Torino, 25 Settembre 2013

gisma
gruppoitalianoscreening mammografico

Screening mammografico: nuove tecnologie, novità, studi di validazione

Tomosintesi: problematiche dosimetriche

F.Cavagnetto

S.C.Fisica Medica

IRCCS Azienda Ospedaliera Universitaria San Martino
IST - Istituto Nazionale per la Ricerca sul Cancro - Genova

Problematiche: Perché?

- *La dose di un esposizione in tomosintesi (DBT-3D) è maggiore di quella in mammografia digitale tradizionale (FFDM-2D)*
- *L'aumento di dose oscilla nel range 30-50%*
- *…..E' un problema?*

Screening Mammografico-Dose

- *Pratica radiologica:*
  - *Principio di ottimizzazione e giustificazione:*
    - ❖Ogni esame radiologico, deve garantire il rispetto dei **principi di ottimizzazione** e **giustificazione** della pratica, cioè **il beneficio** diretto alla paziente derivante dall'esecuzione dell'esame **deve superare il rischio** correlato all'esposizione a radiazioni ionizzanti:
  - **Beneficio**: rilevazione precoce del tumore mammario
  - **Rischio**: tumore radioindotto
- *Pazienti asintomatiche*
- *Ripetitività dell'esame ogni 1-2 anni*

Rischio - Beneficio

- ***Quantificare rischio:***
  - *Valutare la dose dell'esame mammografico*
  - *Correlazione con il rischio di tumore radioindotto*
- ***Valutare il beneficio:***
  - *La tomosintesi dà effettivamente un' informazione in più nella diagnosi?*

Rischio - Beneficio

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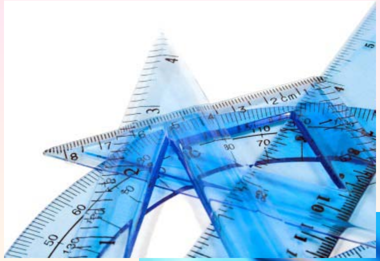
- *Valutare il beneficio:*
  - *La tomosintesi dà effettivamente un' informazione in più nella diagnosi?*

La Dose in Tomosintesi



La Dose in mammografia

Come si misura:

- **ESAK** (Entrance Surface Air Kerma): **mGy**, dose in aria in ingresso alla mammella

- **AGD** (**A**verage **G**landular **D**ose): **mGy**, dose media alla ghiandola mammaria **DGM** (**D**ose **G**hiandolare **M**edia)

La Dose in Mammografia

- **ESAK** (Entrance Surface Air Kerma):
  - Italia: **Decreto Legislativo 187/00** sulla radioprotezione del paziente:
    - LDR (Livelli Diagnostici di Riferimento): ***ESAK <10 mGy***

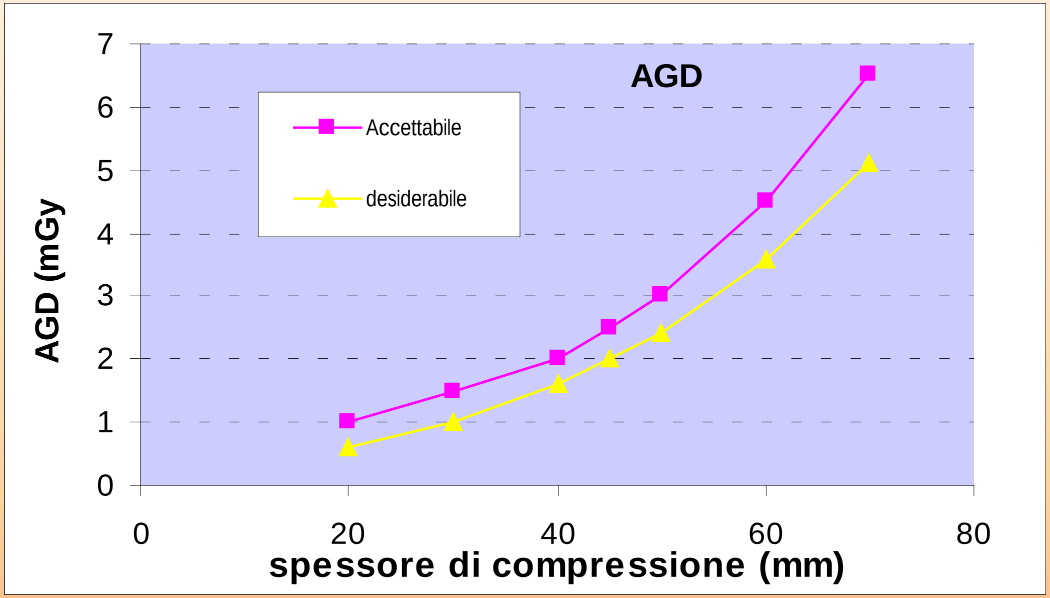
    (spessore di compressione 4,5 cm)

- **AGD** (Average Glandular Dose): **mGy**,
  - **EUREF:** **“**European guidelines for quality assurance in breast cancer screening and diagnosis” 2006
  - **Supplement:** 08/2011

La Dose in Mammografia

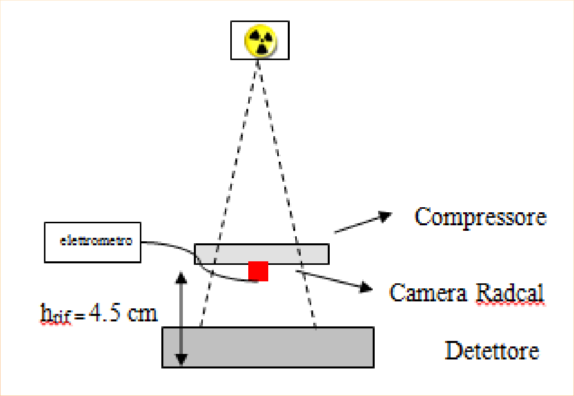
AGD (Average Glandular Dose): **mGy**,

- **EUREF: "**European guidelines for quality assurance in breast cancer screening and diagnosis" 2006



La Dose in Mammografia

- **ESAK** (Entrance Surface Air Kerma):
  - Misura in aria sotto al compressore
  - Strumento calibrato in **Gy**
  - Posizione di riferimento:
    - 6 cm dal bordo toracico
    - 4,5 cm di altezza



La Dose in Mammografia

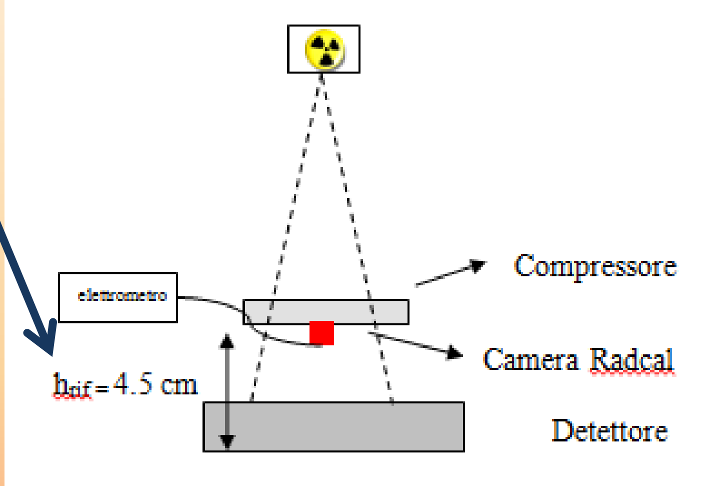
ESAK

Dipende da:

- **Energia del fascio:**
  - accoppiamento anodo/filtro
  - kV
- Spessore di compressione

$$ESAK = output \cdot mAs \cdot \left(\frac{SID - h_{rif}}{SID - x} \right)^2$$

- mAs



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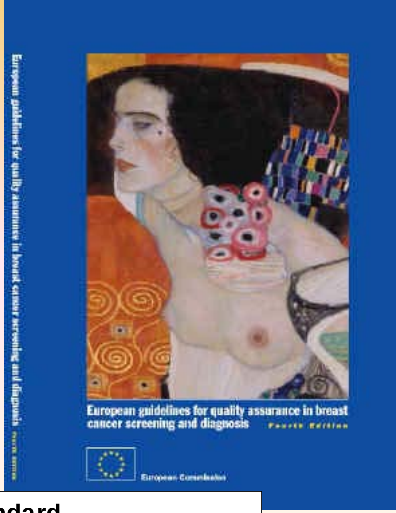
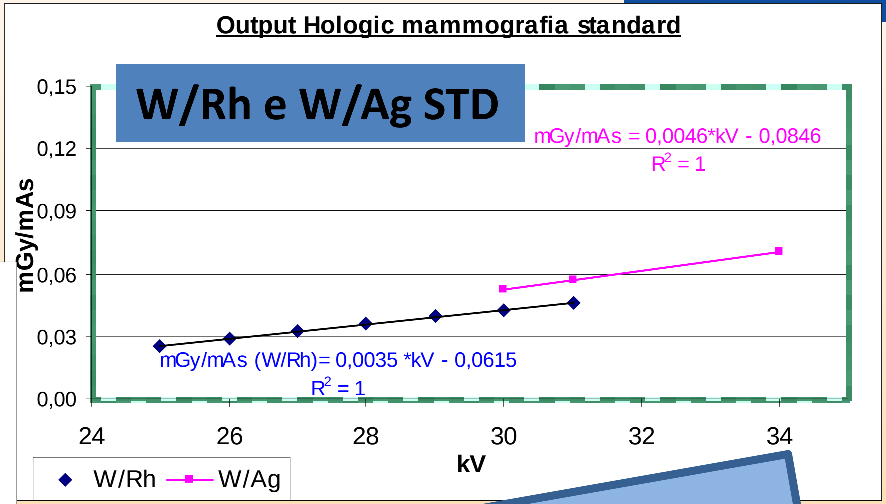
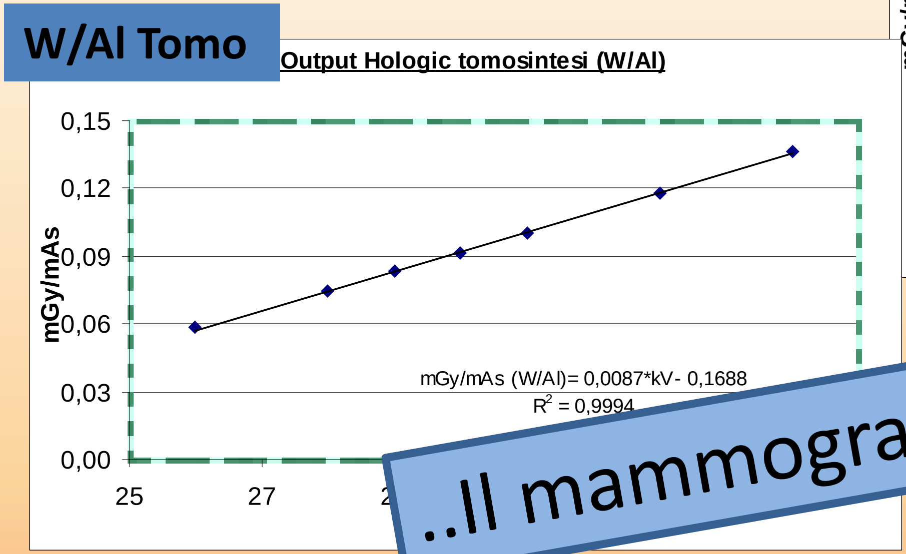
La Dose in Mammografia



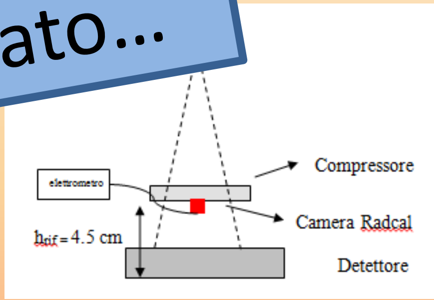
ESAK

$$ESAK = output \cdot mAs \cdot \left(\frac{SID - h_{rif}}{SID - x} \right)^2$$





..Il mammografo va caratterizzato…



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La Dose in Mammografia

AGD = ESAK · g · c · s

- **EASK** = misura in aria senza «backscatter»
- **g** = fattore di conversione per passare da kerma in aria a dose in tessuto (*50% di ghiandola mammaria)*
- **c** = fattore che tiene conto della percentuale di ghiandola mammaria rispetto al tessuto adiposo diversa dal 50% (età della paziente)
- **s** = cambia al variare dello spettro RX
- Tutti i fattori cambiano al variare della qualità del fascio RX (**HVL**)

La Dose in Mammografia

AGD = ESAK · g · c · s

HVL (Half Value Layer)

Parametro che indica la qualità di un fascio RX, è lo spessore di materiale (mm Al) necessario a dimezzare l’intensità del fascio: **dipende dallo spettro energetico del fascio**

Misure di caratterizzazione del mammografo

La Dose in Mammografia

AGD = ESAK · g · c · s

HVL (Half Value Layer)

(EUREF 2001)

	HVL (mm Al) for target filter combination				
kV	Mo + 30 µm Mo	Mo +25 µm Rh	Rh +25 µm Rh	W +50 µm Rh	W +0.45 µm Al[22]
25	0.33 ± .02	0.40 ± .02	0.38 ± .02	0.52 ± .03	0.31 ± .03
28	0.36 ± .02	0.42 ± .02	0.43 ± .02	0.54 ± .03	0.37 ± .03
31	0.39 ± .02	0.44 ± .02	0.48 ± .02	0.56 ± .03	0.42 ± .03
34		0.47 ± .02		0.59 ± .03	0.47 ± .03
37		0.50 ± .02			0.51 ± .03

La Dose in Mammografia

AGD = ESAK · **g** · **c** · **s**

Simulazioni monte Carlo: **D.R.Dance** e al., Phy. Med. Biol.

- Monte Carlo calculation of conversion factors(**1990**)
- Additional factors……**2000**
- Further factors……**2009**
- «Further…..further factors» e Tomosynthesis **2011**
- Spettri fasci RX con diversi accoppiamenti anodo/filtro, spessori 2-11 cm, ghiandolarità 0,1%-100%

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La Dose in Mammografia

$$AGD = ESAK \cdot \mathbf{g} \cdot c \cdot s$$

Breast Thickness (cm)	g-factors (mGy/mGy) HVL (mm Al)						
	0.30	0.35	0.40	0.45	0.50	0.55	0.60
2	0.390	0.433	0.473	0.509	0.543	0.573	0.587
3	0.274	0.309	0.342	0.374	0.406	0.437	0.466
4	0.207	0.235	0.261	0.289	0.318	0.346	0.374
4.5	0.183	0.208	0.232	0.258	0.285	0.311	0.339
5	0.164	0.187	0.209	0.232	0.258	0.287	0.310
6	0.135	0.154	0.172	0.192	0.214	0.236	0.261
7	0.114	0.130	0.145	0.163	0.177	0.202	0.224
8	0.098	0.112	0.126	0.140	0.154	0.175	0.195
9	0.0859	0.0981	0.1106	0.1233	0.1357	0.1543	0.1723
10	0.0763	0.0873	0.0986	0.1096	0.1207	0.1375	0.1540
11	0.0687	0.0786	0.0887	0.0988	0.1088	0.1240	0.1385

