Devices)

Treatment delivery

portal images- Beam's- eye-view

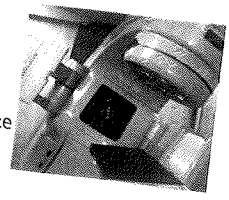


Patient Setup Error Assessment (Electronic Portal Image Devices)

Morbidity after adjuvant radiotherapy of early breast cancer

The risk of morbidity is a key factor in the planning and decision making of how and when RT should be used in breast cancer treatment

Knowledge of morbidity is therefore of the utmost importance



Side effects of RT

early side effects

late side effects

technique of irradiation, anatomical characteristics of patient, surgical technique, associated systemic treatment

Early side effects

- **during and up to 3 months after RT**
- **reversibile**
- skin erythema, dry or moist desquamation

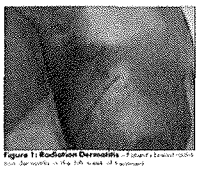


Table 2. Grades of Dermatitis Associated with Radiation/Chemoradiation

Adverse Event	Short Name	1	2	3	4	5
Acute dermatitis associated with radiation therapy + Chemotherapy + Radiation	Dermatitis	Faint erythema or dry desquamation	Moderate to brisk erythema; patchy moist desquamation, mostly confined to skin folds and creases; moderate edema	Moist desquamation other than skin folds and creases; bleeding induced by minor trauma or abrasion	Skin necrosis or ulceration of full dermal thickness; spontaneous bleeding from involved site	Death

Grade 2 skin reaction

Late side effects

- **from 3 months post RT to many years after**
- **often irreversible**
- **may be progressive in severity**

- subcutaneous fibrosis, atrophy of the skin
- vascular damage - telangiectasia- → change in breast appearence, poor aesthetic outcome 5%
- arm edema 5-20%
- pneumonitis and lung fibrosis 1-2%
- heart disease
- brachial plexus damage <1%
- secondary malignancy < 0.1%

Lung

- radiation pneumonitis and lung fibrosis

- clinicaly evident pneumonitis : 1-2 %,
  radiological evident changes: more often
  (pulmonary infiltrate in the irradiated volume)

<u>Radiation pneumonitis:</u>

Greater the irradiated lung volume, the greater the likelihood of pneumonitis

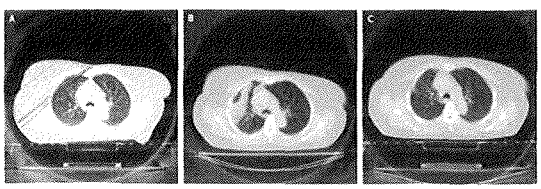
→ more frequent in patients with irradiated breast/chest wall and periclavicular nodes

Lung

- much greater risk of developing pneumonitis if anthracyclines are administered with RT
  (9% vs 1.3%)
  => RT for at least 3 weeks after CT with anthracyclines

- CT with taxanes:
  also an increased risk of pneumonitis

Images in Clinical Medicine
Radiation Pneumonitis after Radiotherapy for Breast Cancer
Edwin Bölke, M.D., and Christiane Matuschek, M.D.
N Engl J Med 2009; 361:e65



Images in Clinical Medicine

Radiation Pneumonitis after Radiotherapy for Breast Cancer

Edwin Bölke, M.D., and Christiane Matuschek, M.D.

N Engl J Med 2009; 361:e65

A 58-year-old woman with a history of stage I cancer in the right breast (T1N0M0, according to the tumor–node–metastasis classification) presented with a 2-week history of shortness of breath and cough. Eight months before presentation, she had undergone lumpectomy and adjuvant radiotherapy to the affected breast. Over a period of 5 weeks, the patient had been treated with a total dose of 50 Gy of radiation over the targeted field, which included breast parenchyma and a portion of the anterior lung, as shown on computed tomography (CT) with superimposed isodose lines (Panel A). The radiotherapy had ended 6 months before presentation. Subsequent CT showed typical features of radiation pneumonitis, which included consolidation in a nonanatomical distribution that did not conform to lobes or bronchopulmonary segments (Panel B). Many air bronchograms are visible with slight dilatation of peripheral bronchi, which often progresses to traction bronchiectasis. Although pneumonitis occurs mainly within the irradiated areas of the lung, it may spread to nonirradiated areas. The patient was given prednisolone at a dose of 100 mg once a day for 3 days, with the dose then slowly reduced, and her symptoms resolved after 5 weeks of treatment (Panel C).

Heart

The risk of radiation induced heart disease depends on:

- total dose of radiation received and irradiated volume of heart
  - dose at each fraction of radiation
  - systemic cardiotoxic therapy (anthracycline, trastuzumab) received
  - age of patients - younger patients are more vulnerable
  - presence of other risk factors for heart disease (smoking, diabetes, arterial hypertension, hyperlipidemia)
  - already established heart disease

Heart

late side effects: after years, decades

The mechanism of failure:
damage to blood vessels, aseptic inflammation → fibrosis

Defects can be in all tissues of the heart: pericardium, myocardium, heart valves, coronary arteries, capillaries, conductive system

- acute pericarditis
- chronic pericarditis
- coronary-disease, ischemic heart disease
- cardiomyopathy
- valvular disease
- conduction disturbances

Heart

old RT techniques : irradiated much higher proportion of heart→ high morbidity from heart disease, especially in patients who were treated after left-sided mastectomy

with new RT techniques the heart dose is significantly lower

Arm edema

incidence depends on the extent of previous surgery (SNB / axillary dissection)

a major risk factor for the occurrence of arm edema is surgery in the axilla, radiotherapy has less impact

Rib fractures

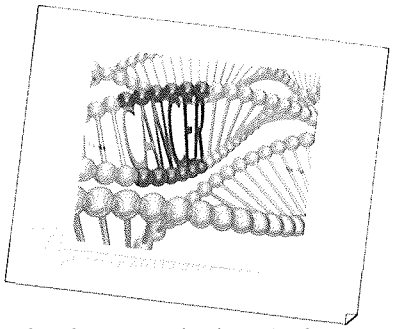
- mostly asymptomatic
- discovered accidentally in the chest x-ray examinations or skeletal scintigraphy
- no specific therapy
- heal spontaneously

Brachial plexus damage

- very rare
- at periclavicular (SCL) field irradiation
- at higher daily doses of irradiation

Secondary tumors

- sarcoma, angiosarcoma (in-field)



Appropriate use of RT far outweighs the risk of radiation-induced malignancy.

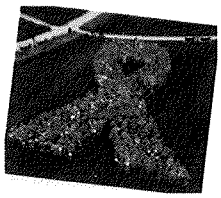
Palliative radiotherapy

- major role in the palliation of locally advanced and fungating breast tumours
- bone, brain, skin, lymph nodes metastases

- prognostic factors, PS and patient preference all affect the final decision made by multidisciplinary team
- TD is smaller, D/fr is higher
  (TD= 5X4 Gy/fr ; 10X3 Gy/fr ;1X8Gy/fr)

Conclusion

- adjuvant RT in early breast cancer significantly reduces the risk of local and regional recurrences and it has an impact on survival



Dora

SCREENING IN SLOVENIA –
where are we now

KADIVEC Maksimiljan
HERTL Kristijana
Institute of Oncology Ljubljana
SLOVENIA

5th International School of Breast Imaging,
29th – 31st of March 2012
Ljubljana.SLOVENIA

WHY?

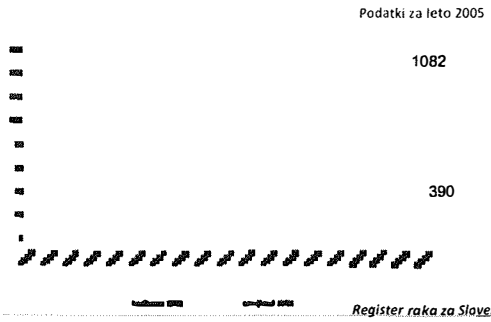
1. EU suggestions
2. Results of the statistics
3. Education of the women population

1

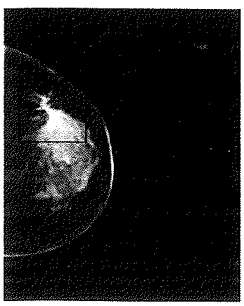
EU,
in june 2003 suggest to EU members,
to begin breast screening program till 2008,
to lower breast cancer mortality for 25 %

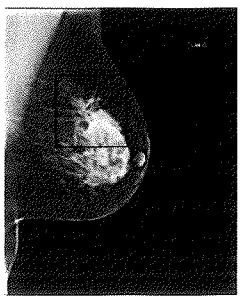
2

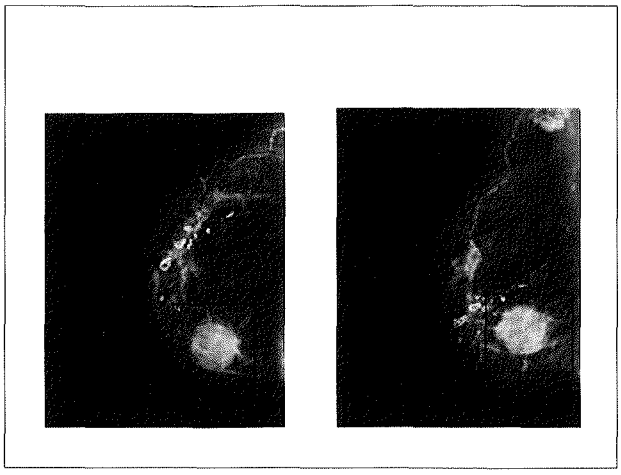
Breast cancer is important problem of the public health

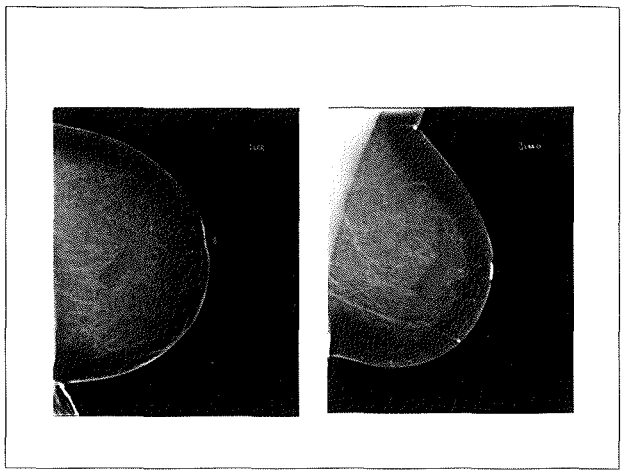


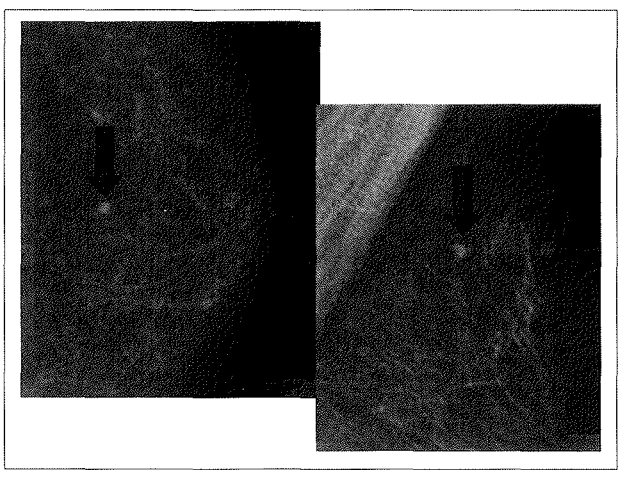
3 education of the population

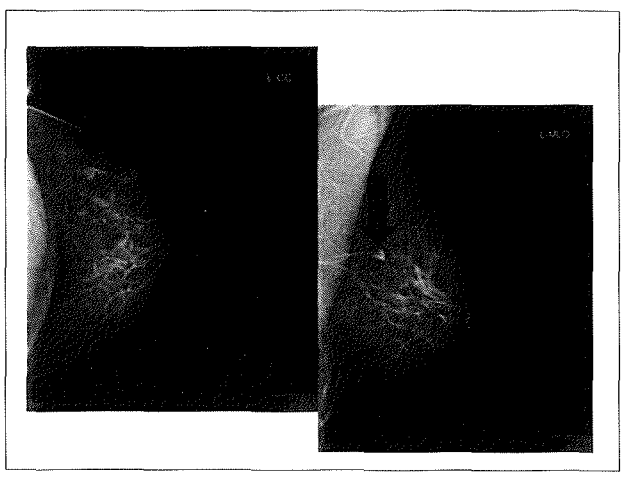


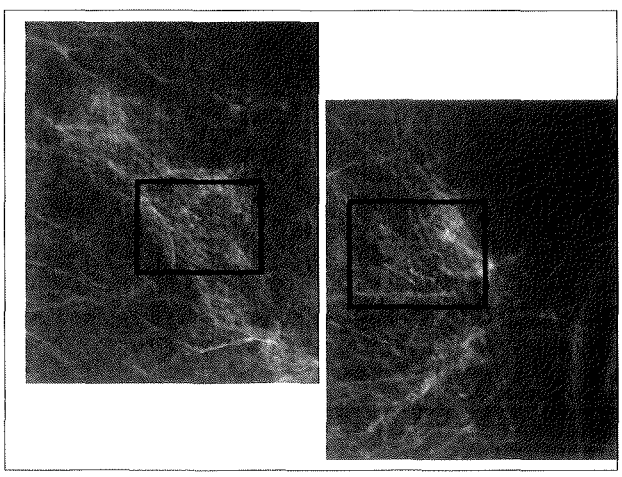












21. april 2008

(invitations in march)

GOAL:

LOWER THE MORTALITY RATE FOR

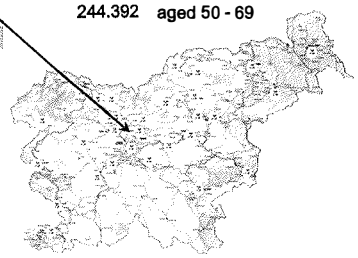
25 – 30 %

to discover cancers under 10 mm

Dora

SLOVENIA

2.003.358 inhabitants
1.021.893 women, of them
244.392 aged 50 - 69



incidence: 1,1/1.000
1113 BC (2006)
400 died (2006)

BREAST CANCER SCREENING IN SLOVENIA

Slovenia – CURRENT SITUATION

- Not yet population based breast cancer screening
- women can attend "preventive" mammography in a diagnostic setting
- the opportunistic screening without quality assurance and control is not giving satisfactory results

BREAST CANCER SCREENING IN SLOVENIA

screened women

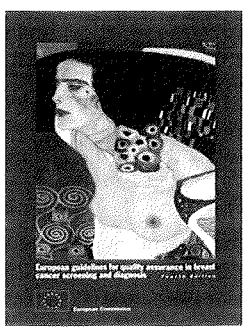
- low proportion of target population in the screened population
- too short screening intervals
- too young women who attend the opportunistic screening
- clinical examination still part of a screening exam

Dora

- old analog mamographs (> 10 y.)
- no supervision of centers for breast disease
- no daily QC
- no data collection
- not enough radiologists

European guidelines for quality assurance in breast cancer screening and diagnosis

(fourth edition)



Dr. Lawrence von Karsa (Lyon, Francija)
EBCN (European Breast Cancer Network) Coordination Office
IARC (International Agency for Research on Cancer)

Dr. Margrit Reichel (Wiesbaden, Nemčija)
Leading radiologist for pilot screening breast cancer program in Germany

Prof. Dr. Peter Dean (Turku, Finska) – Head of the breast screening program in Finland

Prof. Dr. Peer Scane (Oslo, Norveška) – Head of the srceening reference center in Oslo

Dora

ORGANISATION of BREAST CANCER SCREENING IN SLOVENIA - 2007

- Age 50-69, invitation every 2 years
- centralisation of the screening
- only digital equipment
- appropriate education and training of all personnel involved in the screening procedure
- double reading

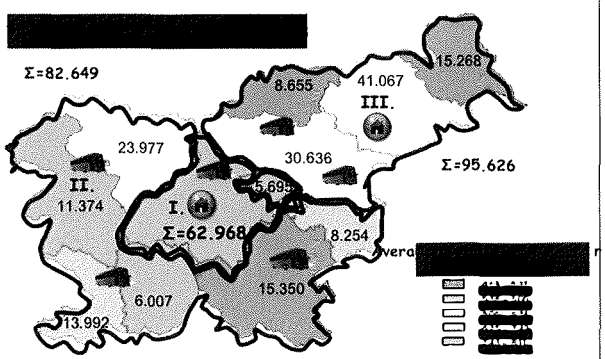
(reader should read 5000 MM per year, lead radiologist 10000 MM per year, first 3000 MM under control of lead radiologist)

Dora

ORGANISATION of BREAST CANCER SCREENING IN SLOVENIA - 2007

- daily, weekly quality control of mammography machines
- no clinical examination
- setting of an adequate information system
- analysing performance indikator

BREAST CANCER SCREENING IN SLOVENIA



Dora

BREAST CANCER SCREENING IN SLOVENIA

EDUCATION

ALL (radiologist, radiographer, surgeon, patologist, administrator, nurse)
MDC – Multidisciplinary Course (2 days)

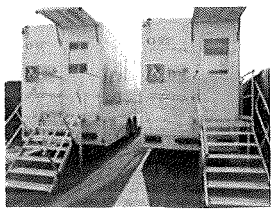
RADIOLOGISTS

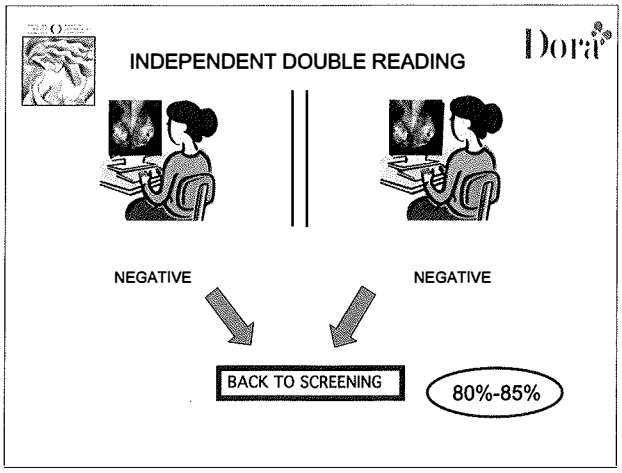
Course for Lead radiologist and Readers	2 days
Course for US + biopsy (only Lead radiologist)	2 days
Lead radiologist - practice (Norway)	1 month
Readers – practice (Norway)	1 week

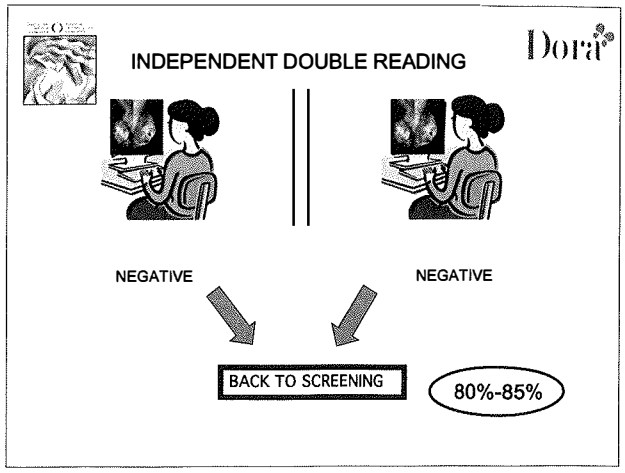
RADIOGRAPHERS

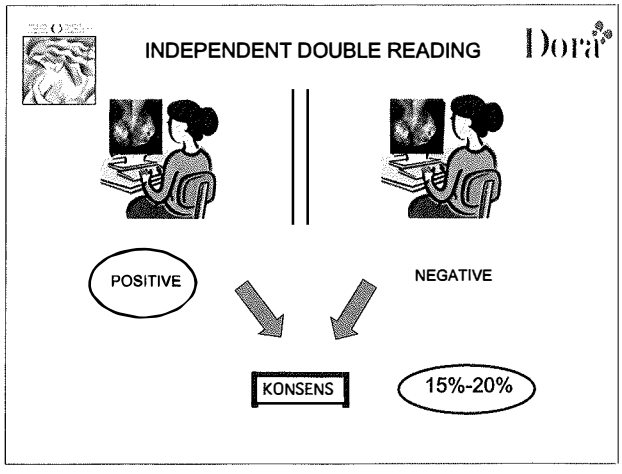
Positioning course	2 days
Practice (Norway)	14 days

