SOLACI CACI '14 ARGENTINA

In partnership with TCT

Actividad Pre-Congreso

PROEDUCAR

SOCIEDAD LATINOAMERICANA DE CARDIOLOGIA INTERVENCIONISTA

V Curso "José Gabay" para Intervencionistas en Formación

"Protección Radiológica en Cardiología Intervencionista"

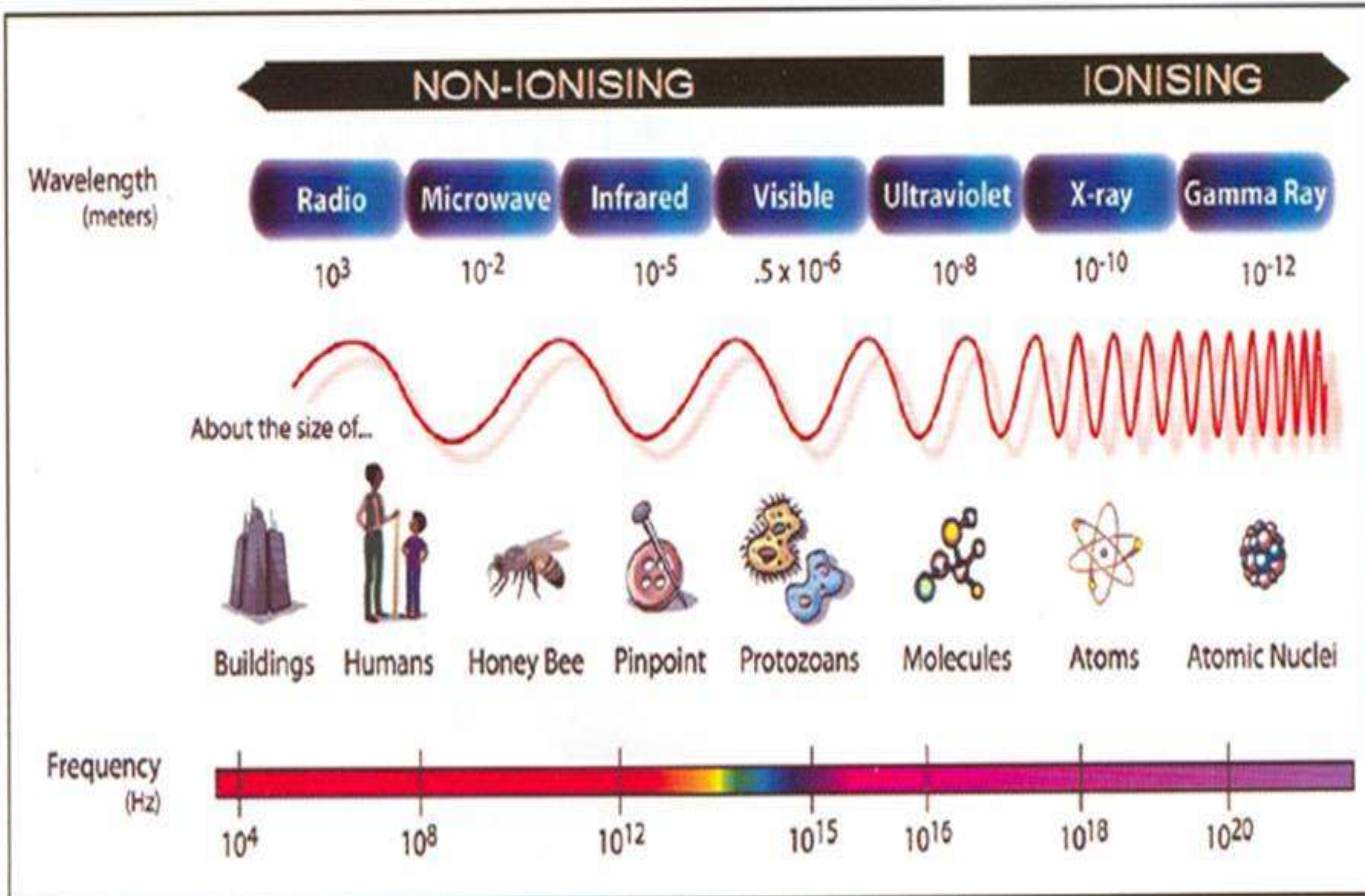
Dr. Ariel Durán, FACC

Consultor OIEA

IAEA.org

International Atomic Energy Agency

The Electromagnetic Spectrum



Wilhelm Conrad Rontgen
Lennep 1845-†Munich 1923
Premio Nobel de Física de 1901

En la tarde del 8 de noviembre de 1895 en Wurzburg descubre los Rx sobre la mano de su esposa.