D.R.Dance e al.2000

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La Dose in Mammografia

$$AGD = ESAK \cdot g \cdot \mathbf{c} \cdot s$$

40-49 anni

Breast Thickness (cm)	c-factors HVL (mm Al)						
	0.30	0.35	0.40	0.45	0.50	0.55	0.60
2	0.885	0.891	0.900	0.905	0.910	0.914	0.919
3	0.894	0.898	0.903	0.906	0.911	0.915	0.918
4	0.940	0.943	0.945	0.947	0.948	0.952	0.955
5	1.005	1.005	1.005	1.004	1.004	1.004	1.004
6	1.080	1.078	1.074	1.074	1.071	1.068	1.066
7	1.152	1.147	1.141	1.138	1.135	1.130	1.127
8	1.220	1.213	1.206	1.205	1.199	1.190	1.183
9	1.270	1.264	1.254	1.248	1.244	1.235	1.225
10	1.295	1.287	1.279	1.275	1.272	1.262	1.251
11	1.294	1.290	1.283	1.281	1.273	1.264	1.256

50-64 anni

Breast Thickness (cm)	c-factors HVL (mm Al)						
	0.30	0.35	0.40	0.45	0.50	0.55	0.60
2	0.885	0.891	0.900	0.905	0.910	0.914	0.919
3	0.925	0.929	0.931	0.933	0.937	0.940	0.941
4	1.000	1.000	1.000	1.000	1.000	1.000	1.000
5	1.086	1.082	1.081	1.078	1.075	1.071	1.069
6	1.164	1.160	1.151	1.150	1.144	1.139	1.134
7	1.232	1.225	1.214	1.208	1.204	1.196	1.188
8	1.275	1.265	1.257	1.254	1.247	1.237	1.227
9	1.299	1.292	1.282	1.275	1.270	1.260	1.249
10	1.307	1.298	1.290	1.286	1.283	1.272	1.261
11	1.306	1.301	1.294	1.291	1.283	1.274	1.266

La Dose in Mammografia

$$AGD = ESAK \cdot g \cdot c \cdot \mathbf{s}$$

Fascio RX	s
Mo/Mo	1,000
Mo/Rh	1,017
Rh/Rh	1,061
Rh/Al	1,044
W/Rh	1,042
W/Al	1,050

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La Dose in Tomosintesi

$$AGD = ESAK \cdot g \cdot c \cdot s \cdot T$$

Estimation of mean glandular dose for breast tomosynthesis: factors for use with the UK, European and IAEA breast dosimetry protocols

2011

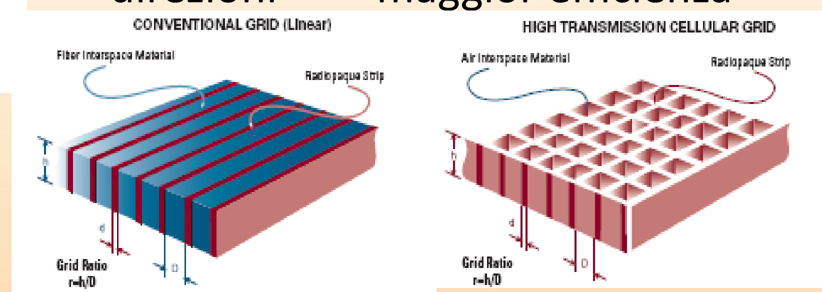
D R Dance[1,2], K C Young[1,2] and R E van Engen[3]

[1]NCCPM, Medical Physics Department, Royal Surrey County Hospital, Guildford GU2 7XX, UK
[2]Dept. of Physics, University of Surrey, Guildford GU2 7XH, UK
[3]National Training and Expert Centre for Breast Cancer Screening (LRCB), Radboud University Nijmegen Medical Centre P.O. Box 6873, 6532 SZ Nijmegen, The Netherlands

Torino, 25 Settembre 2013

Selenia Dimensions Hologic

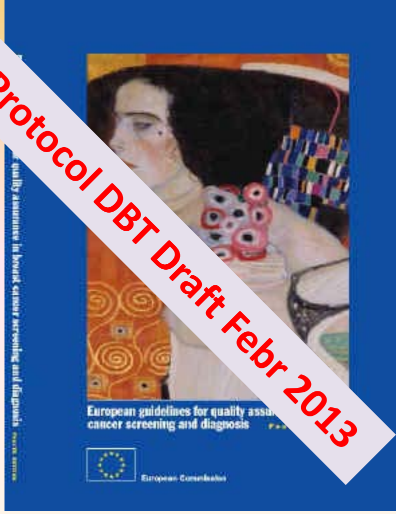
- **Anodo biangolare** Tungsteno-Renio
    - Filtrazioni:
    - 0,05 mm **Rh**
    - 0,05 mm **Ag**
    - **0,7 mm Al** **Tomosintesi**
- **Griglia HTC:** fascio primario non attenuato, scatter assorbito in tutte le direzioni maggior efficienza



- Escursione di **15° (± 7°)**
- 1 acquisizione per grado
- **4 sec** tempo totale
- **DM, TOMO, «COMBO»:**
    - Unica compressione, **DM + TOMO**

- **Detettore: Selenio amorfo**
    - Dimensioni: 24x29 cm;
    - dim. Matrice: 3328 x 4096; 14 bit
    - dim. pixel: 70 micron

La Dose in Tomosintesi



$$AGD = ESAK \cdot g \cdot c \cdot s \cdot T$$

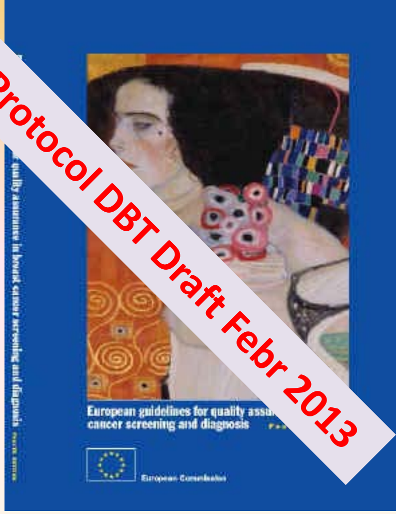
Table 4. *s*-factors for a tungsten target filtered by 0.7 mm aluminium.

Breast thickness (mm)	Glandularity range (%)	Typical glandularity age 50-64	Typical glandularity age 40-49	kV range (kV)	*s*-factor
20	80-100	100	100	25-50	1.052
30	62-82	72	82	25-50	1.060
40	40-65	50	65	25-50	1.076
50	23-49	33	49	25-50	1.087
60	11-35	21	35	25-50	1.105
70	2-24	12	24	28-50	1.121
80	0.1-17	7	14	28-50	1.129
90	0.1-14	4	8	28-50	1.136
100	0.1-13	3	5	28-50	1.140
110	0.1-13	3	5	28-50	1.144