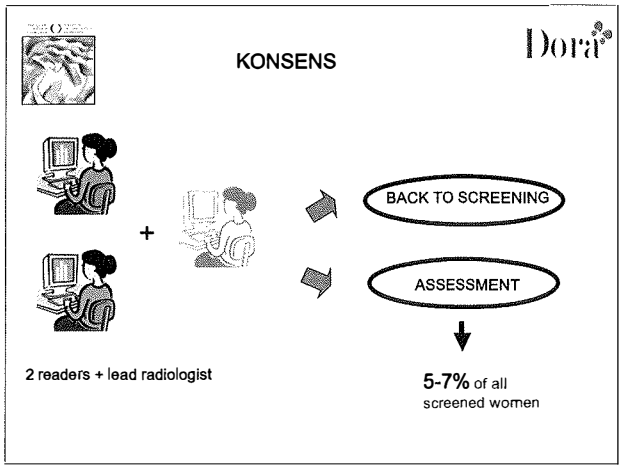
Dora

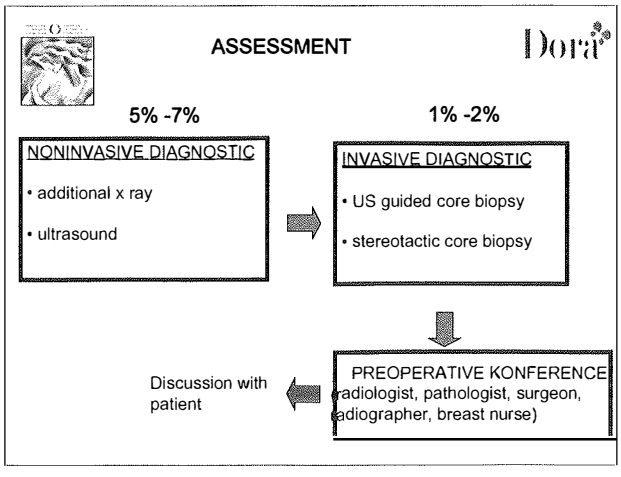


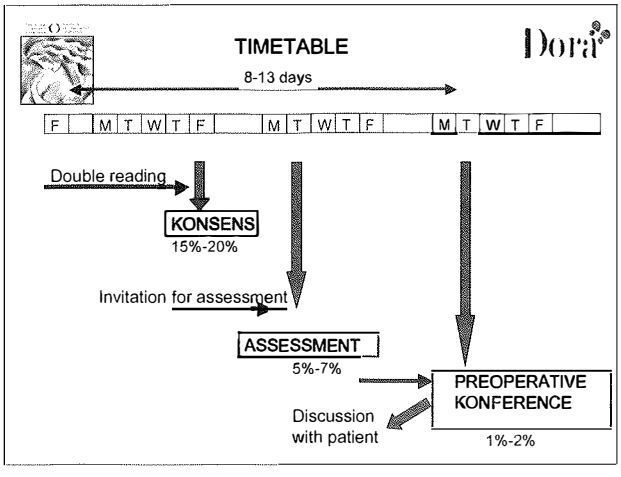

INDEPENDENT DOUBLE READING
Dora
NEGATIVE
NEGATIVE
BACK TO SCREENING
80%-85%

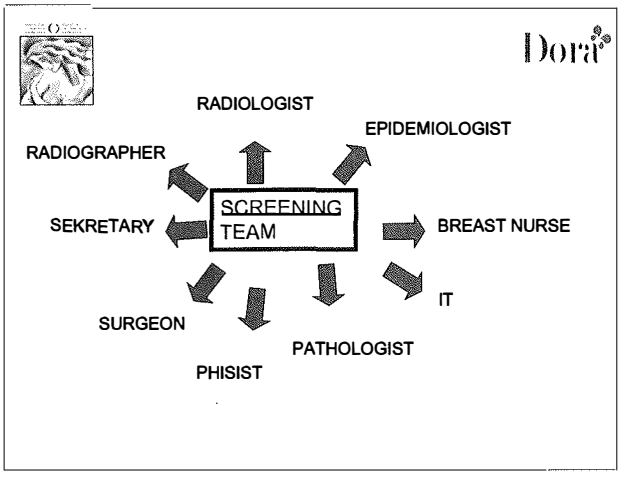

INDEPENDENT DOUBLE READING
Dora
NEGATIVE
NEGATIVE
BACK TO SCREENING
80%-85%

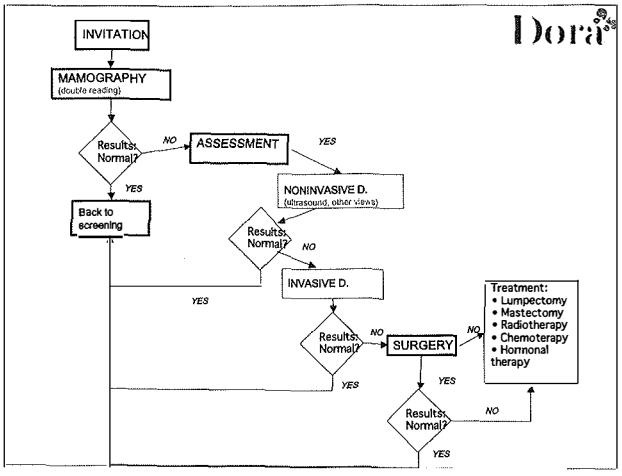

INDEPENDENT DOUBLE READING
Dora
POSITIVE
NEGATIVE
KONSENS
15%-20%


KONSENS
Dora
+
BACK TO SCREENING
ASSESSMENT
2 readers + lead radiologist
5-7% of all screened women


ASSESSMENT
Dora
5% -7%
1% -2%
NONINVASIVE DIAGNOSTIC
• additional x ray
• ultrasound
INVASIVE DIAGNOSTIC
• US guided core biopsy
• stereotactic core biopsy
Discussion with patient
PREOPERATIVE KONFERENCE
radiologist, pathologist, surgeon, radiographer, breast nurse)


TIMETABLE
Dora
8-13 days
F M T W T F M T W T F M T W T F
Double reading
KONSENS
15%-20%
Invitation for assessment
ASSESSMENT
5%-7%
PREOPERATIVE KONFERENCE
Discussion with patient
1%-2%





Results

from 4.2008 to 31.12.2011:

Kazalec kakovosti	sprejemljiva vrednost	želena vrednost	SLO
Udeležba ciljne populacije (%)	> 70%	> 75%	77,2
Nadaljnja obravnava (%) - prvi krog - naslednji krog	 < 7% < 5%	 < 5% < 3%	4,7 2,1
Incidenčna stopnja rakov	3 x IR	> 3 IR	3,6 IR 7,2/1000

Results

21.4. 2008 - 15.7. 2011		
povabljenih	30022	
slikanih	24088	80%
število rakov	215	8/1000

IT support

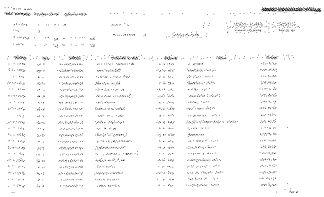
1. **Information sistem DORA**
2. **RIS** – radiological information system (radiološki informacijski sistem)
3. **PACS** – picture archiving communication system (sistem arhiviranja in izmenjave slikovnega materiala)
4. **HIS** – hospital information system (bolnišnični informacijski sistem)

Components of the aplication DORA

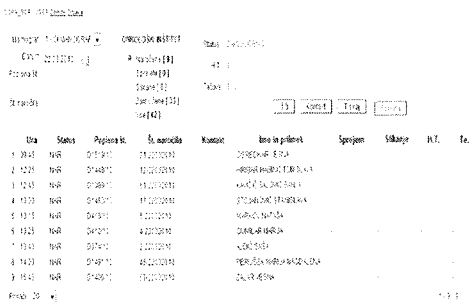
- Central registry DORA
- Aplication for mammography
- Aplication for reading
- Aplication for assessment
- Ware house
- eCRP

CENTRAL REGISTRY DORA RESPONSIBILITIES

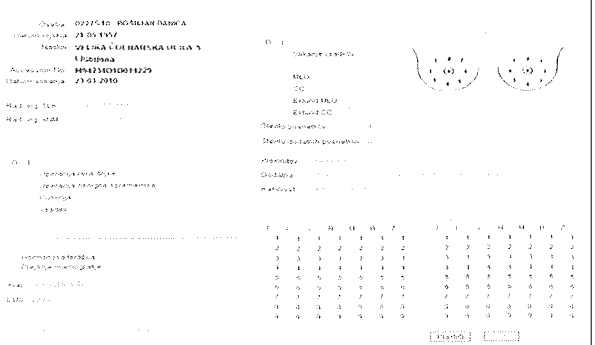
- **Waiting lists**
- **Printig invitations**
- **Re-scadule**
- **refusals**



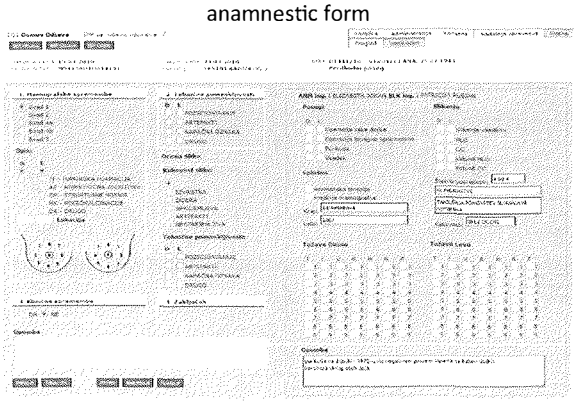
Waiting list for mammography



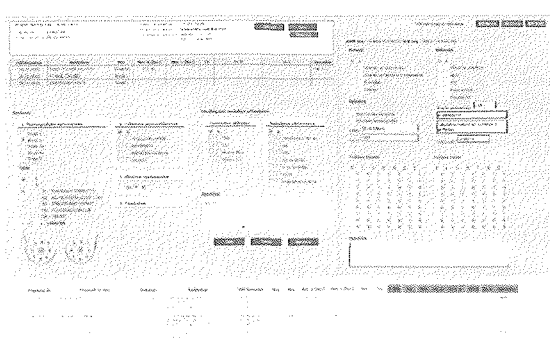
Anamnestic form



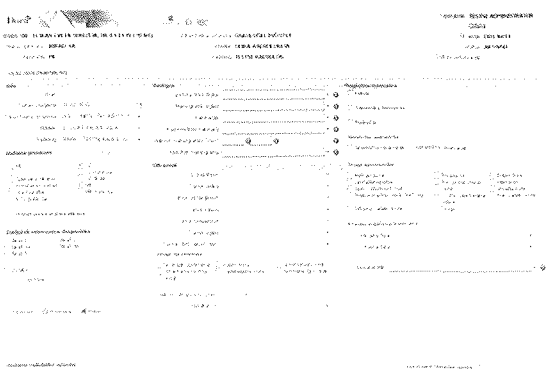
Radiological diagnosis and anamnestic form



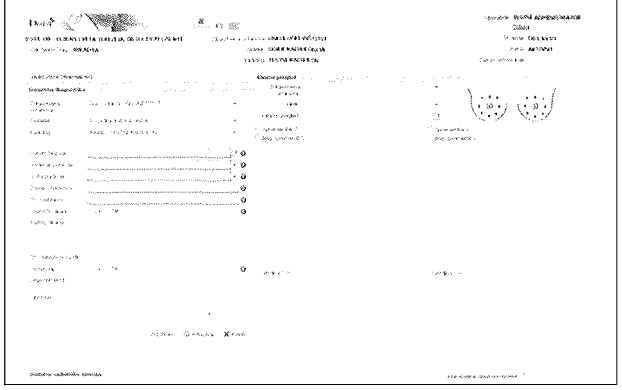
Konsensus form



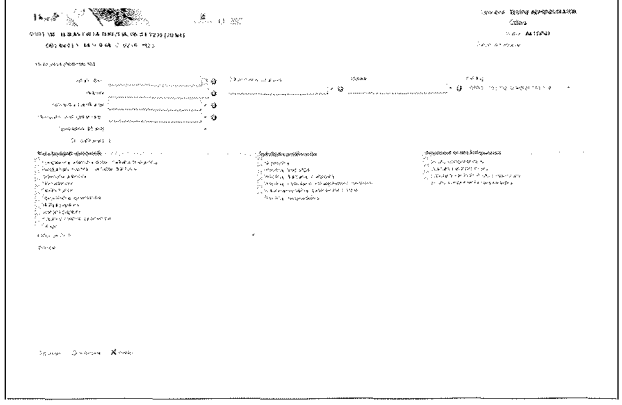
Assessment – noninvasive form



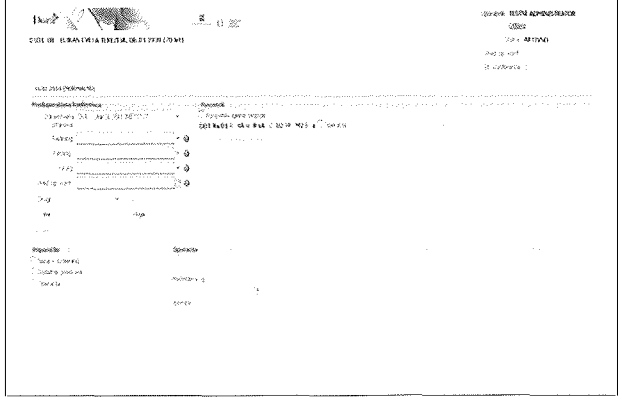
Assessment –invasive form



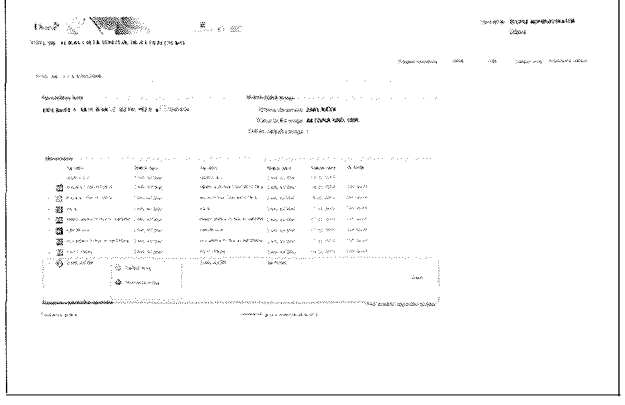
Pathology – needle biopsy report



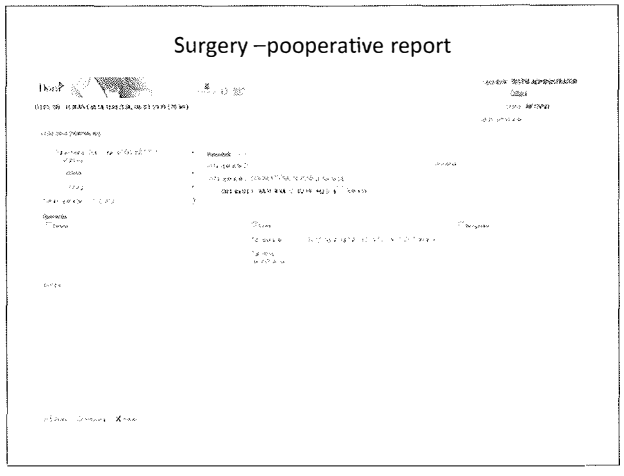
Preoperative conference



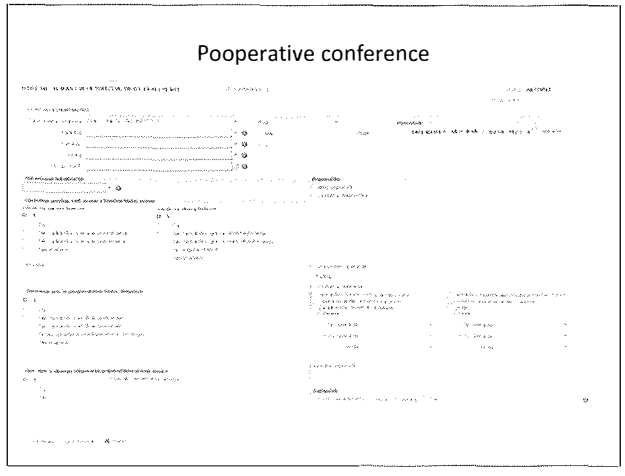
Electronic file of the women



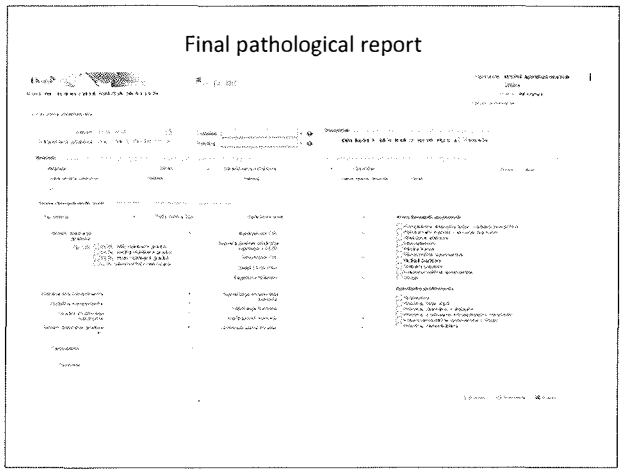
Surgery –pooperative report



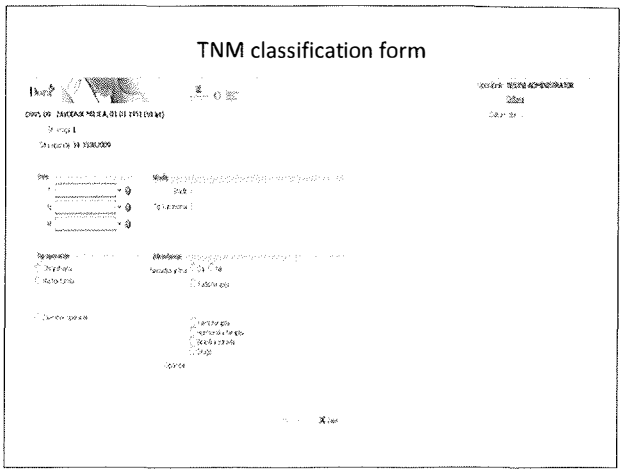
Pooperative conference



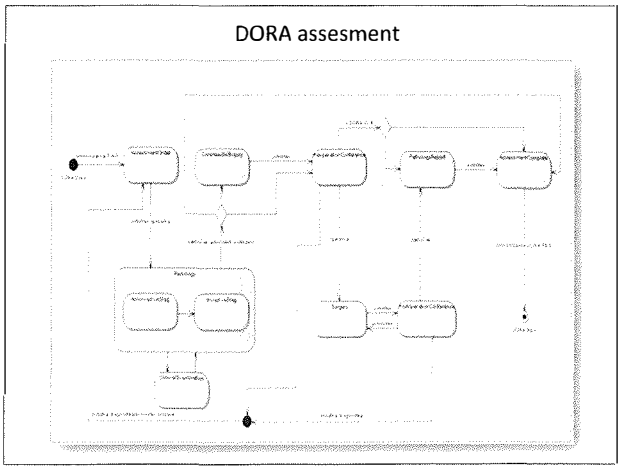
Final pathological report



TNM classification form



DORA assesment



5th International School of Breast Imaging
Ljubljana , 29th – 31th March 2012

Double reading, interobserver variability, and the challenge of consensus (arbitration) meetings in mammography screening

Prof.dr.med. Per Skaane

Oslo University Hospital Ullevaal
Breast Imaging Center
Oslo , Norway

PERSKA@ous-hf.no

30 min.