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Importancia del tema

UNIVERSIDAD DE LA REPÚBLICA

FACULTAD DE MEDICINA

IAEA.org

International Atomic Energy Agency

EVOLUCIÓN !!!!!!!!!!!!!!!!!!!!

Mortalidad Ajustada a Edad en U.S. / año

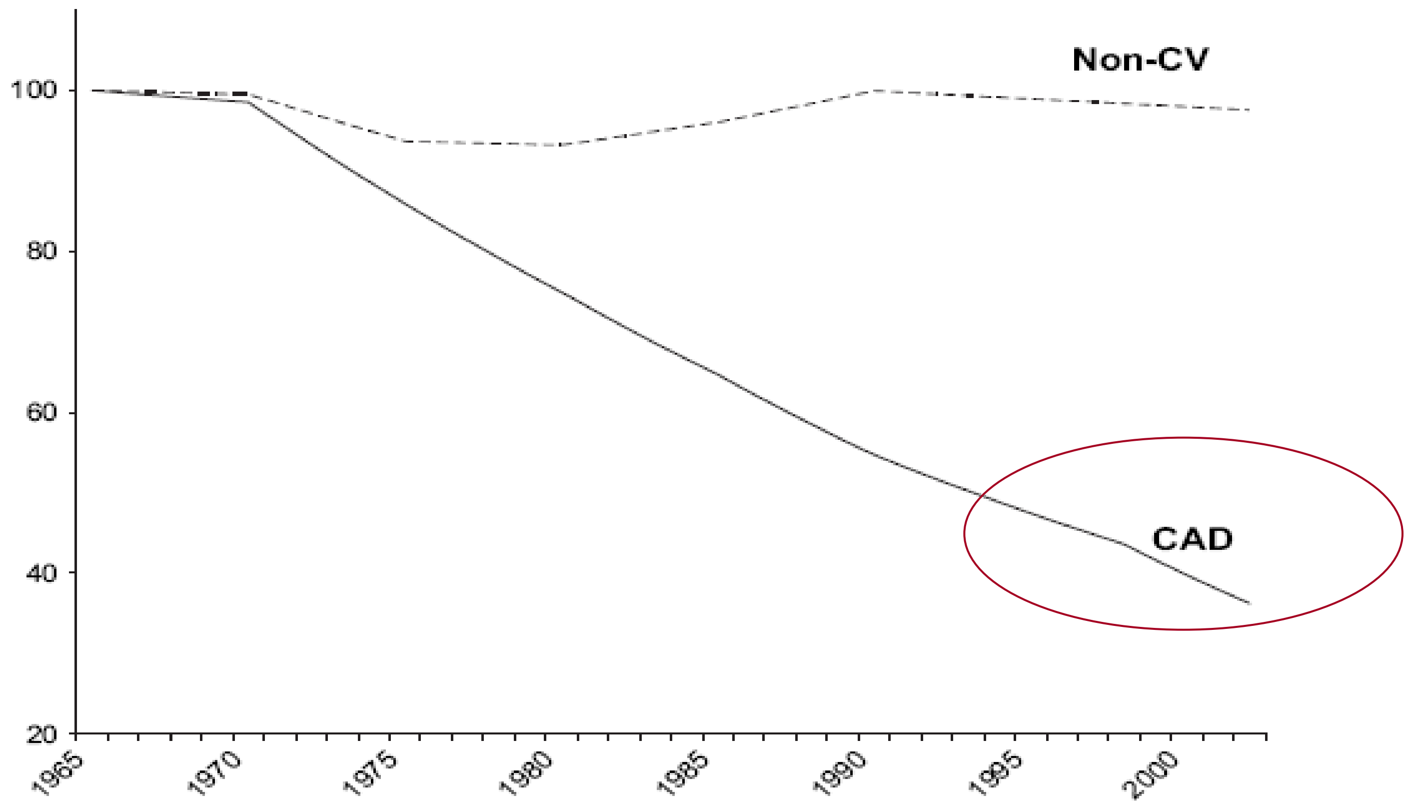
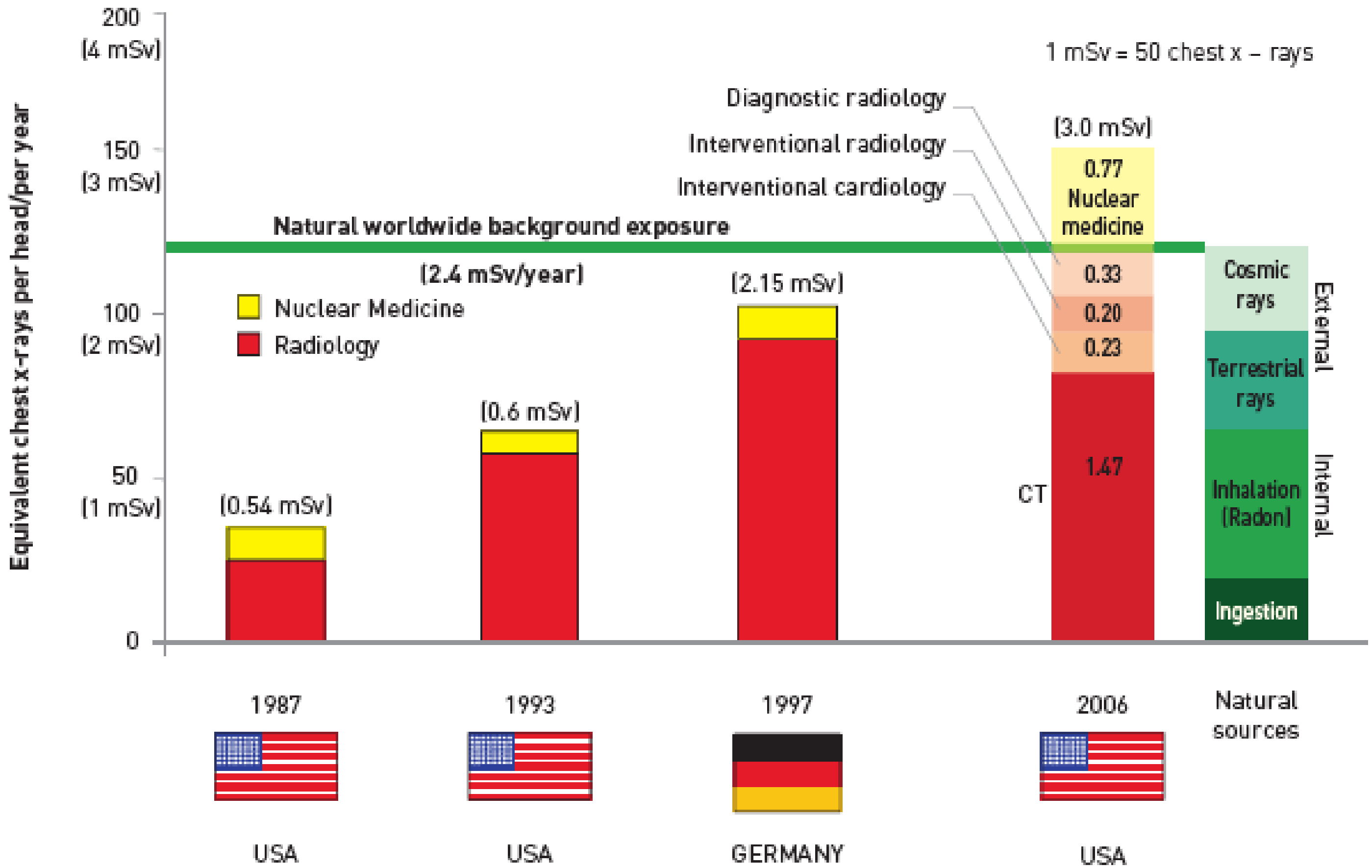


Fig. 1. Age-adjusted death rates in the United States secondary to CAD and noncardiovascular causes (Non-CV) by year, standardized to the 1965 death rate. (*Data from* National Institute of Health. Morbidity and mortality: 2004 chart book on cardiovascular, lung, and blood diseases. Bethesda (MD): US Department of Health and Human Services 2004.)