s factor EUREF **Dance 2000**
W/Al = 1,05

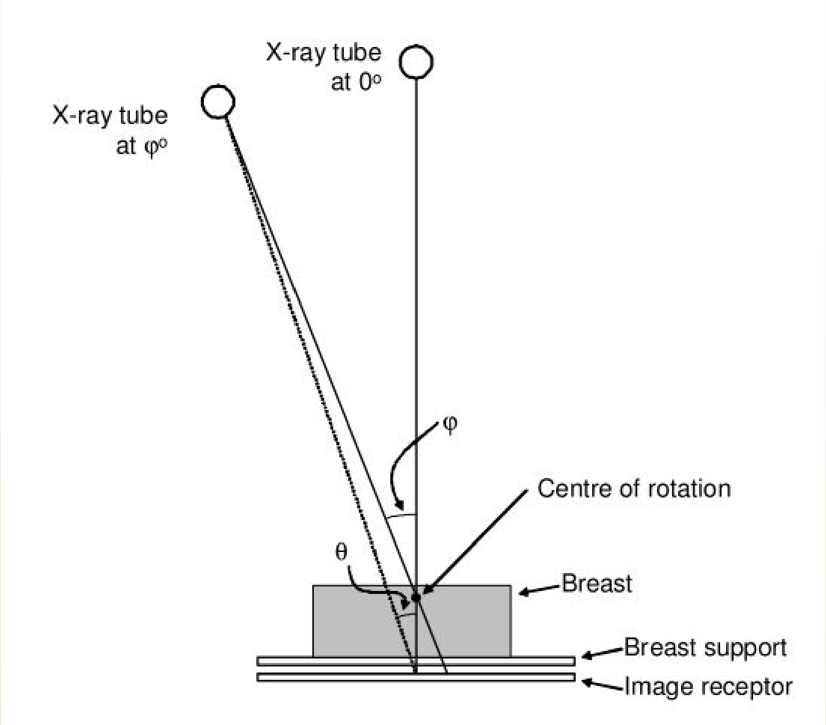
Fascio RX	s
Mo/Mo	1,000
Mo/Rh	1,017
Rh/Rh	1,061
Rh/Al	1,044
W/Rh	1,042
W/Al	**1,050**

La Dose in Tomosintesi



$$AGD = ESAK \cdot g \cdot c \cdot s \cdot T$$

Dance 2011



$$T = \alpha_i \sum_i t(\theta_i)$$

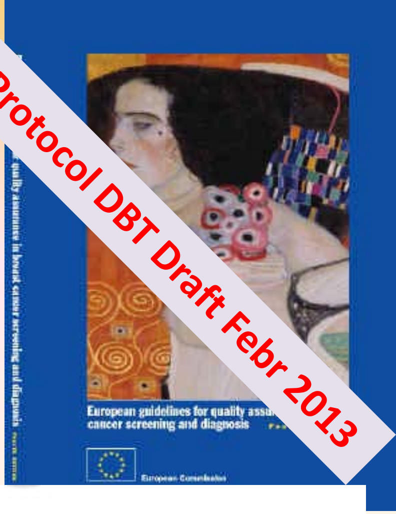
α carico del tubo

$$T = \frac{1}{i} \sum_i t(\theta_i)$$

$$t(\theta) = \frac{ADG(\theta)}{ADG(0°)}$$

Fattore «Tomo»

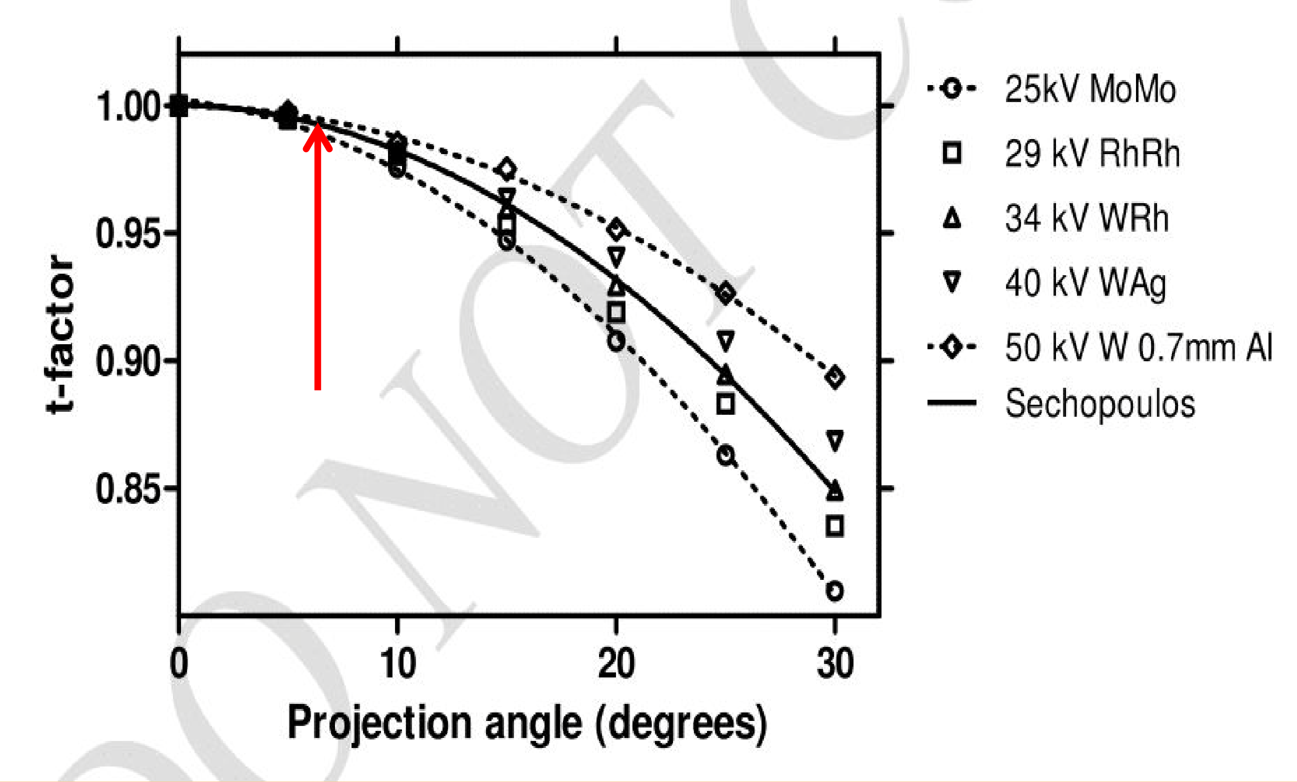
La Dose in Tomosintesi

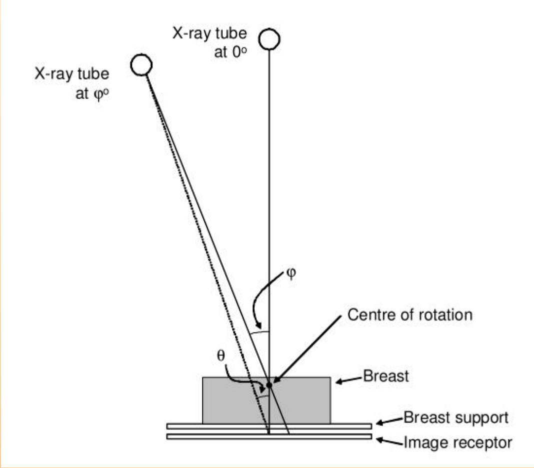


Protocol DBT Draft Febr 2013

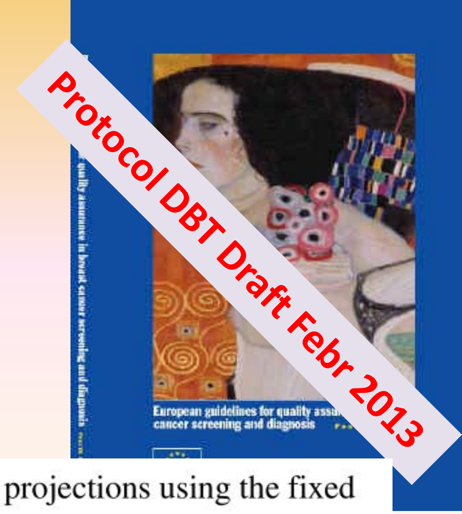
$$AGD = ESAK \cdot g \cdot c \cdot s \cdot T$$

Dance 2011





La Dose in Tomosintesi



$$AGD = ESAK \cdot g \cdot c \cdot s \cdot T$$

Dance 2011

Table 5. *t*-factors for the calculation of MGD for individual projections using the fixed detector geometry.