Objectives:

- Double reading:
  - Why ?
  - How ?
- Interobserver variability:
  - Concordant vs. discordant cancers
  - How big is the problem?
- "Consensus meeting":
  - Consensus vs. arbitration
  - Dismissed cancers
- Conclusion

Double reading:

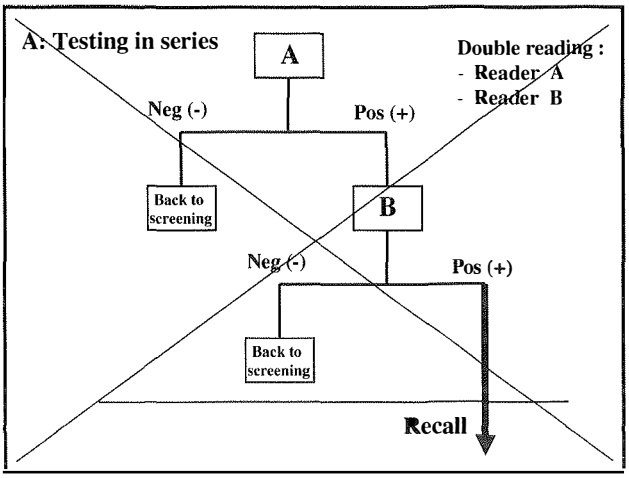
- Advantage:
  - To increase sensitivity (cancer detection rate)
  - Benefit mainly in the detection of small cancers
  - Benefit greatest when readers have different strengths and weaknesses or are less experienced
- Disadvantage:
  - Increased recall rate (decreased specificity): (depending on the recall policy used!!)
  - More expensive

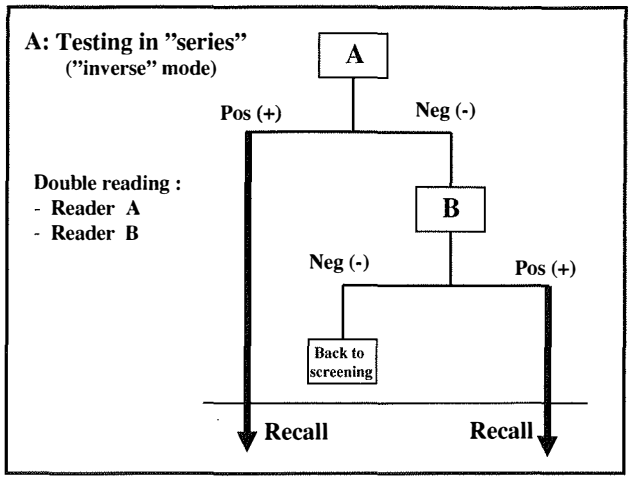
Two independent tests can be used in two different ways :

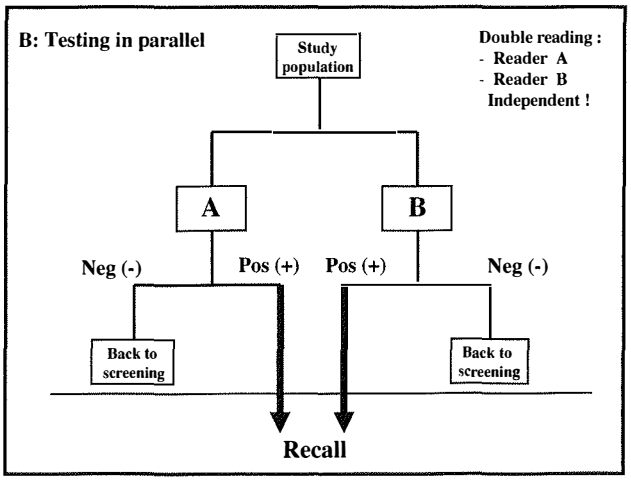
- **Testing in series :**
  Test A is applied first, and all those with a positive result are retested with test B.
  A diagnosis is made only if both tests are positive
- **Testing in parallel :**
  Tests A and B are used together and all those with positive results for either or both tests are considered to be positive

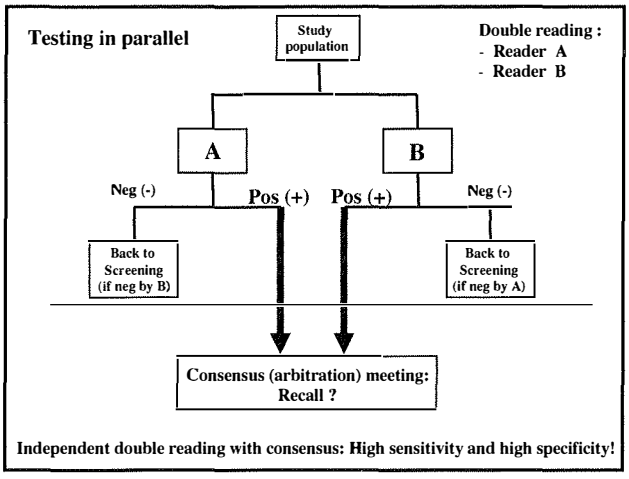
Two independent tests can be used in two different ways :

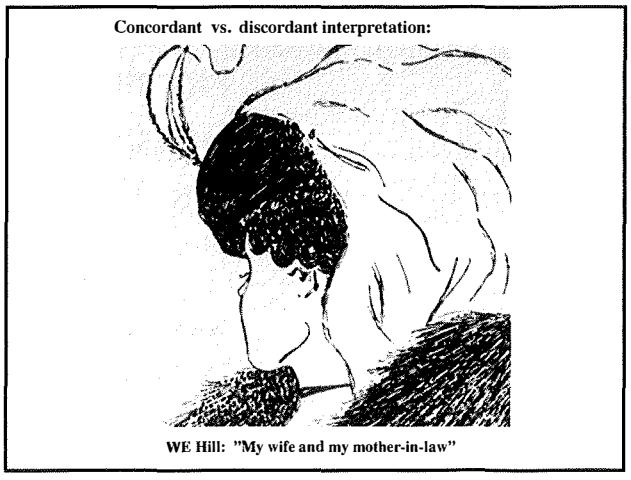
- **A: Testing in series**
  Lower sensitivity but higher specificity
- **B: Testing in parallel**
  Higher sensitivity but lower specificity

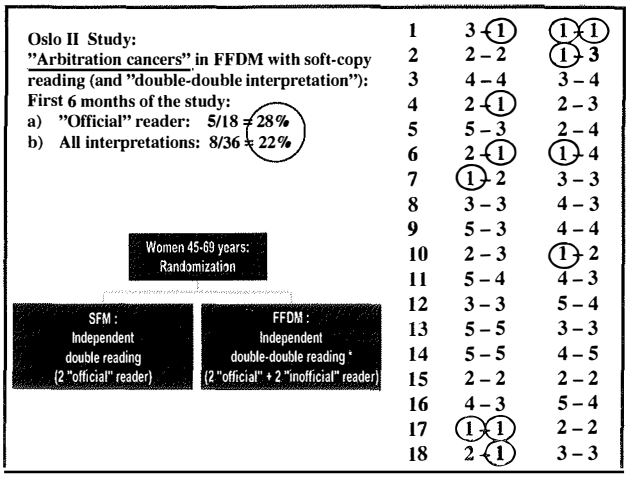



A: Testing in "series"
("inverse" mode)
A
Pos (+)
Neg (-)
Double reading :
- Reader A
- Reader B
B
Neg (-)
Pos (+)
Back to screening
Recall
Recall


B: Testing in parallel
Study population
Double reading :
- Reader A
- Reader B
Independent !
A
B
Neg (-)
Pos (+)
Pos (+)
Neg (-)
Back to screening
Back to screening
Recall


Testing in parallel
Study population
Double reading :
- Reader A
- Reader B
A
B
Neg (-)
Pos (+)
Pos (+)
Neg (-)
Back to Screening (if neg by B)
Back to Screening (if neg by A)
Consensus (arbitration) meeting: Recall ?
Independent double reading with consensus: High sensitivity and high specificity!


Concordant vs. discordant interpretation:
WE Hill: "My wife and my mother-in-law"


Oslo II Study:
"Arbitration cancers" in FFDM with soft-copy reading (and "double-double interpretation"):
First 6 months of the study:
a) "Official" reader: 5/18 = 28%
b) All interpretations: 8/36 = 22%
Women 45-69 years: Randomization
SFM : Independent double reading (2 "official" reader)
FFDM : Independent double-double reading * (2 "official" + 2 "inofficial" reader)
1 3 - 1 1 - 1
2 2 - 2 1 - 3
3 4 - 4 3 - 4
4 2 - 1 2 - 3
5 5 - 3 2 - 4
6 2 - 1 1 - 4
7 1 - 2 3 - 3
8 3 - 3 4 - 3
9 5 - 3 4 - 4
10 2 - 3 1 - 2
11 5 - 4 4 - 3
12 3 - 3 5 - 4
13 5 - 5 3 - 3
14 5 - 5 4 - 5
15 2 - 2 2 - 2
16 4 - 3 5 - 4
17 1 - 1 2 - 2
18 2 - 1 3 - 3

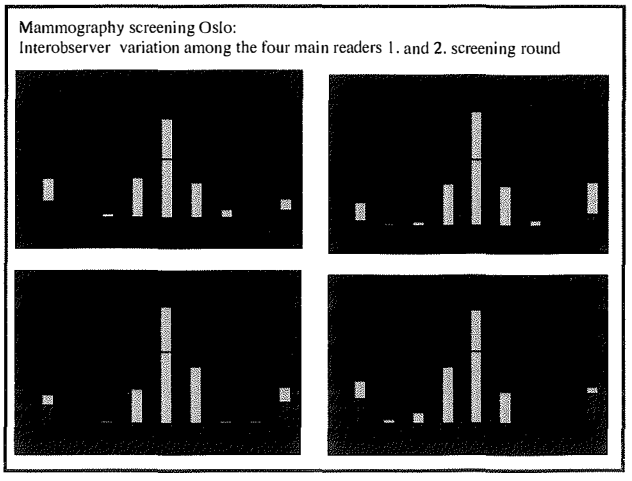

Mammography screening Oslo:
Interobserver variation among the four main readers 1. and 2. screening round

Image interpretation
can be dichotomized into 2 processes:

- **Detection (perception)**
- **Analysis (interpretation)**

Why might a reader miss a breast cancer?

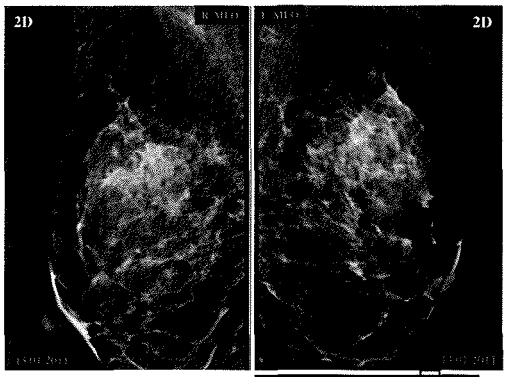
- **Detection (perception) error**
  (abnormality not seen / overlooked)
  - **Insufficient training or expertise**
  - **Incomplete search of the image (too fast reading)**
  - **Heavy workload / fatigue (batch reading!)**
  - **Distractions (sub-optimal viewing conditions)**
  - **Distractions (interruptions)**
  - **Highly demanding visual task:**
    Small size (subtle lesions) / small contrast difference

Why might a reader miss a breast cancer?

- **Interpretation (classification) error**
  (abnormality detected - but dismissed)*
  - **Inexperience (insufficient training)**
  - **Too fast reading**
  - **No prior images for comparison**
  - **Heavily influenced by reading setting:**
    - **Experimental clinical study**
    - **Daily practice (high work-flow / batch reading)**

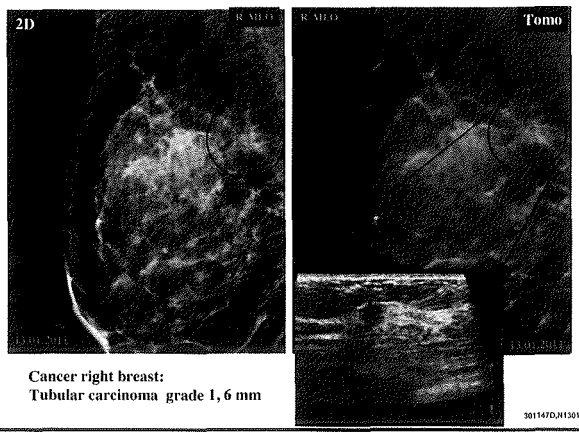
* **Interpretive variability may represent "the weakest link" in the imaging chain !**

A) Detection (perception) error: **Do you see the cancer ??** a) a)



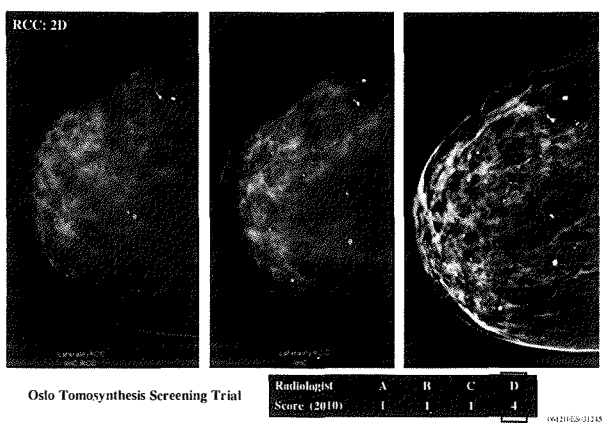
Oslo Tomosynthesis Screening Trial

Detection (perception) error: b)

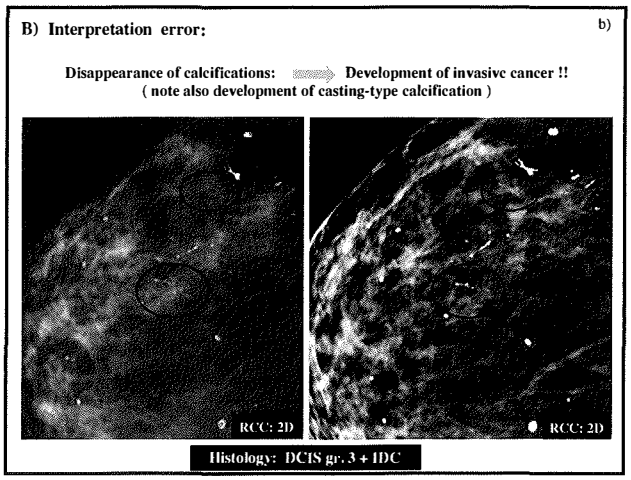


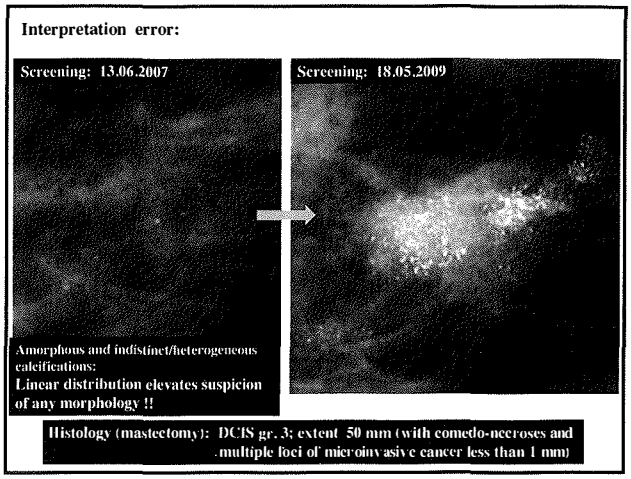
Cancer right breast:
Tubular carcinoma grade 1, 6 mm

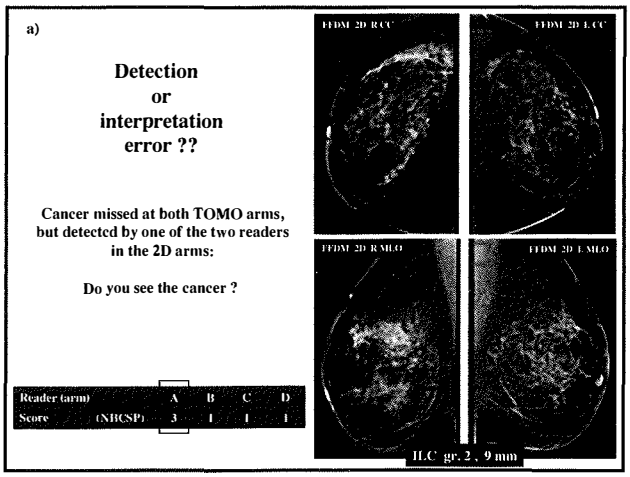
B) Interpretation error: a)

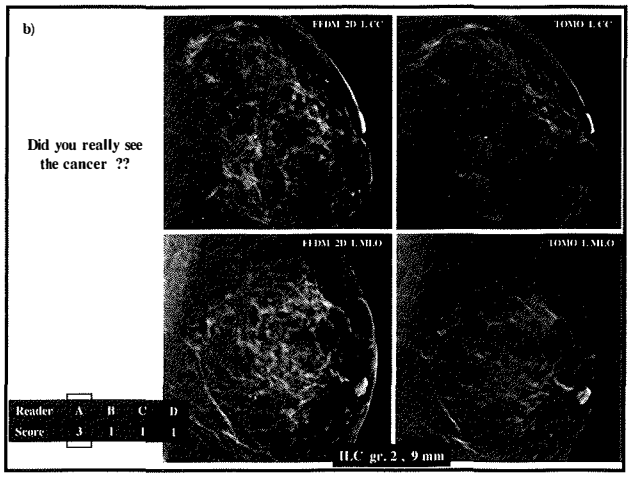


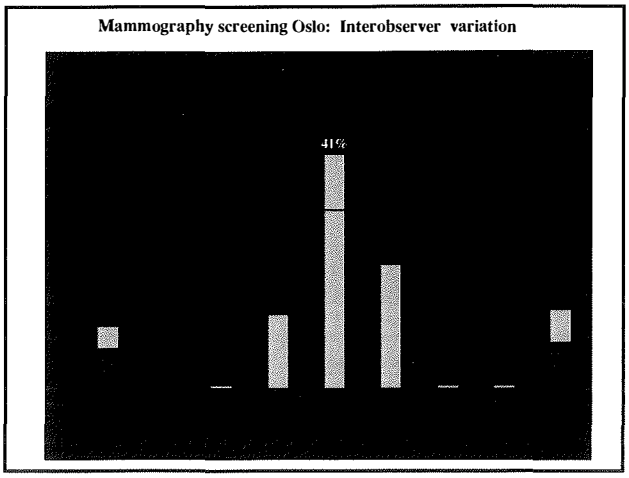
Oslo Tomosynthesis Screening Trial

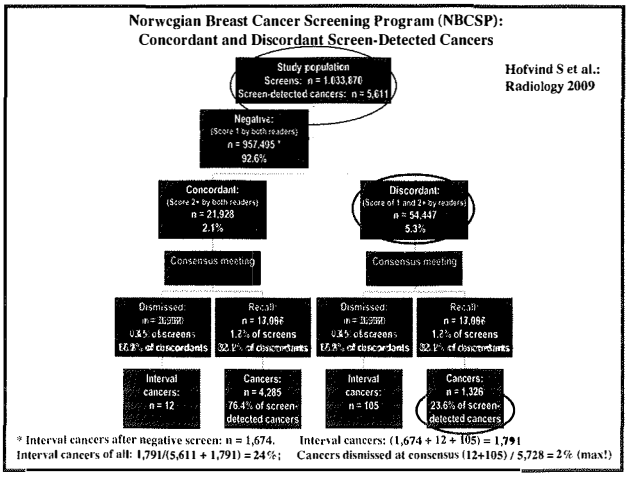

B) Interpretation error:
b)
Disappearance of calcifications: Development of invasive cancer !!
(note also development of casting-type calcification)
RCC: 2D
RCC: 2D
Histology: DCIS gr. 3 + IDC


Interpretation error:
Screening: 13.06.2007
Screening: 18.05.2009
Amorphous and indistinct/heterogeneous calcifications:
Linear distribution elevates suspicion of any morphology !!
Histology (mastectomy): DCIS gr. 3; extent 50 mm (with comedo-necroses and multiple foci of microinvasive cancer less than 1 mm)


a)
Detection or interpretation error ??
Cancer missed at both TOMO arms, but detectcd by one of the two readers in the 2D arms:
Do you see the cancer ?
FFDM 2D RCC
FFDM 2D LCC
FFDM 2D RMLO
FFDM 2D LMLO
Reader (arm) A B C D
Score (NBCSP) 3 1 1 1
ILC gr. 2 , 9 mm


b)
Did you really see the cancer ??
FFDM 2D LCC
TOMO LCC
FFDM 2D LMLO
TOMO LMLO
Reader A B C D
Score 3 1 1 1
ILC gr. 2 , 9 mm


Mammography screening Oslo: Interobserver variation
41%


Norwegian Breast Cancer Screening Program (NBCSP):
Concordant and Discordant Screen-Detected Cancers
Hofvind S et al.:
Radiology 2009
Study population
Screens: n = 1,033,870
Screen-detected cancers: n = 5,611
Negative:
(Score 1 by both readers)
n = 957,405 *
92.6%
Concordant:
(Score 2+ by both readers)
n = 21,928
2.1%
Discordant:
(Score of 1 and 2+ by readers)
n = 54,447
5.3%
Consensus meeting
Consensus meeting
Dismissed:
n = 26,860
0.3% of screens
66.2% of concordants
Recall:
n = 13,068
1.2% of screens
32.1% of discordants
Dismissed:
n = 26,860
0.3% of screens
66.2% of discordants
Recall:
n = 13,068
1.2% of screens
32.1% of discordants
Interval cancers:
n = 12
Cancers:
n = 4,285
76.4% of screen-detected cancers
Interval cancers:
n = 105
Cancers:
n = 1,326
23.6% of screen-detected cancers
* Interval cancers after negative screen: n = 1,674.
Interval cancers of all: 1,791/(5,611 + 1,791) = 24%;
Interval cancers: (1,674 + 12 + 105) = 1,791
Cancers dismissed at consensus (12+105) / 5,728 = 2% (max!)

Screening-detected cancers in the Norwegian Breast Cancer Screening Program: Discordant interpretations in the Norwegian Counties

10.3 Diskordante brystkrefttilfeller

Tabell 41. Diskordante* brystkrefttilfeller (DCIS og infiltrerende brystkreft) etter fullførte fylkesrunder og fylkesområde

County	Fylkesområdenes screeningrunde 1	2	3	4	5	6	7	Totalt
	9 %	18 %	19 %	14 %	16 %	21 %	21 %	17 %
	19 %	22 %	22 %	17 %	23 %	19 %	32 %	21 %
	23 %	30 %	25 %	26 %	19 %	26 %	28 %	26 %
	21 %	27 %	30 %	30 %	26 %	22 %		26 %
	22 %	26 %	33 %	27 %	28 %			28 %
	23 %	29 %	31 %	31 %	35 %			29 %
	17 %	24 %	19 %	32 %	21 %			22 %
	14 %	33 %	20 %	27 %				22 %
	24 %	26 %	19 %	17 %				20 %
	20 %	24 %	19 %	25 %				21 %
	32 %	20 %	19 %	24 %				21 %
	19 %	29 %	26 %	28 %				25 %
	16 %	24 %	25 %	16 %				19 %
	4 %	22 %	23 %	30 %				22 %
	29 %	27 %	24 %					24 %
	21 %	30 %	23 %					23 %
							25 %	26 %
							24 %	24 %
Totalt	19 %	26 %	23 %	23 %	23 %	23 %	24 %	23 %

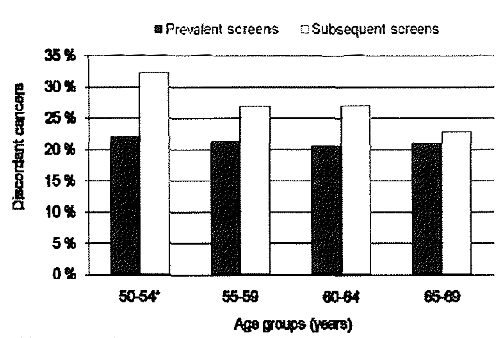
Independent double reading in the Norwegian Breast Cancer Screening Program *
Interobserver Agreement for Screen-detected Cancers (n = 5,611)

		Reader 1				
		1	2	3	4	5
	1	0	253	232	45	16
	2	386	527	330	47	14
Reader 2	3	294	371	836	279	39
	4	81	70	307	446	231
	5	19	16	59	203	510

Observed agreement: 41.3%
Kappa (unweighted) 0.24
Kappa (quadratic weighting) 0.56

* Hofvind S, Geller BM, Skaane P: Radiology 2008; 249(P): 376 RSNA 2008

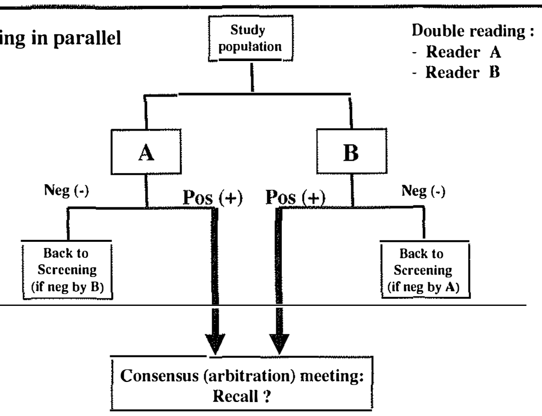
Discordant and Concordant Cancers by Screening History and Age



* Hofvind S, Geller BM, Skaane P: Radiology 2008; 249(P): 376 RSNA 2008

Testing in parallel

Double reading :
- **Reader A**
- **Reader B**



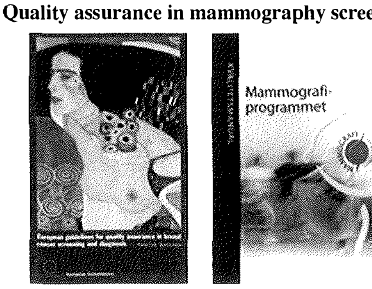
Independent double reading with consensus: High sensitivity and high specificity!

Rates of screen-exams discussed at consensus (Counties and rounds)

Tabell 40 **Rates of screen-exams recalled for assessment at consensus meeting (NBCSP: Counties and rounds)**
etter fullfø

County	Fylkesområdenes screeningrunde 1	2	3	4	5	6	7	Totalt	Totalt
	94 %	83 %	50 %	44 %	44 %	37 %	34 %	47 %	6,5 %
	88 %	95 %	88 %	89 %	95 %	78 %	59 %	79 %	3,5 %
	40 %	39 %	30 %	25 %	20 %	21 %	29 %	29 %	12,4 %
	48 %	44 %	44 %	51 %	47 %	44 %		46 %	9,6 %
	40 %	42 %	48 %	46 %	30 %			37 %	7,3 %
	63 %	68 %	71 %	58 %	62 %			61 %	4,0 %
	84 %	86 %	57 %	44 %	32 %			62 %	4,0 %
	41 %	41 %	32 %	22 %				32 %	13,6 %
	71 %	77 %	61 %	60 %				58 %	4,0 %
	42 %	34 %	35 %	38 %				37 %	12,5 %
	51 %	46 %	44 %	39 %				41 %	7,6 %
	41 %	41 %	39 %	41 %				41 %	5,4 %
	62 %	47 %	50 %	49 %				50 %	5,2 %
	54 %	69 %	42 %	45 %				50 %	6,0 %
	30 %	38 %	41 %					37 %	4,2 %
	43 %	48 %	51 %					44 %	4,7 %
							35 %	35 %	9,0 %
							49 %	49 %	13,1 %
Totalt	50 %	48 %	45 %	41 %	36 %	35 %	37 %	42 %	6,0 %

Quality assurance in mammography screening



European guidelines for quality assurance in mammography screening Performance indicator "Recall rate"		
	Acceptable level	Desirable level
Initial screening examinations	< 7 %	< 5 %
Subsequent screening examinations	< 5 %	< 3 %

Consensus – meeting

Be aware :
Cancers may be dismissed at consensus meeting !

Oslo I follow-up study

Skaane P et al.:
Acta Radiol 2005; 46: 679-689

SFM + FFDM (n = 3683)
Cancer = 31 (Detection rate 0.84%)
2 cancers excluded from further analysis
Cancer for comparison: n = 29

* Prior mammograms available at consensus meeting but not at the interpretation session

SFM positive: 442 (12%) Cancer: n = 27 Consensus meeting		FFDM positive: 612 (17%) Cancer: n = 22 Consensus meeting	
Dismissed = 314: Cancer: n = 2 (FFDM recall)	Recall = 128 (3.5%): Cancer: n = 25	Recall = 168 (4.6%): Cancer: n = 19	Dismissed = 444: Cancer: n = 3 (SFM recall)
Interval cancer: Positive FFDM score in initial round n = 1 / 1			Interval cancer: Positive FFDM score in initial round n = 1 / 1
Subsequent round cancer: Positive FFDM score in initial round n = 8 / 16			Subsequent round cancer: Positive FFDM score in initial round n = 8 / 16

314 / 442 = 71% SFM
444 / 612 = 73% FFDM

Exams dismissed * at consensus meeting

Follow-up and Final Results of the Oslo I Study Comparing SFM and FFDM

Skaane P et al.:
Acta Radiol 2005; 46: 679-689

SFM + FFDM: n = 3683

SFM positive n = 442 (12%) Cancer : n = 28		FFDM positive n = 612 (17%) Cancer : n = 23	
Recall n = 138 (3.5%)	Recall n = 138 (3.5%)	Recall n = 138 (3.5%)	Dismissed: n = 444
FFDM recalled cancers: n = 2	Cancer: n = 26 (0.34%)	Cancer: n = 26 (0.34%)	SFM recalled cancers: n = 3

Cancers dismissed at consensus meeting:
SFM 2/31 = 6.5%
FFDM 3/27 = 11.1%
(Overall 5/58 = 8.6%)

SFM pos. initial round: Interval cancer: n = 3 Subseq.round ca.: n = 0

FFDM pos. initial round: Interval cancer: n = 1 Subseq.round ca.: n = 3

Oslo II Follow-up Study (Skaane P et al.: Radiology 2007; 244: 708-717)

Oslo II follow-up
Study group: n = 23,929
Total number of cancers: n = 214

SFM:
9 subsequent cancers with TP score at screen:
- 2 FN work-up
- 7 dismissed at consens

FFDM:
3 subsequent cancers with TP score at screen:
- 3 dismissed at consens

SFM: n = 16,985 Cancers detected at baseline interpretation: n = 64 (Detection rate: 0.38%)	FFDM: n = 6,944 Cancers detected at baseline interpretation: n = 41 (Detection rate: 0.59%)
Subsequent cancers: n = 82 TP score at baseline reading:	Subsequent cancers: n = 27 TP score at baseline reading:

Cancers dismissed at consensus meeting:
- SFM 7/73 = 9.6%
- FFDM 3/44 = 6.8%
(Overall 10/117 =8.5%)

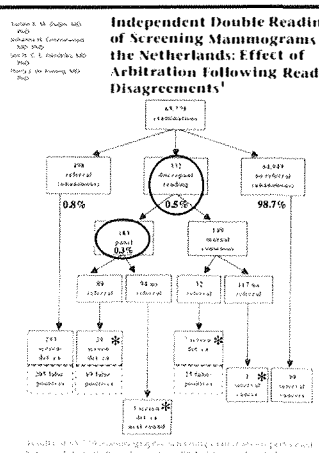
SFM: Total number TP score: 73 Overall TP rate: 73 / 16,985 = 0.43%	FFDM: Total number TP score: 44 Overall TP rate: 44 / 6,944 = 0.63%

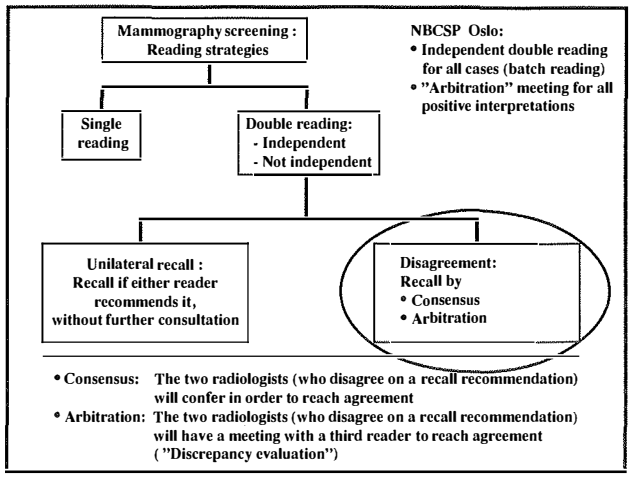
Duijm LEM et al.:
Radiology 2004; 231: 564

Discordant double reading:
1. Consensus meeting: trying to reach consensus
2. No mutual consensus: ⟹ Arbitration panel (3 other radiologists)

Dismissed cancer among discordant interpretations:
4 / 31 = 12.9% *

Please note :
- "Nonspecific minimal sign" findings not recalled
- Unanimous findings excluded





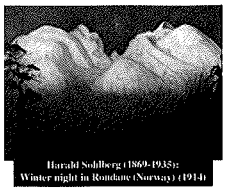
- **Consensus:** The two radiologists (who disagree on a recall recommendation) will confer in order to reach agreement
- **Arbitration:** The two radiologists (who disagree on a recall recommendation) will have a meeting with a third reader to reach agreement ("Discrepancy evaluation")

Breast Cancer Screening with Double Reading

- Double Reading:
  - Independent
  - Non-independent ("second reader bias")
- Recall:
  - Unilateral
  - Decision meeting
- Decision meeting:
  - Consensus
  - Arbitration
- Decision meeting:
  - Discordant interpretations only
  - All positives (incl. concordant scores)

5th International School of Breast Imaging
Ljubljana , 29th – 31th March 2012

Double reading, interobserver variability, and the challenge of consensus (arbitration) meetings in mammography screening



Harald Sohlberg (1869-1935):
Winter night in Rondane (Norway) (1914)

Conclusions

- Independent double reading should be the standard in population-based screening programs
- Consensus (arbitration-) meetings are an essential and very important part of the screening program (education for residents!!)
- On-going quality assurance of the performance is highly recommended

PERSKA@ous-hf.no

5th international mammography school

Ljubljana, 29th - 31st March 2012

Interval cancers

Margrit Reichel
Screening Reference Team

Interval Cancers

Definition by European Guidelines

Interval cancers are defined as breast cancers arising after a negativ screening episode
- which may include assessment –

and occured before the next scheduled screening round.

Incidence Cancers

Incidence cancers are defined as breast cancers

detected in the next screening round

Interval Cancers

Interval cancers are inevitable but their number should be kept as low as possible

A high proportion of interval cancers will reduce the effectiveness of screening and the potential mortality reduction will be lowered

Performance indicator	Acceptable level	Desirable level
Detection rate Initial screening examin subsequent screening ex	1 x underlying expected breast 1.5 x cancer incidence rate	> 3 x underlying expected breast > 1.5 x cancer incidence rate

Limit of interval cancer in the EUL

Interval Cancers	
00 – 11 month	0.3 x underlying expected breast
12 – 24 month	0.5 x cancer incidence rate

Underlying Breast Cancer Incidence

Wiesbaden:
2.65 cancers/1000 women
0.3 x of IR 0.9 Interval Cancers 0 – 11 Mo
0.5 x of IR 1.3 Interval Cancers 12 – 24 Mo
0.8 x of IR 2.2 Interval Cancers in the initial sceening

38.885 women got a mammogram
346 Cancers were detected
76 Interval Cancers - 47 are known

Interval Cancers

Quality assurance

Training of Radiologists

Interval Cancers

Quality assurance and Training

Tracing interval cancers is complex but fundamental to monitor the performance of any screening programme

Interval cancer monitoring is important to evaluate the chosen screening interval and radiological performance

Proportion of women invited for assessment in the initial screening round

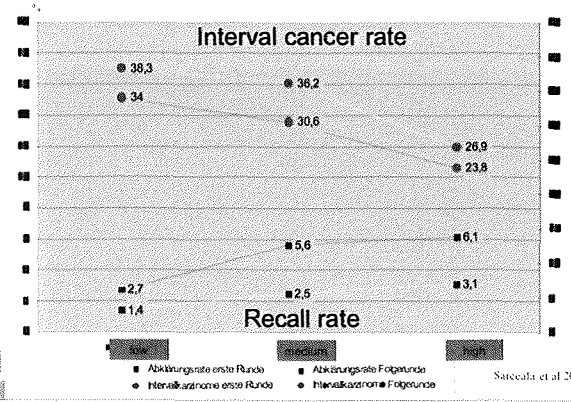
EU-Standard	Bremen	Wiesbaden
< 7 %	5,6 %	6,2 %

Recall rate

Proportion of women invited for assessment in the subsequent screening rounds

EU-Standard	Bremen	Wiesbaden
< 5 %	3,7 %	3,0 %

Abklärung vs. Intervallkarzinome



Sarcealta et al 2006

Interval Cancers

- True interval cancer
  The screening mammogram is normal, no reason for assessment
- Minimal signs
  There is a possible subtil abnormality on the screening film. This would not necessarily be regarded as warranting assessment.
- False negative
  An abnormality is clearly visible and warrants assessment

Duncan KA, Needham G, Gilbert FJ, Deans HE
Clinical Radiology 1998; 53:29-3

n = 112

False negative	19%
Minimal signs	28%
New Lesion	53%

Second Round Incidence Cancers:
How many were visible three years earlier ?

Mammographic features of false negative cases identified by blinded review

n = 25

	%
Ill-defined mass	52
Architectural distortion	20
Asymmetric density	16
Lymphadenopathy	8
Well-defined lesion	4

Daly CA, Apthorpe L, Field S. ClinicalRadiology 1998; 53:25-28

Second Round Incidence Cancers:
How many were visible three years earlier

Daly CA, Apthorpe L, Field S. Clinical Radiology 1998; 53:25-28

Conclusion

On retrospective review 25% of incident round screen detected cancer were potentially detectable on the previous screening mammograms and the majority of these were ill-defined masses sited in the "review areas" of the breast.

However only 7% demonstrated mammographic features clearly identifiable as suspicious of malignancy.

Mammographic and Pathological Features of breast cancers detected at first incident screening
Wheatley DC et al. The Breast 1997; 6: 259-265

- 1st round screening mammograms of women diagnosed at the second round retrospectively reviewed (blinded)
- Of 56 cancers 63% were true negatives and 27% false negatives (13.5% missed and 13.5% minimal signs)
- Architectural distortion and microcalcifications were the most common false negative mammographic sign
- In 9 (65%) of the false negative cases the tumors were of good or very good prognosis - delay in diagnosis unlikely to have affected outcome
- In 5 (35%) of the false negative cases the tumors were of moderate or poor prognosis - delay in diagnosis may have affected outcome

47 Interval Cancers
MSZ - Wiesbaden vom 1.7.2001 – 30.09.2004

True interval	25	53,1 %
minimal signs	15	31,9 %
false negativ	7	14,9 %

47 Interval Cancers
MSZ - Wiesbaden vom 1.7.2001 – 30.09.2004

true interval	25	53,1 %	ACR 4 pattern 10 cases
minimal signs	15	31,9 %	7 cases
false negative	7	14,9 %	2 cases

47 Interval Cancers
MSZ - Wiesbaden vom 1.7.2001 – 31.12.2004

Invasive ductal carcinoma	44
Invasive lobular carcinoma	2
Medullary carcinoma	1

47 Interval Cancers

MSZ - Wiesbaden vom 1.7.2001 – 30.09.2004

Ill defined mass	25
Well circumscribed mass	4
Mass with calcifications	3
Calcifications without mass	10
Architectural distorsion	5

47 Interval Cancers

MSZ - Wiesbaden vom 1.7.2001 – 30.09.2004

Tumor size

pt 1a	4
pt 1b	9
pt 1c	18
pt 2	16

Interval Cancers
Case report

Referenzzentrum
Mammographie-Screening
Wiesbaden

5th International School of Breast Imaging
Ljubljana , 29th – 31th March 2012

Computer Assisted Detection (CAD) on Mammography

Prof.dr.med. Per Skaane

Oslo University Hospital Ullevaal
Breast Imaging Center
Oslo , Norway

PERSKA@ous-hf.no

30 min.

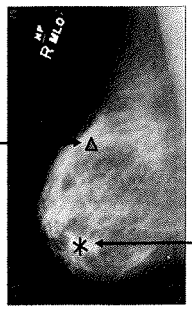
5th International School of Breast Imaging
Ljubljana , 29th – 31th March 2012

Computer Assisted Detection (CAD) on Mammography

Objectives:

- What is CAD (how does it work)
- Why do the readers miss breast cancers
  - Perception error
  - Interpretation error
- The true positive CAD marks
- The challenge of false positive CAD marks
- Summary of study results
- Conclusion

The CAD system acts like a SpellChecker for the Radiologist

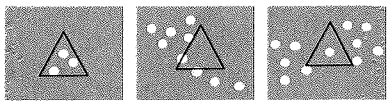


The "Δ " marks a cluster of bright spots suggestive of microcalcifications

The "*" marks a region of increased density suggestive of a mass

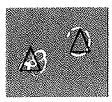
Microcalcification Code

The CAD System searches for clusters of bright spots which are suggestive of microcalcification clusters.

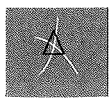


Normal structures at times can satisfy the software's criteria for patterns associated with microcalcifications

calcified artery

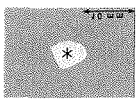


clustered or rim benign calcifications

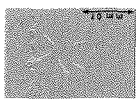


crossing bands

Mass Code

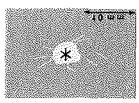


central mass alone is marked

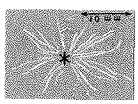


less pronounced radiating lines

no central mass is not marked



central mass is marked



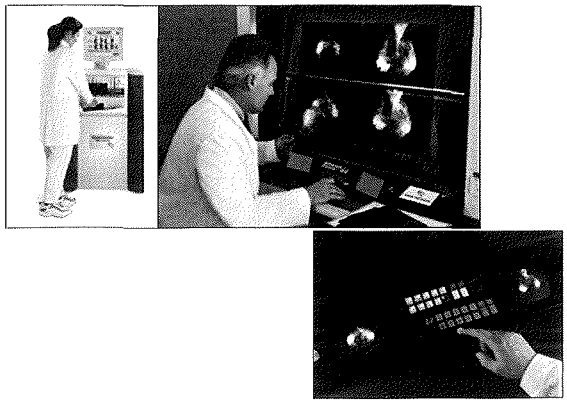
pronounced radiating lines marked without or with central mass.

however, normal breast structures can also be marked:

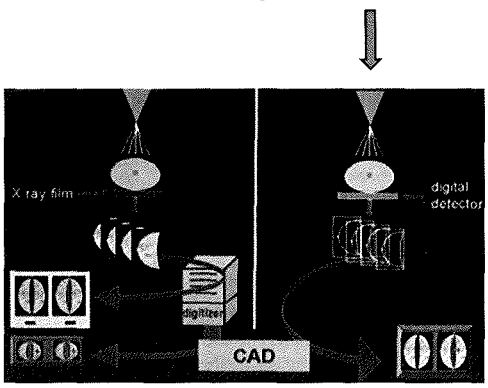
ducts and tissue radiating from the nipple

crossing parenchymal bands

CAD system : Screen-film mammography



FFDM mammography screening
Computer-Aided Detection (CAD)



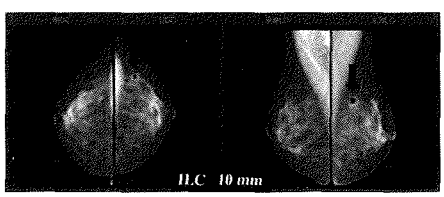
Why might a reader miss a cancer?