Breast thickness mm	Conversion factor *t* for Projection angle (degrees) 5	10	15	20	25	30
20	0.997	0.988	0.976	0.958	0.930	0.895
30	0.996	0.986	0.970	0.944	0.914	0.870
40	0.996	0.984	0.964	0.937	0.902	0.859
50	0.995	0.983	0.961	0.932	0.897	0.855
60	0.994	0.980	0.960	0.926	0.894	0.851
70	0.993	0.980	0.956	0.927	0.894	0.851
80	0.993	0.979	0.955	0.924	0.892	0.852
90	0.991	0.977	0.951	0.924	0.892	0.854
100	0.993	0.975	0.949	0.924	0.892	0.845
110	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

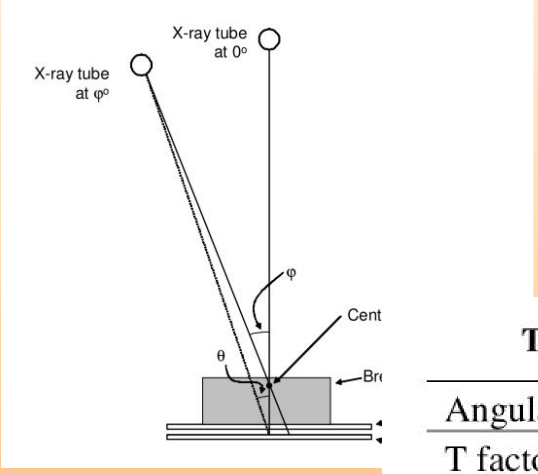
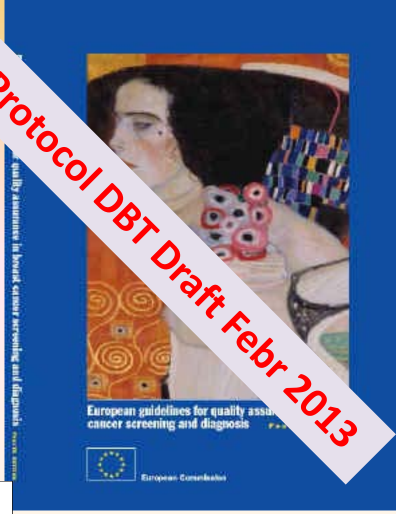


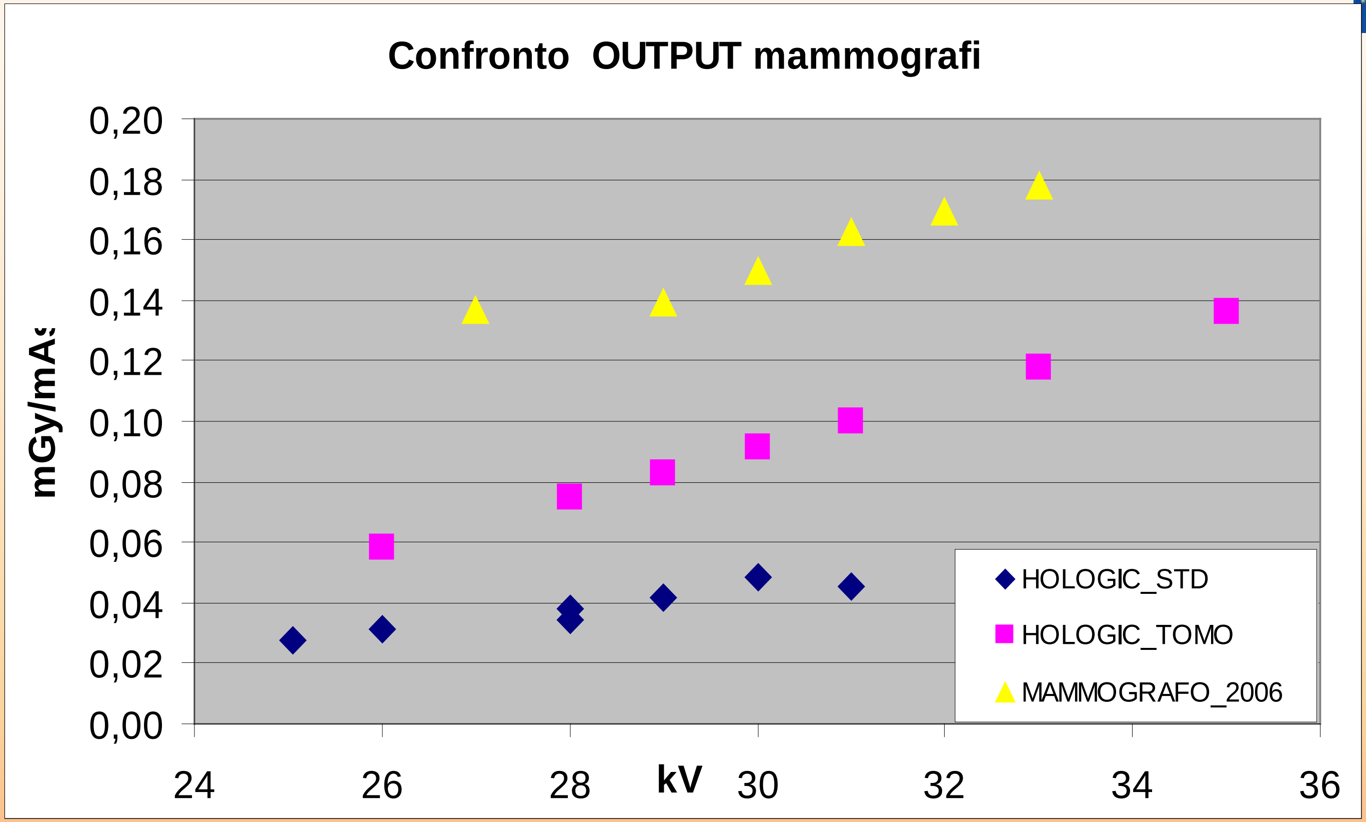
Table 7. Example of *T*-factors for different scan ranges with the fixed detector geometry.

Angular range (degrees)	-10 to +10	-15 to +15	-20 to +20	-25 to +25	-30 to +30
T factor	0.990	0.981	0.971	0.959	0.944
Max fractional error	0.010	0.016	0.022	0.029	0.037

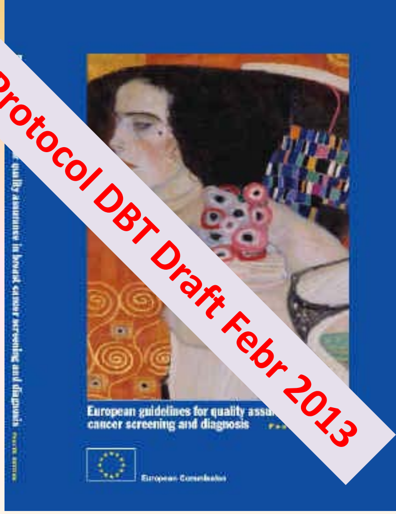
La Dose in Tomosintesi



$$AGD = \mathbf{ESAK} \cdot g \cdot c \cdot s \cdot T$$



La Dose in Tomosintesi



$$AGD = ESAK \cdot g \cdot c \cdot s \cdot T$$

- Raccolta dati mammografie da studio multicentrico (300 pz)
- Doppia esposizione con stessa compressione (tecnica **COMBO**)
- **FFDM** (**F**ull **F**ield **D**igital **M**ammography)
- **DBT** (**D**igital **B**reast **T**omosynthesis)

Torino, 25 Settembre 2013

La Dose in Tomosintesi

Radiat Prot Dosimetry. 2013 Jun 3. [Epub ahead of print]

'IN VIVO' AVERAGE GLANDULAR DOSE EVALUATION: ONE-TO-ONE COMPARISON BETWEEN DIGITAL BREAST TOMOSYNTHESIS AND FULL-FIELD DIGITAL MAMMOGRAPHY.