- **Screening: Highly demanding visual task**
  - Small, subtle and rare abnormalities
  - Complex and variable background
- **Pressures and distractions**
  - Heavy screening workload
  - Sub-optimal viewing conditions
  - Interruptions
- **Insufficient training or expertise**
- **Incomplete search of the image (detection error)**
  Abnormality not seen
- **Classification error (interpretation error)**
  Abnormality detected but dismissed

Computer Aided Detection (CAD) in Screening Mammography

Perception challenges in screening

- **Complex image interpretation**
- **High volume**
- **Short viewing time**
- **Extremely low incidence / prevalence (3 – 5 / 1,000)**



(retrospective standalone CAD analysis !)

Mammography screening: FFDM double reading 1 – 1 (missed by both reader)

How might CAD help?

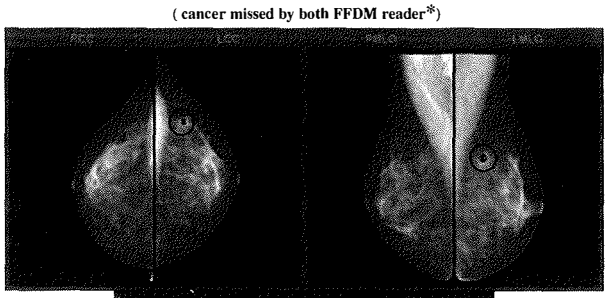
- **Incomplete search**
  - **attract attention to potentially abnormal regions**
- **Classification error**
  - **cause reader to treat dismissed regions with greater suspicion**

Using CAD

- **Reader performs unprompted search of image**
- **Reader accesses prompts**
- **Reader revisits original image to check on prompted areas**

Oslo Mammography Screening Program:

Independent double-reading FFDM 1 - 1
(cancer missed by both FFDM reader*)

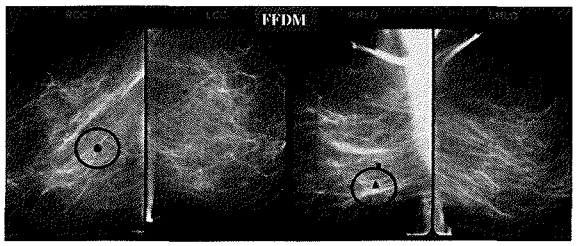


(retrospective standalone CAD analysis !)

* Cancer detected by both SFM reader (scores 2 – 3)

Oslo Mammography Screening Program: a)

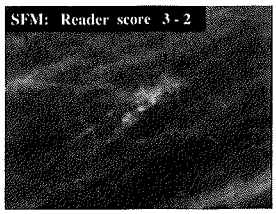
SFM: 3 – 2 FFDM: 1 - 1



Histology: DCIS gr. 3, 15 mm

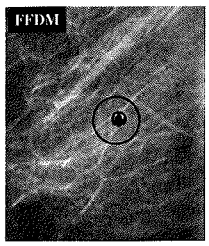
(retrospective standalone CAD analysis !)

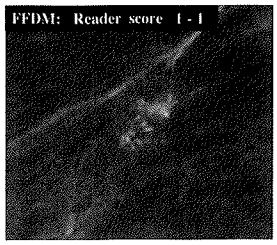
b)



Oslo Mammography Screening Program

Histology: DCIS gr. 3, 15 mm





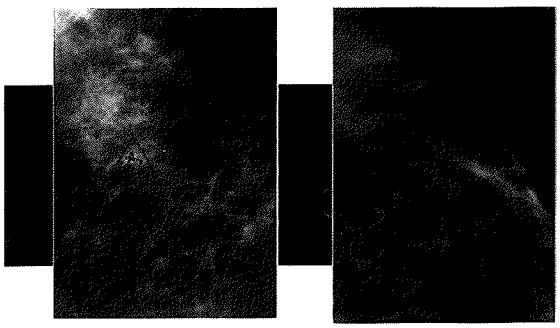
CAD: Examples a)

Screening mammography:
FFDM independent double reading 1 – 1 (missed by both reader)

Histology: DCIS grade 3, 18 mm

(retrospective standalone CAD analysis !)

Screening mammography: b)
FFDM independent double reading 1 – 1 (missed by both reader)



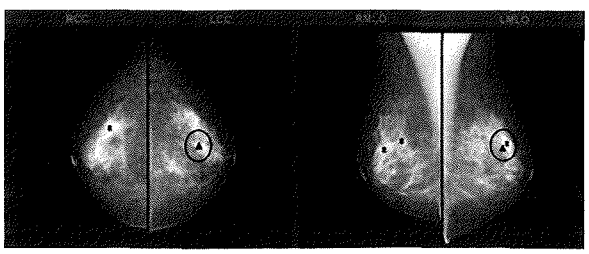
LO 140246

Histology: DCIS gr. 3, 18 mm

a)

Oslo Mammography Screening Program:

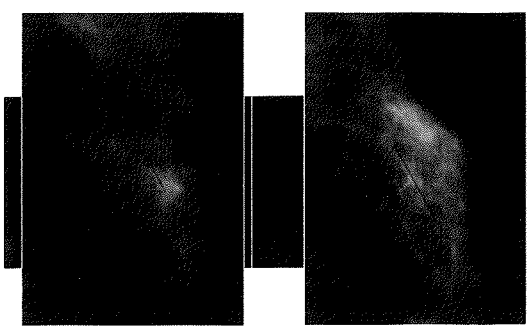
FFDM independent double-reading 1 - 1



Cancer in subsequent round:
(IDC and DCIS gr. 3)

(retrospective standalone CAD analysis !)

Mammography screening: FFDM independent double-reading 1 - 1

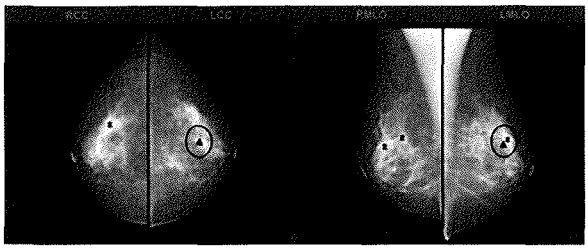


AB 150940

Cancer in subsequent round: IDC and DCIS

Oslo Mammography Screening Program: c)

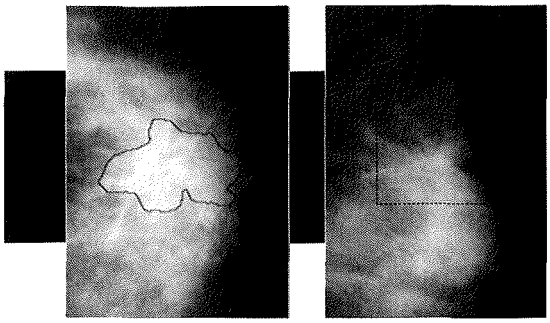
FFDM independent double-reading 1 - 1



Cancer in subsequent round:
(IDC and DCIS gr. 3)

Mammography screening :

FFDM independent double reading 1 - 1

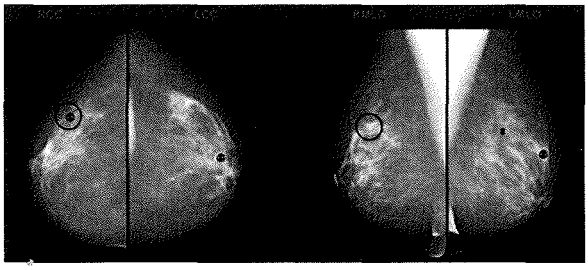


GL 1007-48

Interval cancer: IDC 20 mm (histology at diagnosis)

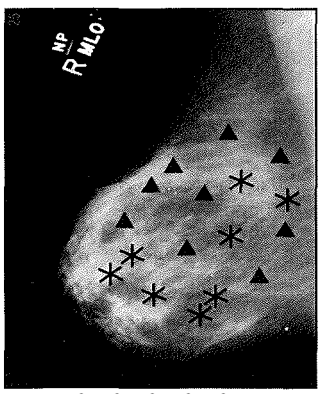
Mammography screening:

FFDM independent double reading 2 – 1 (true positive score)
(dismissed at consensus meeting)



Interval cancer: IDC 17 mm (histology at diagnosis)

(retrospective standalone CAD analysis !)



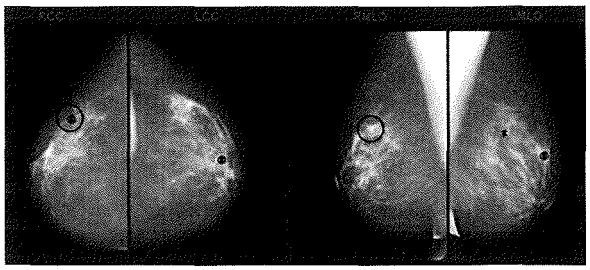
? ? ? ? ?

Why is the false positive marker rate an important metric in CAD performance?

An excessive number of false positive marks may distract the reader, resulting in the true positive mark to be ignored

c)

Screening 06/2000: Independent double reading:
SFM: 2 – 1 (dismissed at consensus meeting)
FFDM: 1 - 1

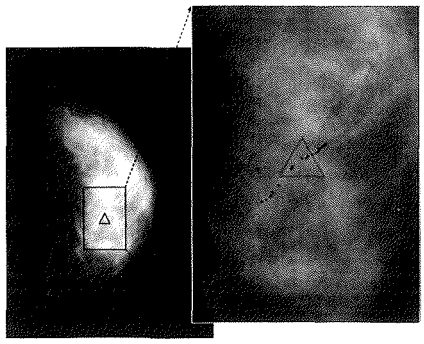


Interval cancer 03/2002: IDC 17 mm

Retrospective classification of baseline mammograms: Minimal sign - actionable

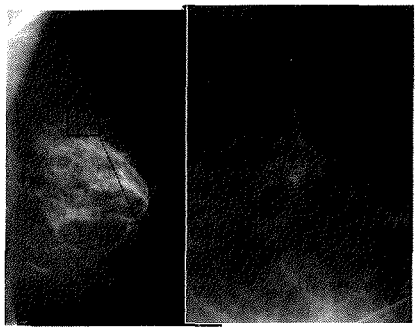
(retrospective standalone CAD analysis !)

Typical Example of Calcification False Marker II



Benign arterial calcifications

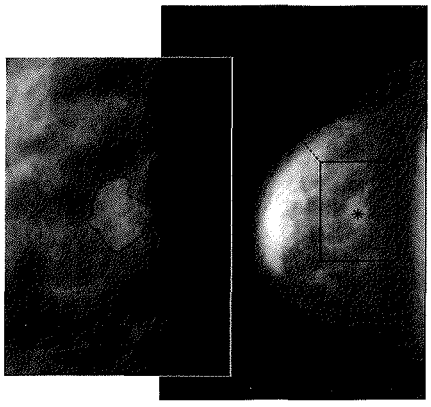
Typical Example of Mass False Marker II



Vessels crossing parenchymal tissue giving an appearance of spiculations

Typical Example of Mass False Marker I

Benign tissue Isolated from Primary dense tissue that happens to contain crossing structures giving an appearance of central density radiating spiculations



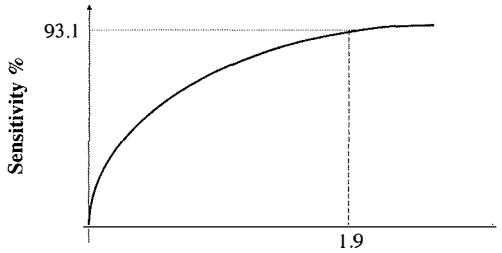
Possible causes of false marks (mass)

- Crossing vessels
- Lymph nodes, cysts, fibroadenomas etc.
- Benign fibroglandular tissue
- Scar or scarring tissue

Possible causes of false marks (calcifications)

- Arterial calcifications
- Fibroglandular crossing structure
- Benign calcifications
- Artifact (powder or deodorant) etc.

Putting the false marker rate in the perspective of the CAD sensitivity for Oslo I initial screening data *



Note : Data based on 29 cancer and 97 consecutive normal cases in the initial screening round of Oslo I study.

*** Skaane P et al : IWDM 2004, Durham NC**

Study	Incremental Cancer Detection with CAD (%)	Incremental Recall Rate with CAD (%)
Florence studies*	85/617 (14%)	245/703 (36%)
Freer 2001	8/41 (19%)	34/344 (10%)
Helvie 2004	1/10 (10%)	57/487 (12%)
Gur 2004	4/206 (2%)	214/1163 (18%)
Khoo 2005	2/61 (1%)	18/372 (6%)
Birdwell 2005	2/27 (7%)	73/887 (8%)
Cupples 2005	17/101 (17%)	164/2100 (8%)
Ko 2006	2/45 (4%)	100/602 (17%)
Morton 2006	8/105 (8%)	191/1996 (9%)
Dean 2006	10/104 (10%)	152/590 (26%)

* Ciatto S 2003 From: Houssami N et al. J Med Imag Radiat Oncol 2009 (modified)

Prospective independent double reading for screen-film (SFM) and full-field digital mammography (FFDM) and standalone CAD performance *

	Baseline cancers	Concordant cancers		Discordant cancers	
		n (%)	CAD pos (%)	n (%)	CAD pos (%)
SFM	64	48 (75)	46 (96)	16 (25)	15 (94)
FFDM	40	32 (80)	29 (91)	8 (20)	8 (100)
All	104	80 (77)	75 (94)	24 (23)	23 (96)

Concordant interpretation: True-positive score by both radiologists
Discordant interpretation: Cancer missed by one reader
CAD pos: A true-positive CAD mark on one or both standard views

* Skaane P et al.: Acta Radiol 2012 (in press)

Mammographic features on the baseline mammograms of 104 screen-detected and 29 "actionable" subsequent (15 interval and 14 next screening round) cancers and CAD standalone performance *

Mammographic feature	Screen-detected cancers n	CAD +	Subsequent actionable cancers n	CAD +	Total cancers n	CAD+ (n,%)
Soft tissue density						
Circumscribed mass	20	17	1	1	21	18 (86)
Spiculated mass	38	36	6	6	44	42 (95)
Asymmetric density	3	3	4	2	7	5 (71)
Distortion	2	1	3	3	5	4 (80)
Subtotal	63	57	14	12	77	69 (90)
Microcalcifications						
Calcifications alone	31	31	7	7	38	38 (100)
Calcifications + density	10	10	8	8	18	18 (100)
Subtotal	41	41	15	15	56	56 (100)
Total	104	98	29	27	133	125 (94)

CAD +: A true-positive CAD mark on one or both standard views

* Skaane P et al.: Acta Radiol 2012 (in press)

Classification of interval cancers

Modified retrospective classification of baseline screening films a)

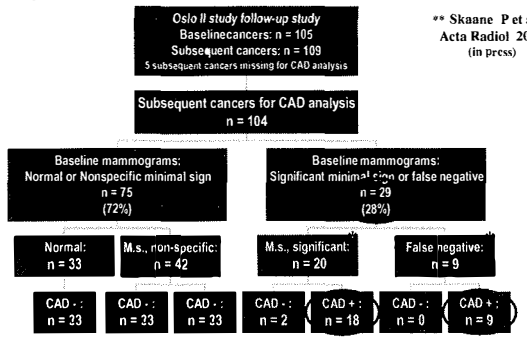
Categories	Screening mx	Diagnostic mx
Negative (normal)	Negative	Pos., neg., or not available*
Minimal signs - Non-specific signs** - Significant signs	Minimal signs	Positive or not available*
Overlooked (missed) cancer	Positive	Positive or not available*

* If diagnostic mammograms are not available: Surgical and/or histological report

** Minimal signs, non-specific: Probably no recall even if correctly prompted by CAD (true positive CAD marks misinterpreted as false positives)

a) - European guidelines; Fourth edition 2006, p. 193 (modified)
- Skaane P et al.: Am J Roentgenol AJR 2007; 188: 377-84

Retrospective classification of baseline mammo's and standalone CAD analysis **



** Skaane P et al.: Acta Radiol 2012 (in press)

* 10 cancers with TP CAD marks dismissed at consensus or FN work-up excluded from analysis

Additional cancers detectable at baseline screening round :
[(104)+(27-10) / 104] = **16% rel. increase in cancer detection**

Increased cancer detection rate from 0.43% (104/23.923) to 0.51% (121/23.923) (p=0.13)

Computer-Aided Detection Evaluation Trial II (CADET II)

(Gilbert FJ et al.: N Engl J Med 2008;359:1675-84)

	Single Reading with CAD	Double Reading	Difference (p – value)
Recall rates	3.9 %	3.4 %	p < 0.001
Cancers detected	198/227 (87.2%)	199/227 (87.7%)	p = 0.89

* Prospective trial in the UK
National Health Service Breast Screening Programme (NHSBSP)
* Arbitration used in cases of disagreement for double reading
* 227 cancers among 28,204 women (overall detection rate of 0.8%)

Evaluating CAD: Several challenges

- Impact of CAD on the reader:
  - Training is important
  - Studies performed with inadequate training may be unreliable
  - Considerable interobserver variation (experienced vs non-experienced breast radiologists)
- Effect on (to be shown in prospective studies):
  - Sensitivity
  - Specificity
  - Small cancer detection rate
  - Work-flow
- How to use CAD (for mc's only? / not consensus meetings?)

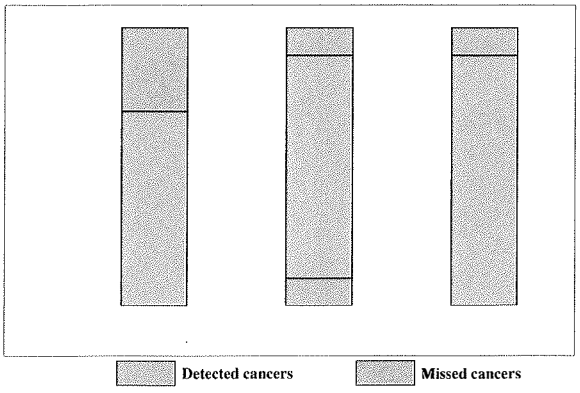
Conclusions (takeaway points) a)

CAD: Application

- **Prompting :**
  Marks show suspicious lesion ,
  i.e., helps detection only (increased sensitivity)
- **Classification :**
  Marks indicate probability of malignancy ,
  i.e., helps clinical decision making (increased specificity)
- **Pre - screening :**
  - Radiologist looks only at prompted cases / areas
- **Single reading :**
  - CAD replaces one radiologist ("second reader")
- **Double reading :**
  - Reduce variability / enhance performance / increase workflow

Conclusions (takeaway points) b)

Potential benefit of CAD



Conclusions (takeaway points) c)

Computer-Aided Detection (CAD) on Mammography

- CAD has the potential to increase the cancer detection rate in breast cancer screening
- CAD may be of special value in reading sessions with a high work-flow (screening environment - batch reading)
- CAD has the potential to increase cancer detection in screening programs with independent double reading
- Unknown if all (or especially non-dedicated) breast radiologists will profit from CAD, and to what extent
- Prospective trials in mammography screening should be encouraged to evaluate the effect of CAD .....
  BUT .... Do we need to improve / adjust our current CAD's with more attention on specificity (reduced FP's) and decision making ("computer-aided DIAGNOSIS) ?

PERSKA@ous-hf.no

5th international mammography school

Ljubljana, 29th – 31st March 2012

Masses
Architectural distorsions
Asymmetric densities

M. Reichel
Screening Reference Team
Wiesbaden

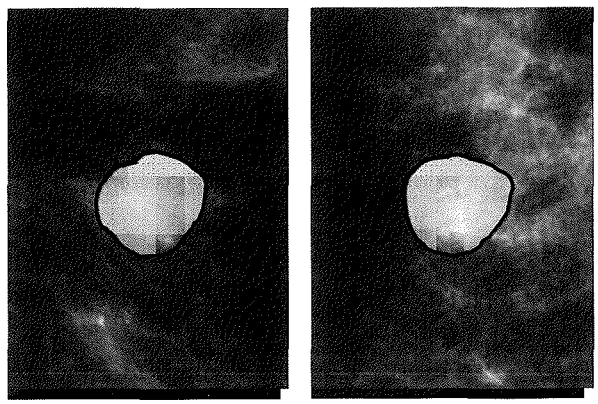
Structure

- Definition: Mass –architectural distorsion – asymmetric density
- Influence of the density on the breast
- Risk of malignancy based on the Swedish Two-County-Study
- BI-RADS-Classification
- Case reports

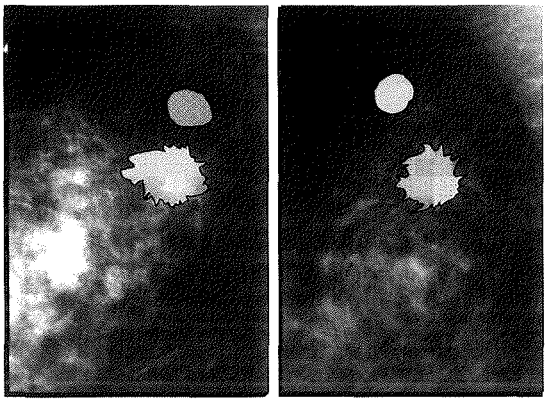
Mass vs. Architectural distorsion vs. Asymmetric density

Finding	*Number of views*	*Charakteristics*	*Berandung*
Mass	2	Solid centre	konvex
Architectural distorsion	2 or 1	No solid centre	koncav
Asymmetric density	2 or 1		partly konvex partly koncav

Mass



Mass



Mass vs. Architectural distorsion vs. Asymmetric density

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Mass	2	Solid centre	konvex
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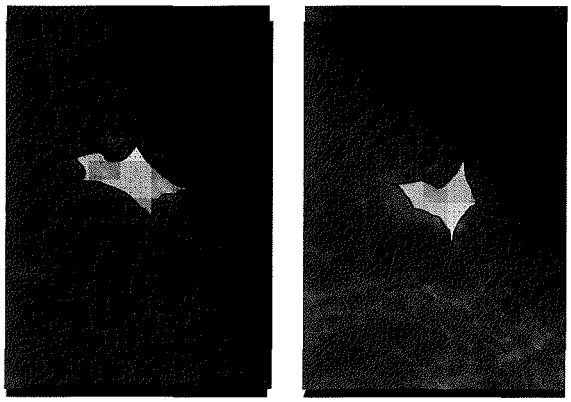
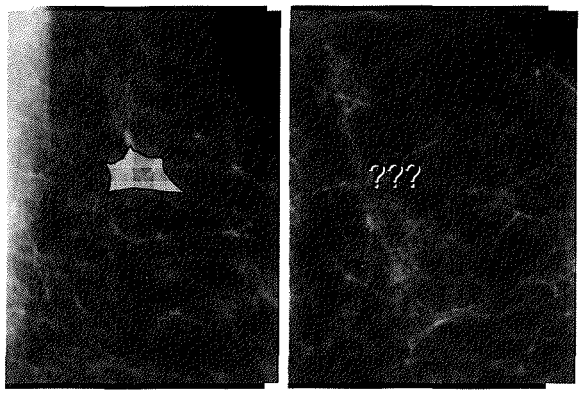
Architectural distorsion



Architectural distorsion



Mass vs. Architectural distorsion vs. Asymmetric density

Finding	*Number of views*	*Charakteristics*	*Berandung*
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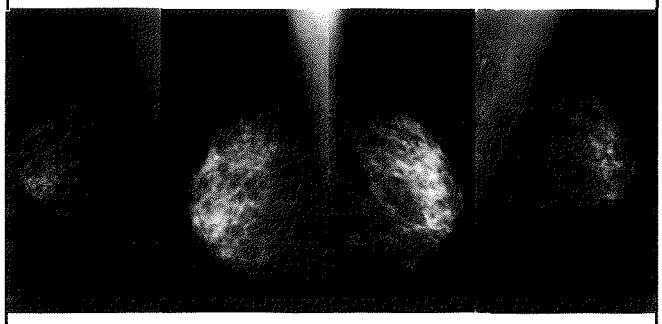
Asymmetric density	2 or 1		partly konvex partly koncav

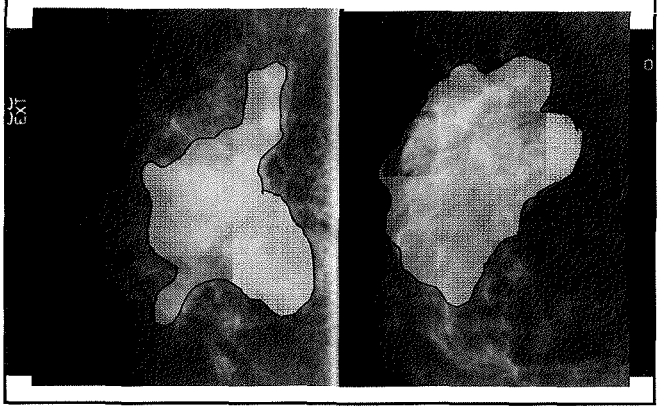
Asymmetric density

Asymmetrische Verdichtung

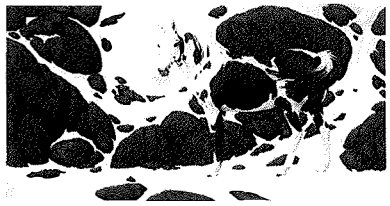
Asymmetrische Verdichtung



Asymmetric density

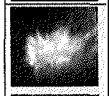
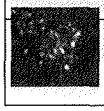


Detection – differential diagnosis



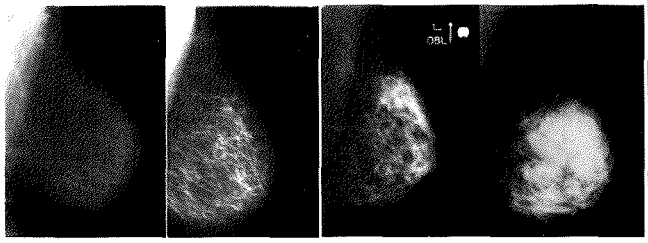
© Beverly Doolittle

Detection

result		detection	Differential-diagnosis
	masses	E	DD
	Asymmetric density Architectural distorsion	E	DD
	Mikrover-kalkungen	E	DD

Mammographische Drüsenkörperdichte

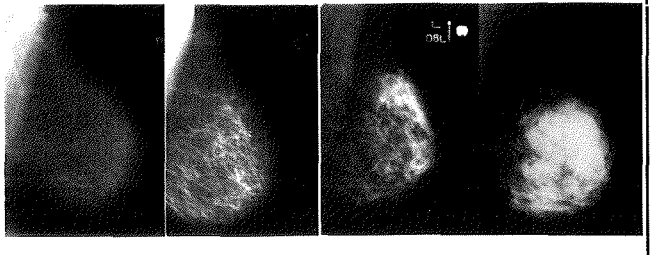
Einteilung nach Wolfe



N	P1	P2	DY
Involutionsbrust	Überwiegende Involution	Mäßig dichtes Drüsengewebe	Sehr dichtes Drüsengewebe

Mammographische Drüsenkörperdichte

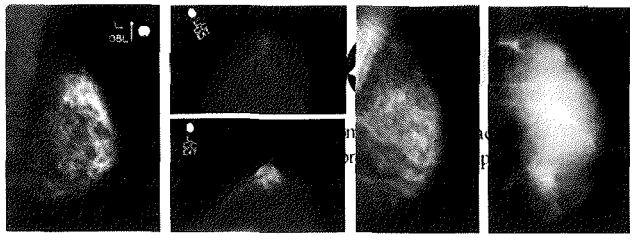
Einteilung nach 4 ACR-Typen (ACR = American College of Radiology)



Typ 1	Typ 2	Typ 3	Typ 4
Involutionsbrust	Überwiegende Involution	Mäßig dichtes Drüsengewebe	Sehr dichtes Drüsengewebe

Mammographische Drüsenkörperdichte

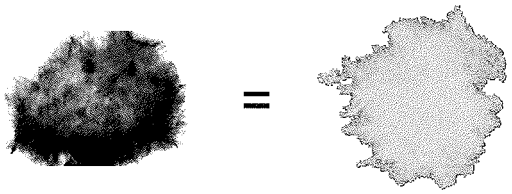
„Pattern" nach Tabar



Pattern I	Pattern II Pattern III	Pattern IV	Pattern V

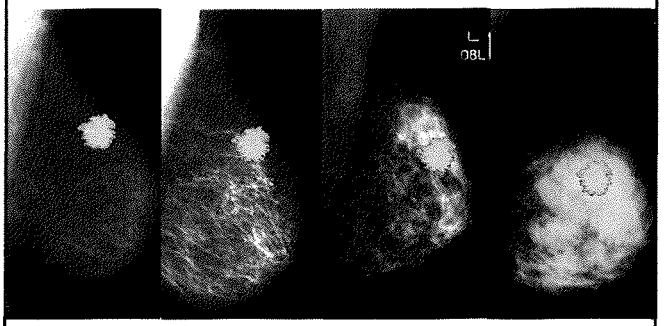
Influence of the density on the diagnostic sensitivity

Appearance of the typical breast carcinomas

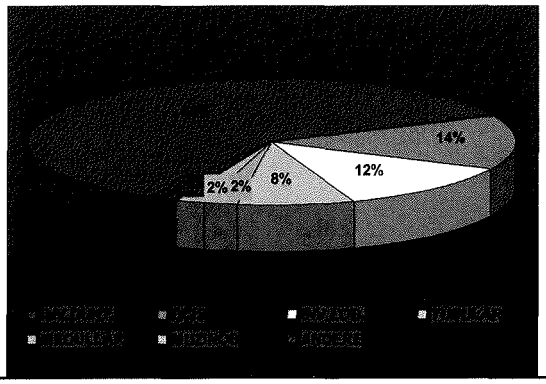


Mammographic density

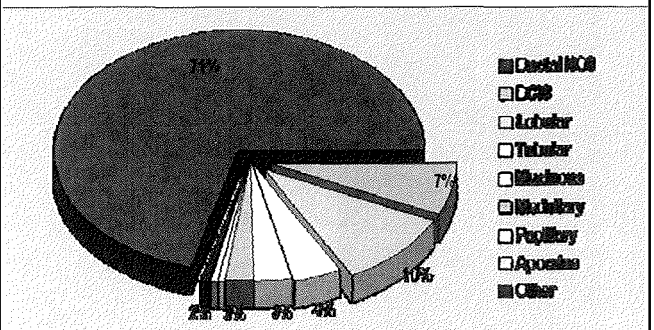
Influence of the density on the diagnostic sensitivity



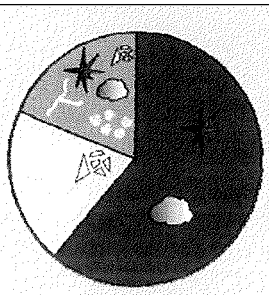
Distribution of the breast carcinomas



Heterogenität von Mammakarzinomerkrankungen



Mammographic appearance of malignant histopathologic lesions

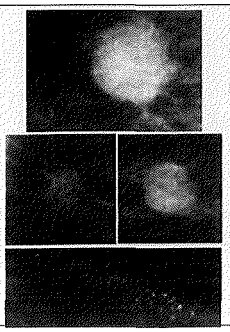


17 % (148 / 866)
Spiculated lesions and masses with mikrocalcinati

64 % (552 / 866)
Spiculated lesions and masses without microcalcinati

19 % (166 / 866)
Only microcacinati

Mammographic appearance of malignant histopathologic lesions



17 % (148 / 866)
Spiculated lesions and masses with mikrocalcinati

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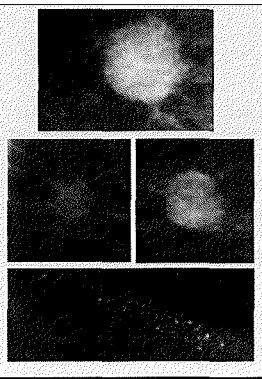
19 % (166 / 866)
Only microcacinati

Mammographisches Erscheinungsbild histologisch maligner Läsionen

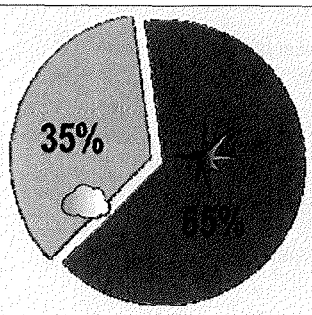


17 %
Spikulierte Läsionen und Rundherde mit Mikroverkalkungen

64 %
Spikulierte Läsionen und Rundherde ohne Mikroverkalkungen

19 %
ausschließlich Mikrokalk

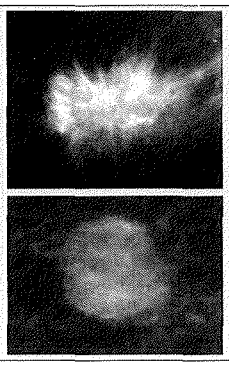
Malignant ratio round/oval vs. spiculated lesion



Spiculated Malignant carcinomas (499/694)

round / oval Malignant carcinomas (245/694)

Malignant ratio round/oval vs. spiculated lesion



Spiculated Malignant carcinomas (499/694)

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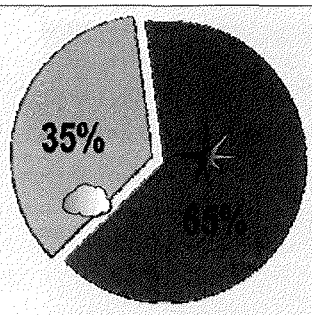
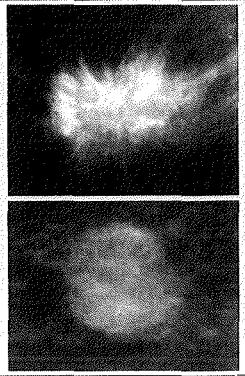
Malignant ratio round/oval vs. spiculated lesion



Spikulierte maligne Tumoren (499/694)

Runde / ovale maligne Tumoren (245/694)

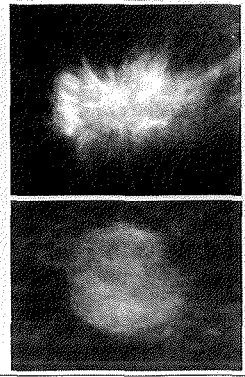
Malignitätsratio runde/ovale vs. spikulierte Läsionen



Spikulierte maligne Tumoren (65%)

Runde / ovale maligne Tumoren (35%)

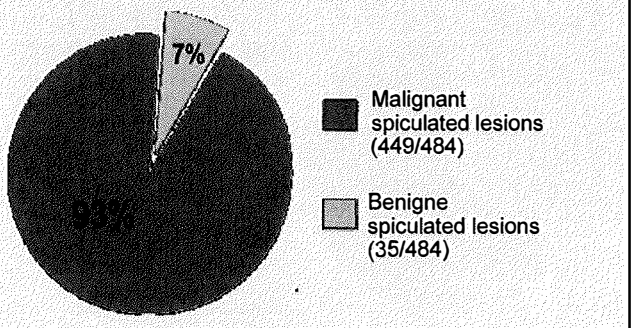
Malignitätsratio runde/ovale vs. spikulierte Läsionen



Spikulierte maligne Tumoren (65%)

Runde / ovale maligne Tumoren (35%)

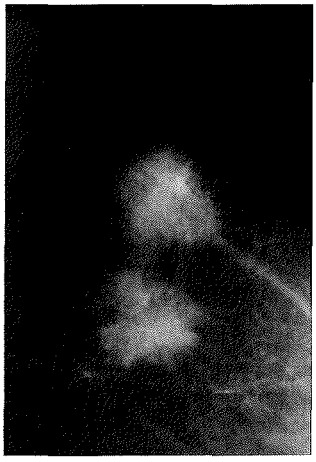
Malignant ratio of spiculated lesions

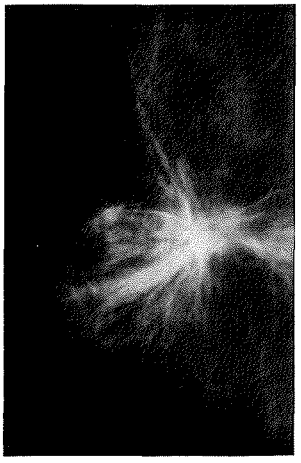


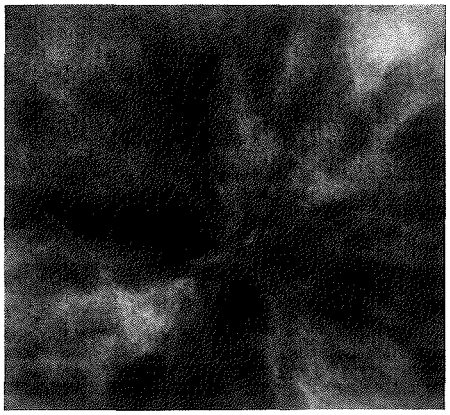
1

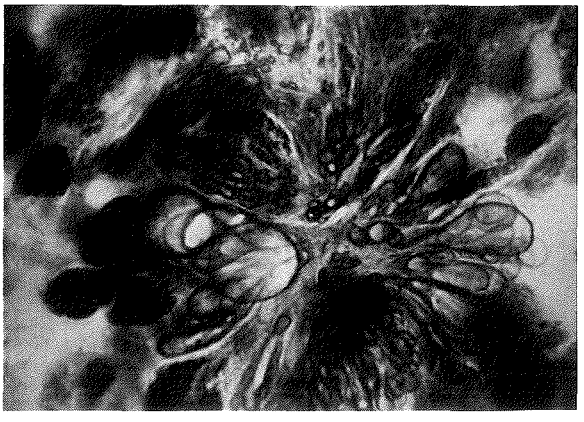
Differential diagnosis of spiculated masses

carcinoma
postoperative scar
radial scar
fettnecrosis/abscess
haematoma

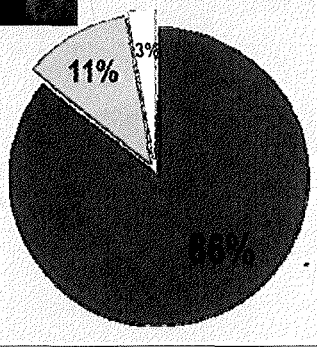






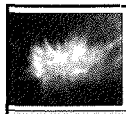


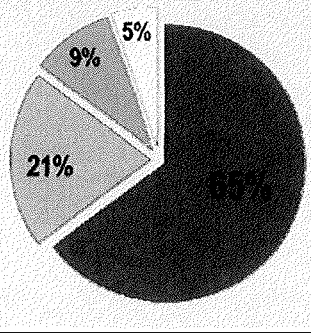
Histology of benigne spiculated lesions



- Radial scar (30/ 35)
- fettnecrosis (4/ 35)
- other (1/ 35)
  Granularzelltumor

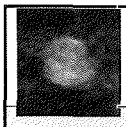
Histology of malignant spiculated lesions

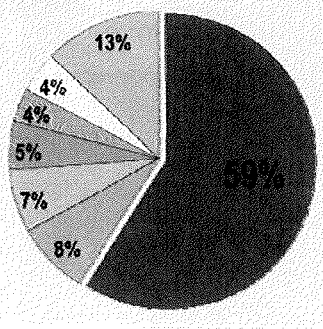




- IDC NOS (290/449)
- ILC (93/449)
- tubular (42/449)
- other (42/449)

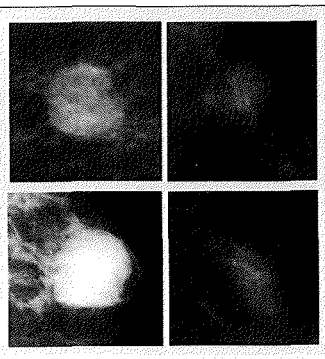
Histology of malignant round/ovale lesions





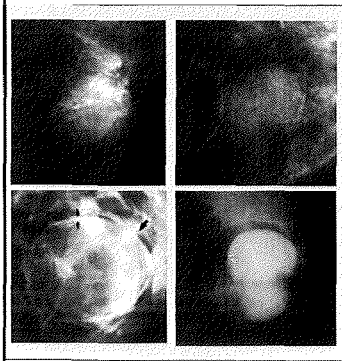
- IDC NOS (145/245)
- Medullär (/245)
- Mucinös (17/245)
- Intracystic (13/245)
- tubular (9/245)
- ILC (11/245)
- Other (31/245)

Histologie maligner runder/ovaler Läsionen



- IDC NOS (59 %)
- Medullär (8%)
- Mucinös (7%)
- Intrazystisch (5%)
- Tubulär (4%)
- ILC (4%)
- Sonstige (13%)

Histology of benign round/ovale lesions



- Fibroadenomas (35%)
- Fibrocystic change (19%)
- Papillomas (18%)
- Abscesse (8%)
- Other (20%)
  Riesenfibroadenome, Phylloidestumoren, Fokale Fibrose, Granularzelltumoren, Intramam. LK