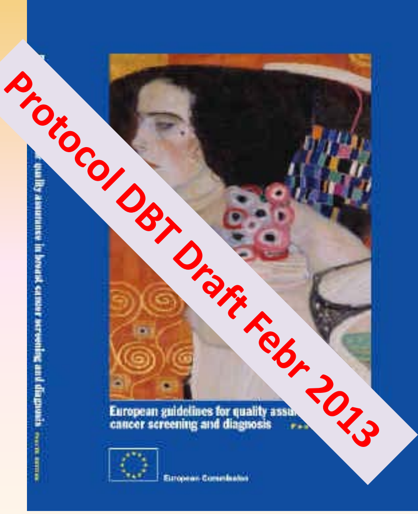
Cavagnetto F, Taccini G, Rosasco R, Bampi R, Calabrese M, Tagliafico A.

Department of Medical Physics and Radiology, S.C.Fisica Medica e Sanitaria, A.O.U. IRCCS San Martino-IST, Largo R Benzi 10, Genova 16132, Italy.

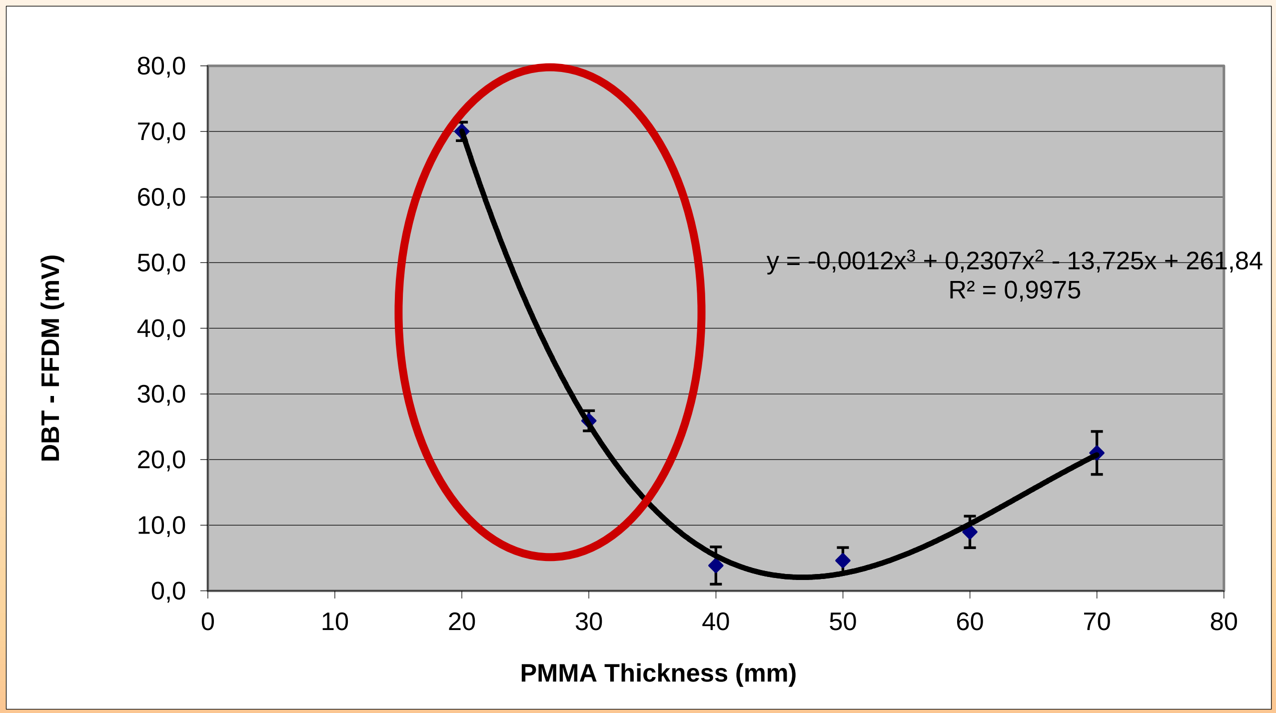
Abstract

We analysed 300 patients X rayed with digital breast tomosynthesis (DBT), full-field digital mammography (FFDM) and 'COMBO' (single view both in FFDM and DBT in a single breast compression)-Hologic Selenia Dimension-W/Rh-Ag-Al: three different anode-filter combinations-automatic exposure control modalities. Examination parameter data collection (EPDC) and 'in vivo' dosimetry using metal oxide semiconductor field effect transistor (MOSFET) were utilised to determine and compare entrance skin air kerma (ESAK) and average glandular dose (AGD) from a radioprotection viewpoint in the DBT and COMBO modalities. MOSFET has been tested to be introduced in clinical routine. EPDC of DBT underlines increase in ESAK and AGD compared with FFDM ($p < 0.05$). The mean percentage increase was 34 % (+17 %) in ESAK and 46 % (+16 %) in AGD. In the COMBO modality, the mean percentage increase in ESAK was 162 % (+41 %) and in AGD was 202 % (+61 %). Differences between MOSFET measurement and calculated values were <8 % for breasts thicker than 30 mm; otherwise, the errors are >15 %. DBT increases ESAK and AGD, due to the 3D acquisition modality. MOSFET may be considered in DBT as a routine check.