Reporting System and Description

Reporting System BI-RADS™

(1)	Masses	
	(a)	Size
	(b)	Shape, margin, density
	(c)	Associated calcifications
	(d)	Additional findings
	(e)	Location
	(f)	Description of changes of previous Mx

American College of Radiology: Illustrated BI-RADS® 3rd edition. Reston VA
Akkreditierte deutsche Übersetzung Fischer 2003

Description BI-RADS™

Shape	round	oval	lobulated	irregular	
Margin	Circum-scribed	mikro-lobulated	obscured	indistinct	spiculated
Density	hyperdens	isodens	hypodens		

American College of Radiology: Illustrated BI-RADS® 3rd edition. Reston VA
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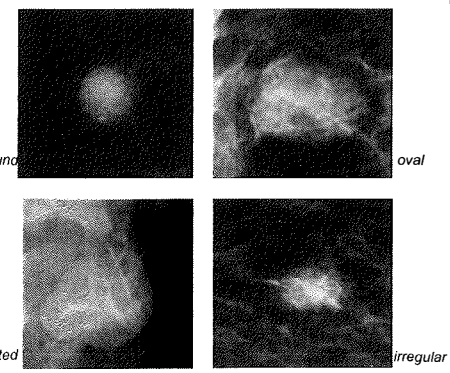
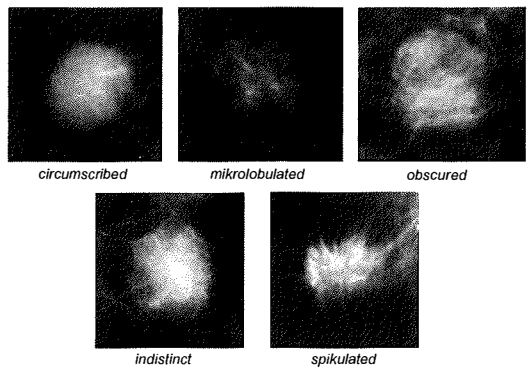
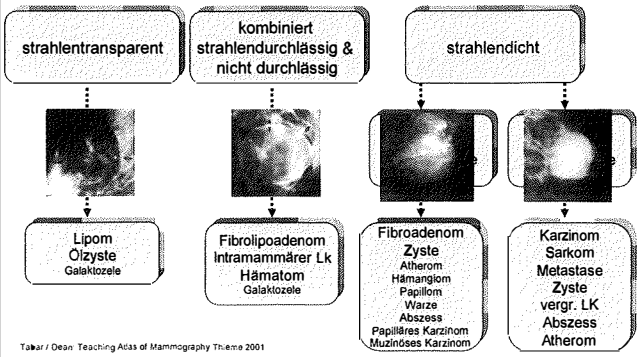
Description BI-RADS™ Shape



Description BI-RADS™ Margins

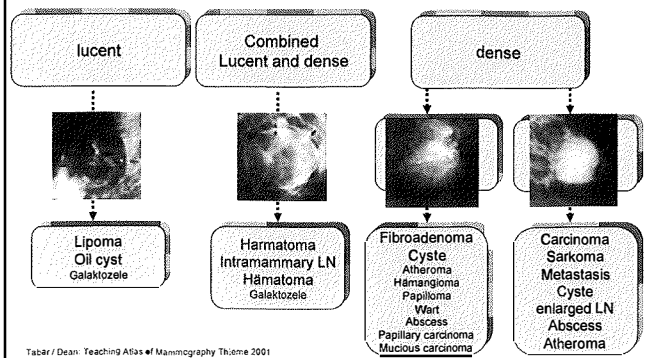


Mammographic density BI-RADS™



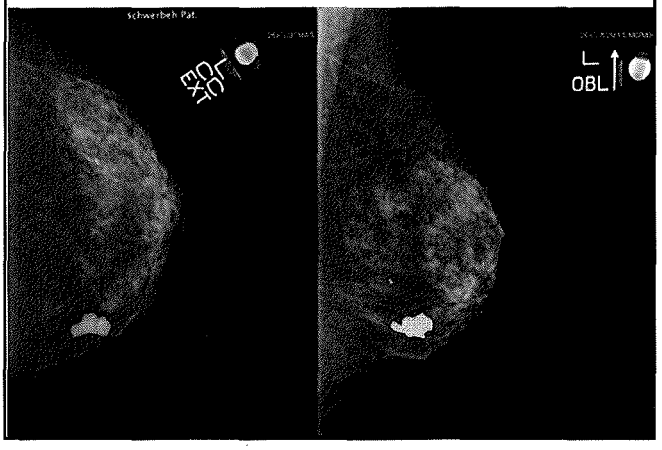
Tabar / Dean: Teaching Atlas of Mammography Thieme 2001

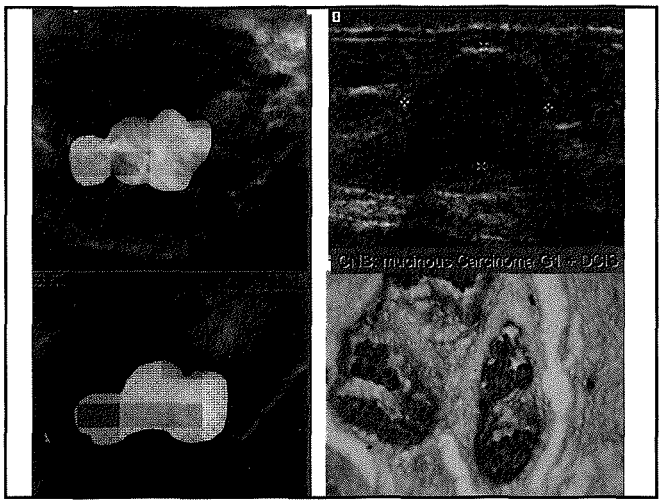
Mammographic density BI-RADS™

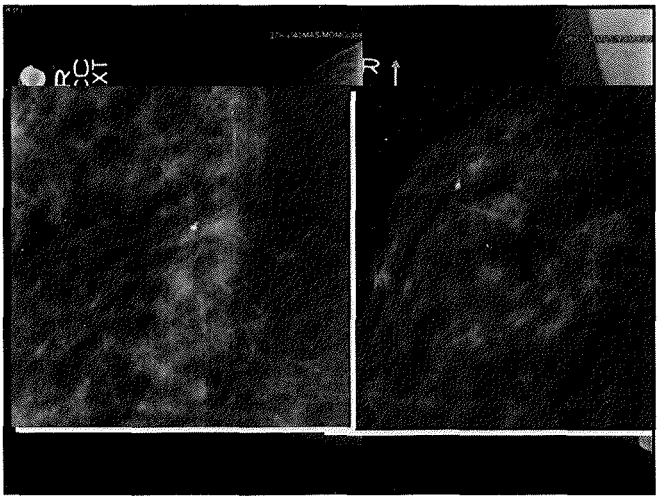


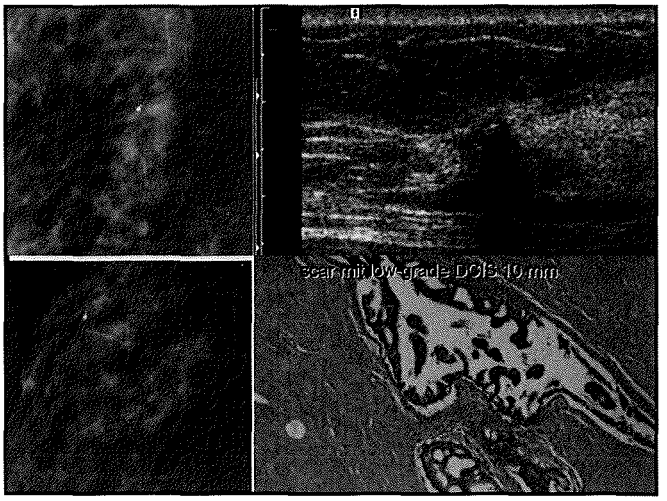
Tabar / Dean: Teaching Atlas of Mammography Thieme 2001

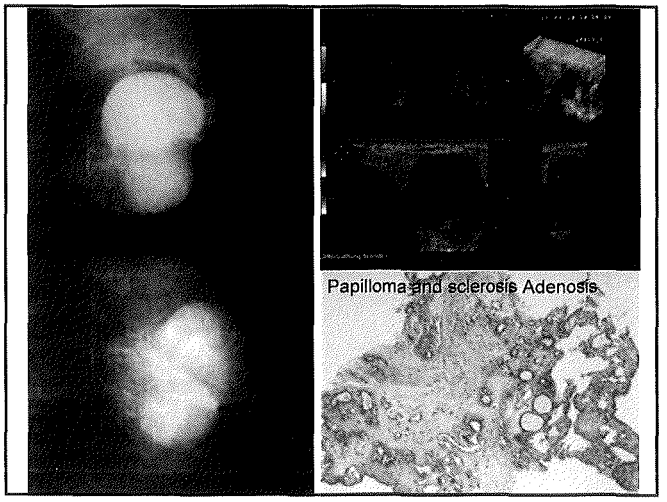
Cases

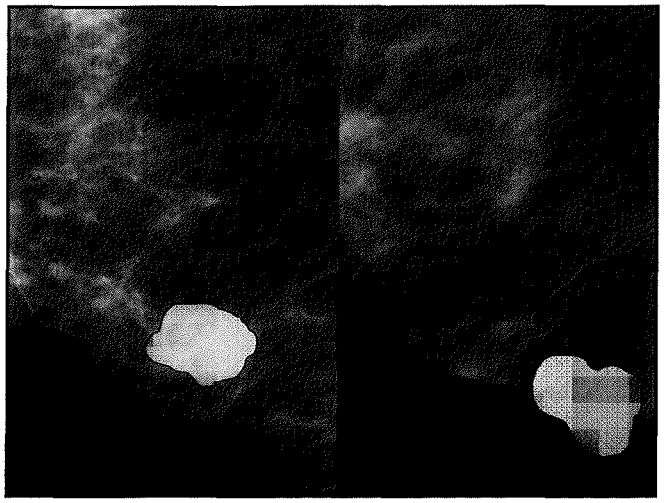

Schwerbeh Pat.
OBL

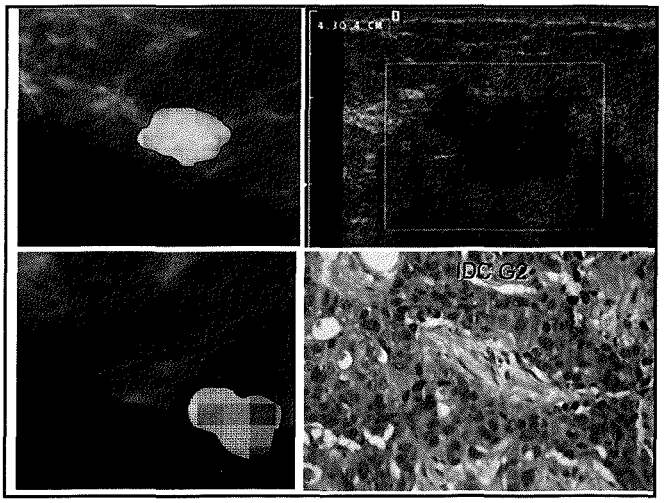

CME: mucinous Carcinoma G1 + DCIS

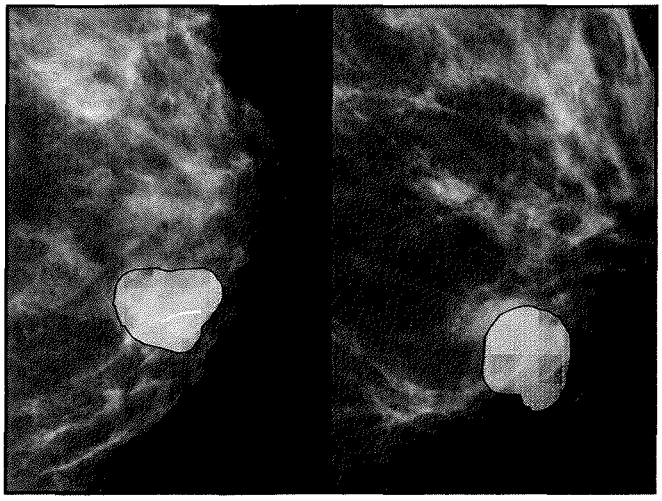


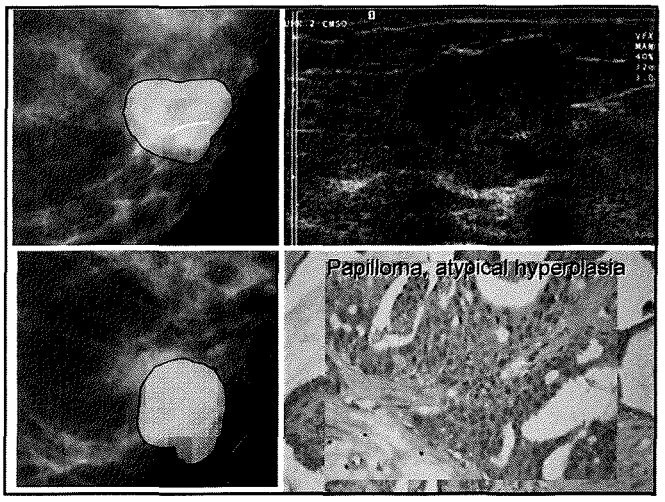

Szear mit low-grade DCIS 10 mm

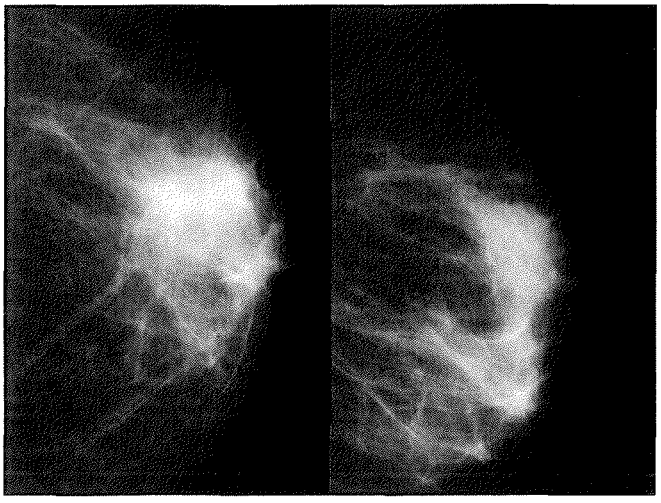

Papilloma and sclerosis Adenosis

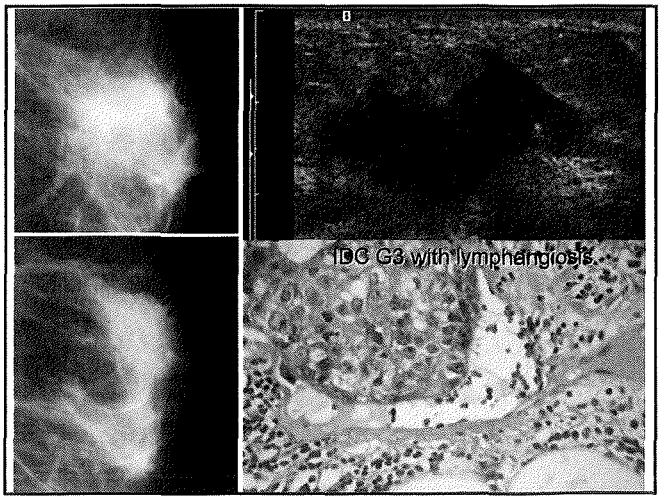


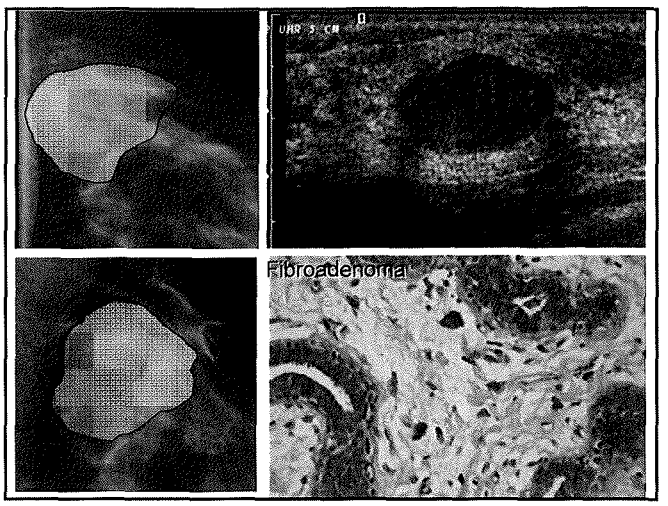

IDC G2

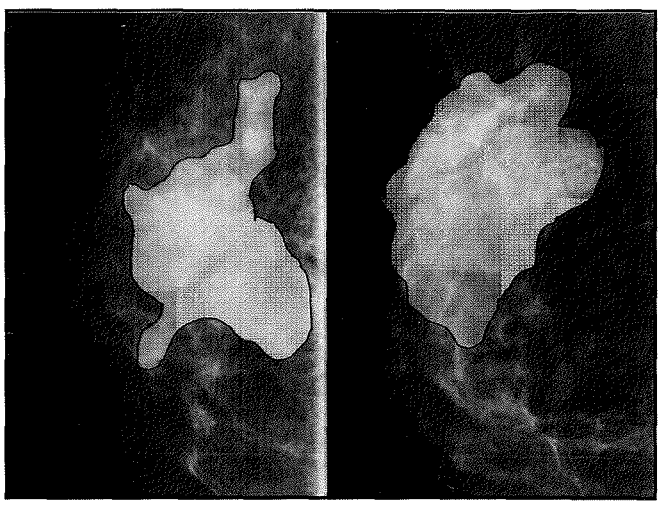


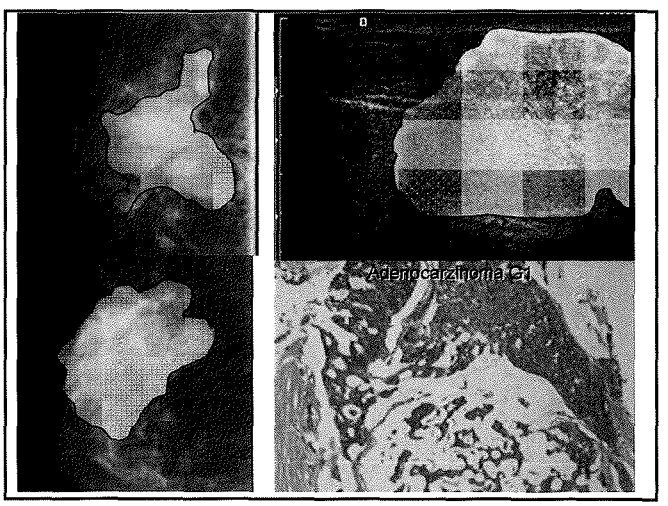

Papilloma, atypical hyperplasia

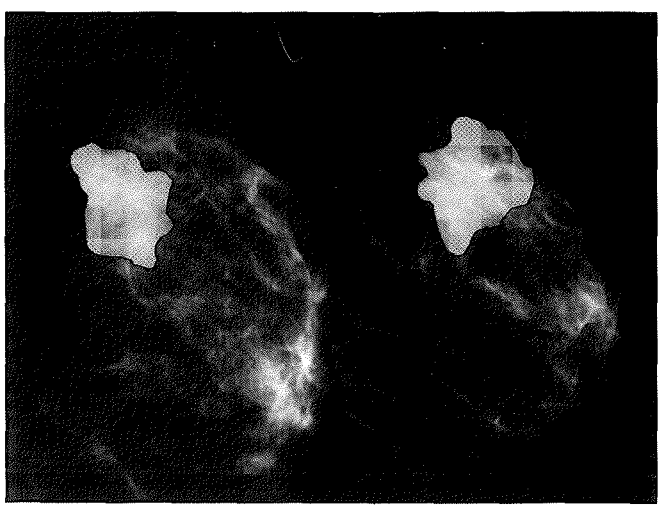


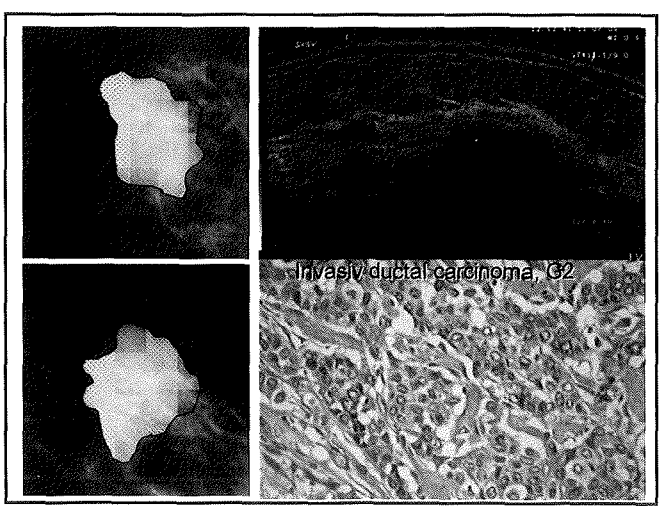

IDC G3 with lymphangiosis

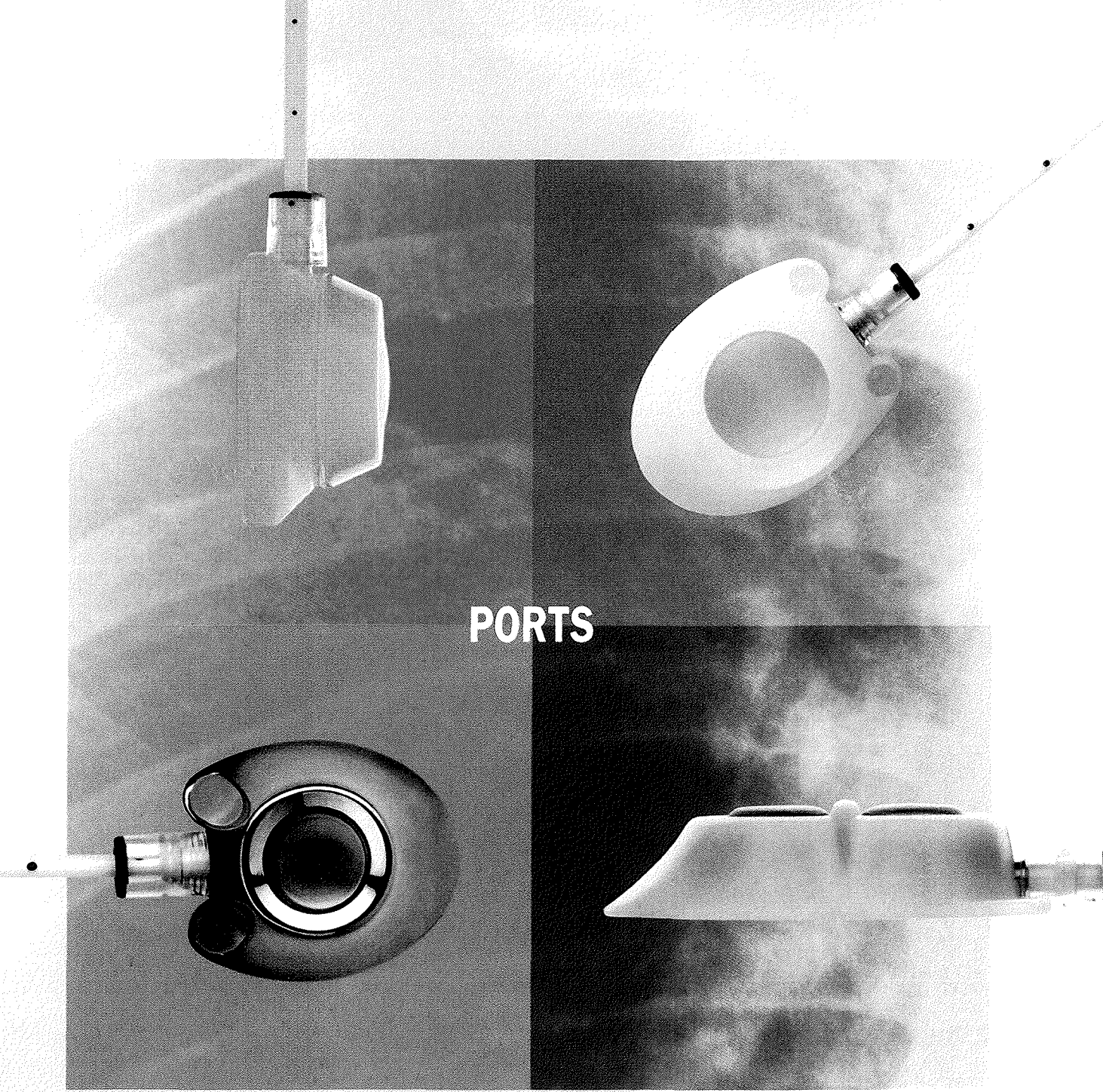

Fibroadenoma




Adenocarzinoma G1




Invasiv ductal carcinoma, G2



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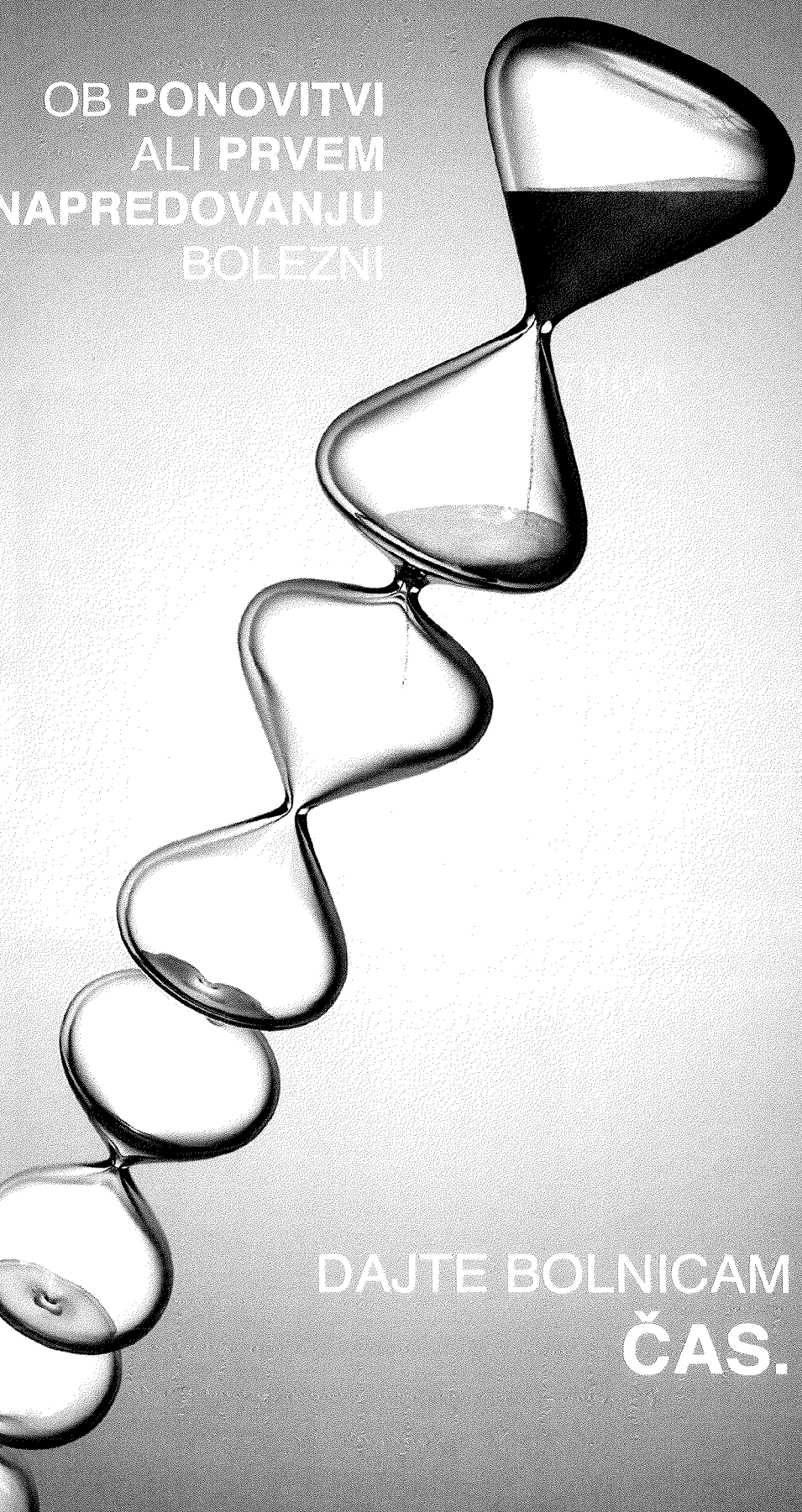

DAJTE BOLNICAM
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Faslodex 250 mg raztopina za injiciranje (fulvestrant)

Skrajšan povzetek glavnih značilnosti zdravila

Sestava: Ena napolnjena injekcijska brizga vsebuje 250 mg fulvestranta v 5 ml raztopine.
Indikacije: Zdravljenje žensk po menopavzi s pozitivnimi estrogenskimi receptorji pri lokalno napredovalem ali metastatskem raku dojke ob ponovitvi bolezni med ali po adjuvantnem zdravljenju z antiestrogeni ali ob napredovanju bolezni med zdravljenjem z antiestrogeni.
Odmerjanje in način uporabe: *Odrasle ženske (vključno s starejšimi):* Priporočeni odmerek je 500 mg v enomesečnih presledkih ter dodaten 500 mg odmerek, uporabljen dva tedna po začetnem odmerku. Zdravilo Faslodex je treba dati v dveh zaporednih injekcijah po 5 ml; injicirati ju je treba počasi (1-2 min/injekcijo) intramuskularno, eno injekcijo v vsak glutealni predel.
Kontraindikacije: Preobčutljivost za zdravilno učinkovino ali katerokoli pomožno snov, nosečnost in dojenje, huda jetrna okvara.
Opozorila in previdnostni ukrepi: Zdravilo Faslodex uporabljajte previdno pri bolnicah z blago do zmerno jetrno okvaro. Zdravilo Faslodex uporabljajte previdno pri bolnicah s hudo ledvično okvaro (kreatininski očistek manjši od 30 ml/min). Zaradi intramuskularne poti uporabe zdravilo Faslodex uporabljajte previdno pri zdravljenju bolnic s hemoragično diatezo, trombocitopenijo ali bolnic, ki se zdravijo z antikoagulanti. Tromboembolične dogodke so pogosto opažali pri ženskah z napredovalim rakom dojke, opazili pa so jih tudi v kliničnih preskušanjih z zdravilom Faslodex. Glede na mehanizem delovanja fulvestranta obstaja tveganje za razvoj osteoporoze.
Medsebojno delovanje zdravil: Prilagoditev odmerka ni potrebna pri bolnicah, ki sočasno uporabljajo fulvestrant in zaviralce ali induktorje CYP 3A4.
Neželeni učinki: Najpogostejši neželeni učinki, o katerih so poročali, so: reakcije na mestu injiciranja, astenija, navzea in zvišanje jetrnih encimov. Pogosti so tudi: glavobol, bruhanje, driska, okužbe sečil, izpuščaj, bolečine v križu, anoreksija, venska trombembolija, navali vročine, preobčutljivostne reakcije, zvišanje bilirubina.
Vrsta in vsebina ovojnine: Ena napolnjena injekcijska brizga iz prozornega stekla tipa 1 s polistirenskim potisnim batom z zaporko, ki ščiti pred posegom, vsebuje 5 ml Faslodex raztopine za injekcije.
Način predpisovanja in izdaje zdravila: Samo na recept, uporaba samo v javnih zdravstvenih zavodih ter pri pravnih in fizičnih osebah, ki opravljajo zdravstveno dejavnost.
Datum priprave besedila: februar 2012
Imetnik dovoljenja za promet: AstraZeneca UK Limited, Alderley Park, Macclesfield, Cheshire, SK10 4TG, Velika Britanija
Pred predpisovanjem, prosimo, preberite celoten povzetek glavnih značilnosti zdravila.
Dodatne informacije so na voljo pri: AstraZeneca UK Limited, Podružnica v Sloveniji, Verovškova 55, 1000 Ljubljana, telefon: 01/51 35 600.

Samo za strokovno javnost.

Informacija pripravljena marca 2012.

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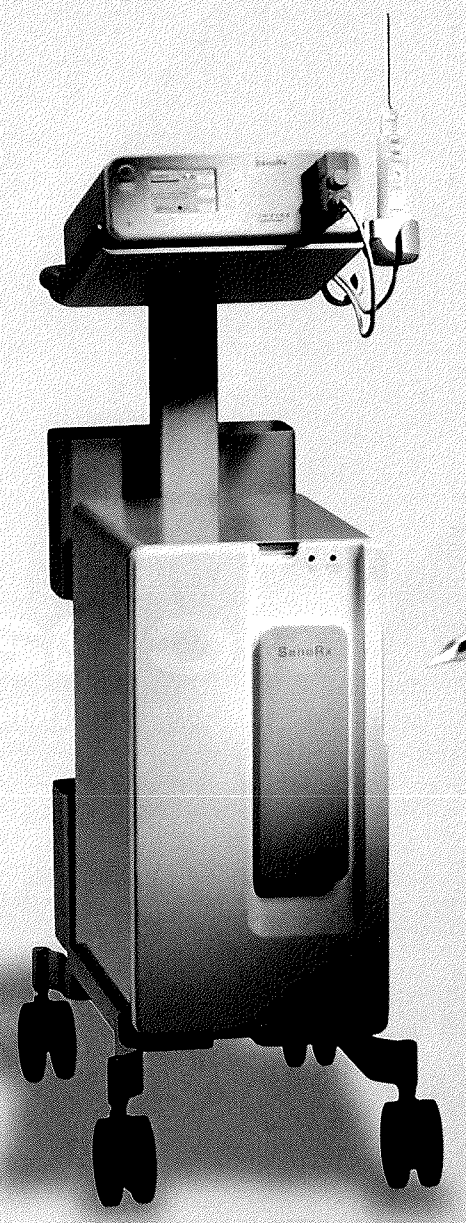

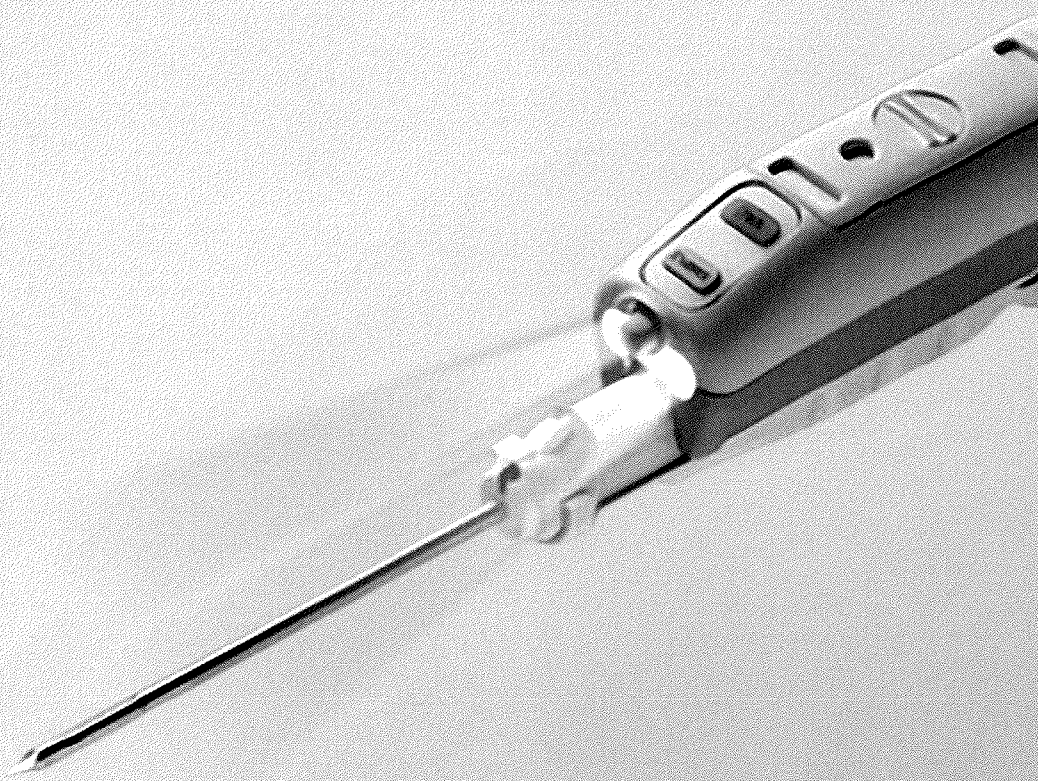

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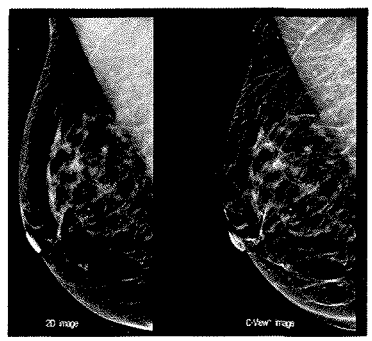
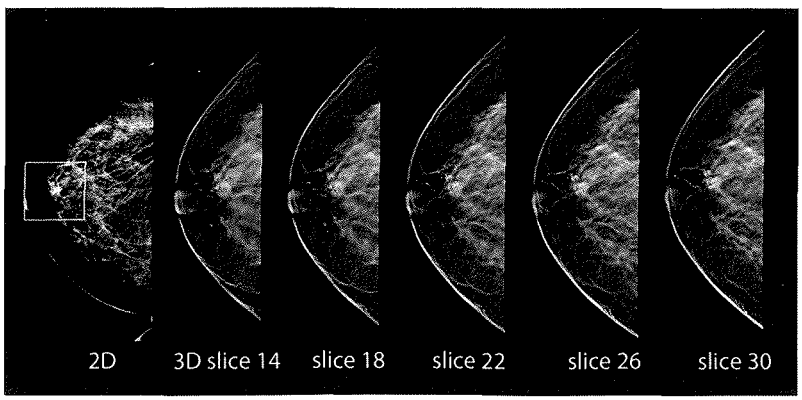


C-view:
rekonstrukcija mamografske slike iz tomosinteze - bistveno nižja doza

Tomosinteza: pogled v globino



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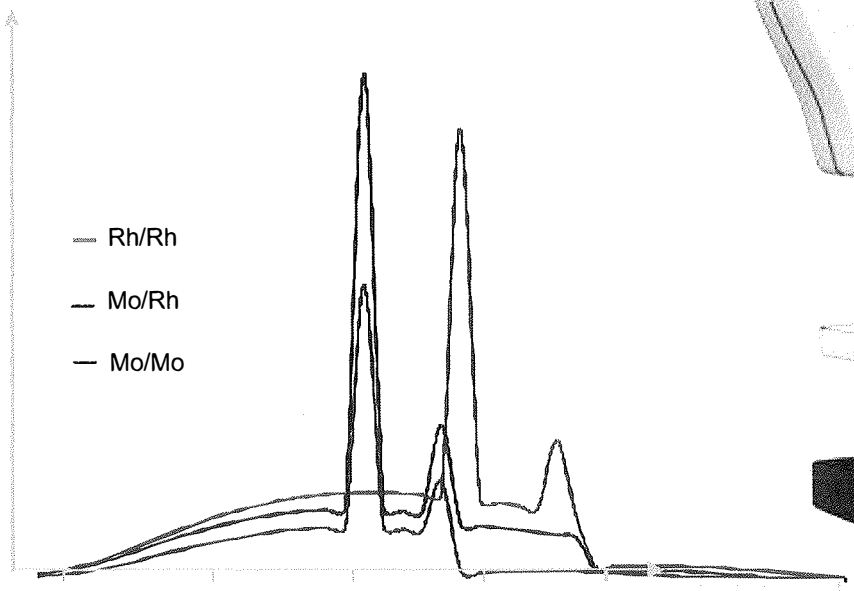

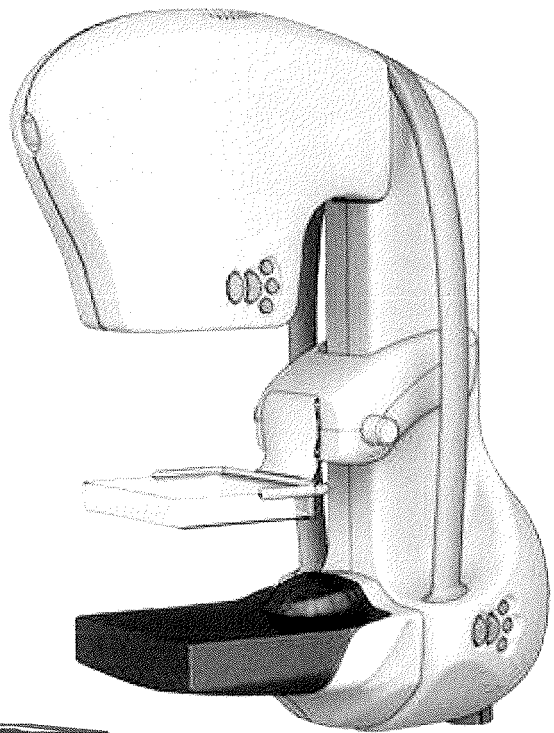

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