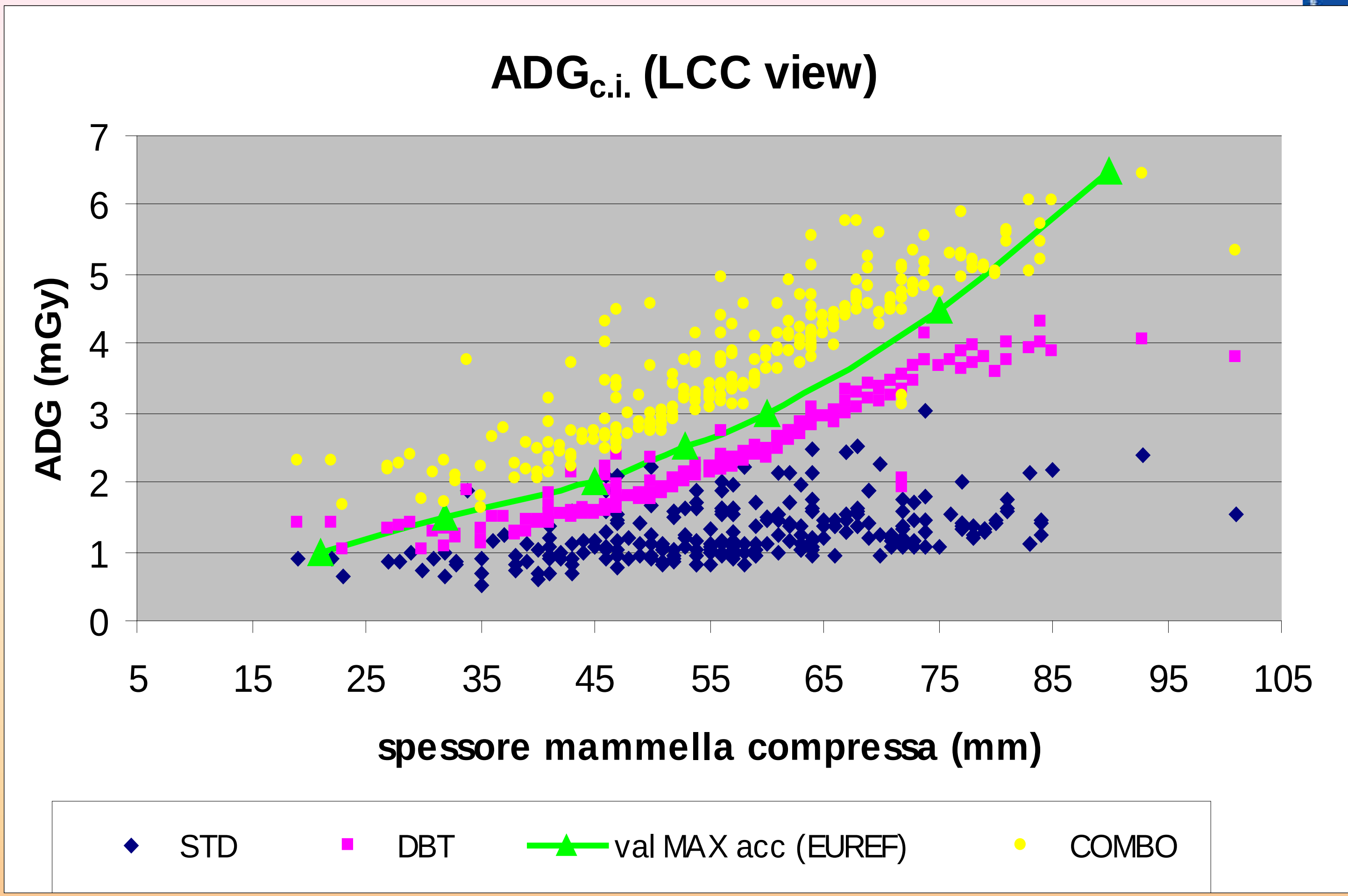
La Dose in Tomosintesi



- Aumento medio AGD: 46%



La Dose in Tomosintesi



Rischio - Beneficio

- ***Quantificare rischio:***
  - *Valutare la dose dell'esame mammografico*
  - ***Correlazione con il rischio di tumore radioindotto***
- *Valutare il beneficio:*
  - *La tomosintesi dà effettivamente un informazione in più nella diagnosi?*

SPECIAL REPORT

- **Radiation Doses and Cancer Risks from Breast Imaging Studies**
- R.Edward Hendrick, PhD, Colorado University
- *Radiology: vol 257, N°1, Oct 2010*

- ***PURPOSE***: *to compare radiation doses and Lifetime Attributable Risks (LARs) of radiation-induced cancer incidence and mortality from breast imaging studies involving the use of ionizing radiation*
- *BEIR VII data (Biologic Effects of Ionizing Radiation)*

Radiation Doses and Cancer Risks from Breast Imaging Studies

Analisi:

- **Two-view digital mammography (DM)**
- **Screen film mammography**
- **Screening**
- Breast-specific gamma imaging (BSGI)
- Positron emission mammography (PEM)
- Dedicated breast CT
- **Tomosynthesis**

Radiation Doses and Cancer Risks from Breast Imaging Studies

- **ICRP** (**I**nternational **C**ommission on **R**adiological **P**rotection)
- **ICRP** rischio da radiazioni: **Dose efficace (Sv)**
  - Dose al corpo intero come somma pesata della dose ai singoli organi
  - Fattore peso $\mathbf{W_T}$ per la mammella nel **2007** è passato da **0,05** (1997) a **0,12**

Radiation Doses and Cancer Risks from Breast Imaging Studies

Risultati Hendrick:

Average Glandular Dose (AGD)

- ***3,7 mGy*** mammografia digitale (2 proiez)
- **4,7 mGy** mammografia schermo film (2 proiez)
- 1,3 – 1,7 casi per 100000 donne (40 anni)
- < 1 su 1000000 per 80 anni
- **Screening annuale**: 20-25 casi su 100000

CONFRONTI

Risultati Hendrick:
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Singola proiezione

Table 1. Three hundred mammography acquisition parameter data analysis, and differences in FFDM, DBT and COMBO modalities.

	Average AGD (mGy)	Min–max AGD (mGy)	Average increase vs. FFDM (%)	
			ESAK	AGD
FFDM	1.31	0.53–3.01	–	–
DBT	2.56	0.93–4.53	34	46
COMBO	3.87	1.46–7.54	162	202

FFDM, full-field digital mammography; DBT, digital breast tomosynthesis; AGD, average glandular dose; ESAK, entrance surface air kerma.

Rischio - Beneficio

- *Quantificare rischio:*
  - *Valutare la dose dell'esame mammografico*
  - *Correlazione con il rischio di tumore radioindotto*
- ***Valutare il beneficio:***
  - ***La tomosintesi dà effettivamente un informazione in più nella diagnosi?***

Torino, 25 Settembre 2013

Beneficio

Lancet Oncol. 2013 Jun;14(7):583-9. doi: 10.1016/S1470-2045(13)70134-7. Epub 2013 Apr 25.

Integration of 3D digital mammography with tomosynthesis for population breast-cancer screening (STORM): a prospective comparison study.

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Abstract

BACKGROUND: Digital breast tomosynthesis with 3D images might overcome some of the limitations of conventional 2D mammography for detection of breast cancer. We investigated the effect of integrated 2D and 3D mammography in population breast-cancer screening.

METHODS: Screening with Tomosynthesis OR standard Mammography (STORM) was a prospective comparative study. We recruited asymptomatic women aged 48 years or older who attended population-based breast-cancer screening through the Trento and Verona screening services (Italy) from August, 2011, to June, 2012. We did screen-reading in two sequential phases-2D only and integrated 2D and 3D mammography-yielding paired data for each screen. Standard double-reading by breast radiologists determined whether to recall the participant based on positive mammography at either screen read. Outcomes were measured from final assessment or excision histology. Primary outcome measures were the number of detected cancers, the number of detected cancers per 1000 screens, the number and proportion of false positive recalls, and incremental cancer detection attributable to integrated 2D and 3D mammography. We compared paired binary data with McNemar's test.

FINDINGS: 7292 women were screened (median age 58 years [IQR 54-63]). We detected 59 breast cancers (including 52 invasive cancers) in 57 women. Both 2D and integrated 2D and 3D screening detected 39 cancers. We detected 20 cancers with integrated 2D and 3D only versus none with 2D screening only ($p<0.0001$). Cancer detection rates were 5.3 cancers per 1000 screens (95% CI 3.8-7.3) for 2D only, and 8.1 cancers per 1000 screens (6.2-10.4) for integrated 2D and 3D screening. The incremental cancer detection rate attributable to integrated 2D and 3D mammography was 2.7 cancers per 1000 screens (1.7-4.2). 395 screens (5.5%; 95% CI 5.0-6.0) resulted in false positive recalls: 181 at both screen reads, and 141 with 2D only versus 73 with integrated 2D and 3D screening ($p<0.0001$). We estimated that conditional recall (positive integrated 2D and 3D mammography as a condition to recall) could have reduced false positive recalls by 17.2% (95% CI 13.6-21.3) without missing any of the cancers detected in the study population.

INTERPRETATION: Integrated 2D and 3D mammography improves breast-cancer detection and has the potential to reduce false positive recalls. Randomised controlled trials are needed to compare integrated 2D and 3D mammography with 2D mammography for breast cancer screening.

FUNDING: National Breast Cancer Foundation, Australia; National Health and Medical Research Council, Australia; Hologic, USA; Technologic, Italy.

Beneficio

Eur Radiol. 2013 Aug;23(8):2061-71. doi: 10.1007/s00330-013-2820-3. Epub 2013 Apr 4.

Prospective trial comparing full-field digital mammography (FFDM) versus combined FFDM and tomosynthesis in a population-based screening programme using independent double reading with arbitration.

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Abstract

OBJECTIVES: To compare double readings when interpreting full field digital mammography (2D) and tomosynthesis (3D) during mammographic screening.

METHODS: A prospective, Ethical Committee approved screening study is underway. During the first year 12,621 consenting women underwent both 2D and 3D imaging. Each examination was independently interpreted by four radiologists under four reading modes: Arm A-2D; Arm B-2D + CAD; Arm C-2D + 3D; Arm D-synthesised 2D + 3D. Examinations with a positive score by at least one reader were discussed at an arbitration meeting before a final management decision. Paired double reading of 2D (Arm A + B) and 2D + 3D (Arm C + D) were analysed. Performance measures were compared using generalised linear mixed models, accounting for inter-reader performance heterogeneity ($P < 0.05$).

RESULTS: Pre-arbitration false-positive scores were 10.3 % (1,286/12,501) and 8.5 % (1,057/12,501) for 2D and 2D + 3D, respectively ($P < 0.001$). Recall rates were 2.9 % (365/12,621) and 3.7 % (463/12,621), respectively ($P = 0.005$). Cancer detection was 7.1 (90/12,621) and 9.4 (119/12,621) per 1,000 examinations, respectively (30 % increase, $P < 0.001$); positive predictive values (detected cancer patients per 100 recalls) were 24.7 % and 25.5 %, respectively ($P = 0.97$). Using 2D + 3D, double-reading radiologists detected 27 additional invasive cancers ($P < 0.001$).

CONCLUSION: Double reading of 2D + 3D significantly improves the cancer detection rate in mammography screening.

KEY POINTS: • Tomosynthesis-based screening was successfully implemented in a large prospective screening trial. • Double reading of tomosynthesis-based examinations significantly reduced false-positive interpretations. • Double reading of tomosynthesis significantly increased the detection of invasive cancers.

Beneficio

Radiology. 2013 Jul 30. [Epub ahead of print]

Comparison of Tomosynthesis Plus Digital Mammography and Digital Mammography Alone for Breast Cancer Screening.

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Abstract

Purpose:To compare screening recall rates and cancer detection rates of tomosynthesis plus conventional digital mammography to those of conventional digital mammography alone.Materials and Methods:All patients presenting for screening mammography between October 1, 2011, and September 30, 2012, at four clinical sites were reviewed in this HIPAA-compliant retrospective study, for which the institutional review board granted approval and waived the requirement for informed consent. Patients at sites with digital tomosynthesis were offered screening with digital mammography plus tomosynthesis. Patients at sites without tomosynthesis underwent conventional digital mammography. Recall rates were calculated and stratified according to breast density and patient age. Cancer detection rates were calculated and stratified according to the presence of a risk factor for breast cancer. The Fisher exact test was used to compare the two groups. Multivariate logistic regression was used to assess the effect of screening method, breast density, patient age, and cancer risk on the odds of recall from screening.Results:A total of 13 158 patients presented for screening mammography; 6100 received tomosynthesis. The overall recall rate was 8.4% for patients in the tomosynthesis group and 12.0% for those in the conventional mammography group ($P < .01$). The addition of tomosynthesis reduced recall rates for all breast density and patient age groups, with significant differences ($P < .05$) found for scattered fibroglandular, heterogeneously dense, and extremely dense breasts and for patients younger than 40 years, those aged 40-49 years, those aged 50-59 years, and those aged 60-69 years. These findings persisted when multivariate logistic regression was used to control for differences in age, breast density, and elevated risk of breast cancer. The cancer detection rate was 5.7 per 1000 in patients receiving tomosynthesis versus 5.2 per 1000 in patients receiving conventional mammography alone ($P = .70$).Conclusion:Patients undergoing tomosynthesis plus digital mammography had significantly lower screening recall rates. The greatest reductions were for those younger than 50 years and those with dense breasts. A nonsignificant 9.5% increase in cancer detection was observed in the tomosynthesis group.© RSNA, 2013.

Beneficio

AJR Am J Roentgenol. 2013 Feb;200(2):291-8. doi: 10.2214/AJR.12.8881.

Can digital breast tomosynthesis replace conventional diagnostic mammography views for screening recalls without calcifications? A comparison study in a simulated clinical setting.

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Abstract

OBJECTIVE: This study evaluated digital breast tomosynthesis (DBT) as an alternative to conventional diagnostic mammography in the workup of noncalcified findings recalled from screening mammography in a simulated clinical setting that incorporated comparison mammograms and breast ultrasound results.

SUBJECTS AND METHODS: One hundred forty-six women, with 158 abnormalities, underwent diagnostic mammography and two-view DBT. Three radiologists viewed the abnormal screening mammograms, comparison mammograms, and DBT images and recorded a DBT BI-RADS category and confidence score for each finding. Readers did not view the diagnostic mammograms. A final DBT BI-RADS category, incorporating ultrasound results in some cases, was determined and compared with the diagnostic mammography BI-RADS category using kappa statistics. Sensitivity and specificity were calculated for DBT and diagnostic mammography.

RESULTS: Agreement between DBT and diagnostic mammography BI-RADS categories was excellent for readers 1 and 2 ($\kappa = 0.91$ and $\kappa = 0.84$) and good for reader 3 ($\kappa = 0.68$). For readers 1, 2, and 3, sensitivity and specificity of DBT for breast abnormalities were 100%, 100%, and 88% and 94%, 93%, and 89%, respectively. The clinical workup averaged three diagnostic views per abnormality and ultrasound was requested in 49% of the cases. DBT was adequate mammographic evaluation for 93-99% of the findings and ultrasound was requested in 33-55% of the cases.

CONCLUSION: The results of this study suggest that DBT can replace conventional diagnostic mammography views for the evaluation of noncalcified findings recalled from screening mammography and achieve similar sensitivity and specificity. Two-view DBT was considered adequate mammographic evaluation for more than 90% of the findings. There was minimal change in the use of ultrasound with DBT compared with diagnostic mammography.

Beneficio

Acad Radiol. 2012 Feb;19(2):166-71. doi: 10.1016/j.acra.2011.10.003. Epub 2011 Nov 18.

Dose reduction in digital breast tomosynthesis (DBT) screening using synthetically reconstructed projection images: an observer performance study.

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Abstract

RATIONALE AND OBJECTIVES: The aim of this study was to retrospectively compare the interpretive performance of synthetically reconstructed two -dimensional images in combination with digital breast tomosynthesis (DBT) versus full-field digital mammography (FFDM) plus DBT.

MATERIALS AND METHODS: Ten radiologists trained in reading tomosynthesis examinations interpreted retrospectively, under two modes, 114 mammograms. One mode included the directly acquired full-field digital mammograms combined with DBT, and the other included synthetically reconstructed projection images combined with DBT. The reconstructed images do not require additional radiation exposure. The two modes were compared with respect to sensitivity, namely, recommendation to recall a breast with either a pathology-proven cancer (n = 48) or a high-risk lesion (n = 6), and specificity, namely, no recommendation to recall a breast not depicting an abnormality (n = 144) or depicting only benign abnormalities (n = 30).

RESULTS: The average sensitivity for FFDM with DBT was 0.826, compared to 0.772 for synthetic FFDM with DBT (difference, 0.054; P = .017 and P = .053 for fixed and random reader effects, respectively). The proportions of breasts with no or benign abnormalities recommended to be recalled were virtually the same: 0.298 and 0.297 for the two modalities, respectively (95% confidence intervals for the difference, -0.028 to 0.036 and -0.070 to 0.066 for fixed and random reader effects, respectively). Sixteen additional clusters of microcalcifications ("positive" breasts) were missed by all readers combined when interpreting the mode with synthesized images versus FFDM.

CONCLUSIONS: Lower sensitivity with comparable specificity was observed with the tested version of synthetically generated images compared to FFDM, both combined with DBT. Improved synthesized images with experimentally verified acceptable diagnostic quality will be needed to eliminate double exposure during DBT-based screening.

Conclusioni

- Indubbio il beneficio dell'uso della tomosintesi anche nello screening, ma solo limitatamente si può usare da sola
- 2D da 3D?
- Bilancio rischio beneficio? …moderazione…
- Tecnologia in aiuto: dose più bassa con migliore definizione immagini

….Grazie per l'attenzione…….