Figure 1



The PCR-EAPCI Textbook – Percutaneous interventional cardiovascular medicine

Radiation protection

Eugenio Picano, Maria Grazia Andreassi, Madan M. Rehani, Leonardo Bolognese, Eliseo Vano

EDUCATIONAL CONTENT ENDORSED BY EAPCI,
A REGISTERED BRANCH OF THE EUROPEAN SOCIETY OF CARDIOLOGY

Figure 2

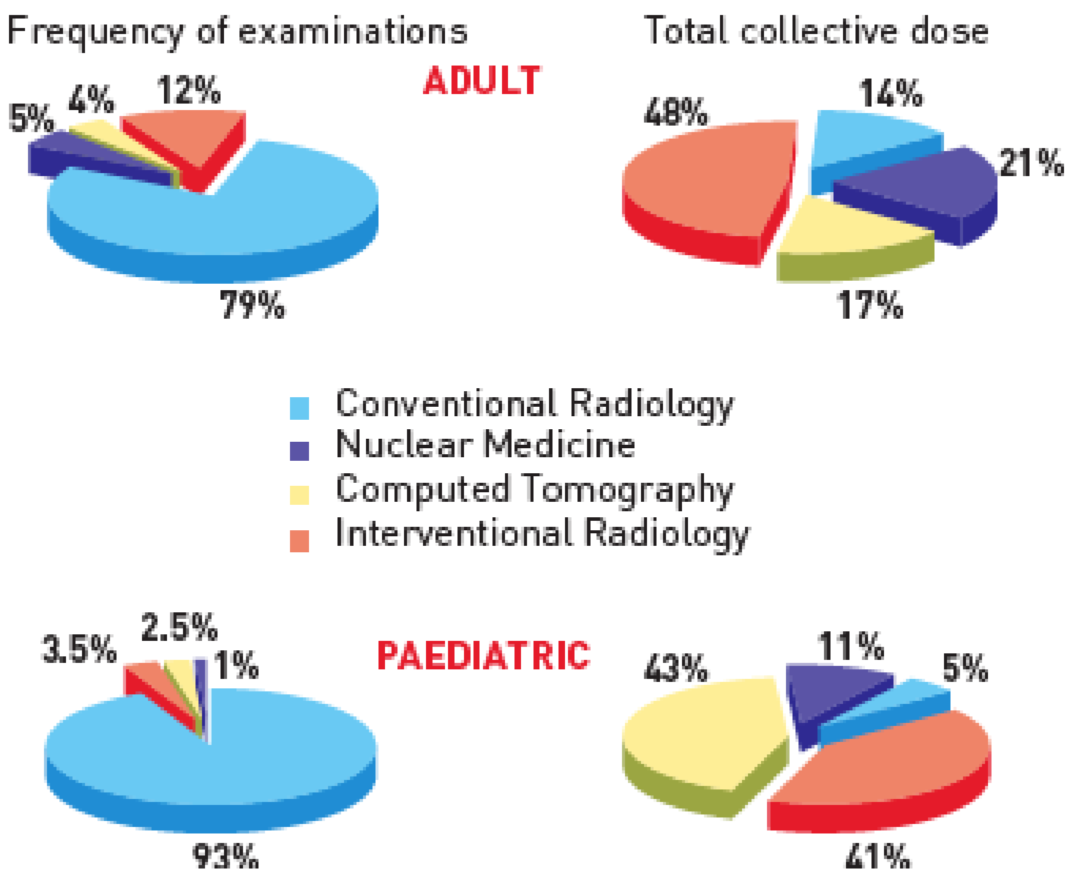


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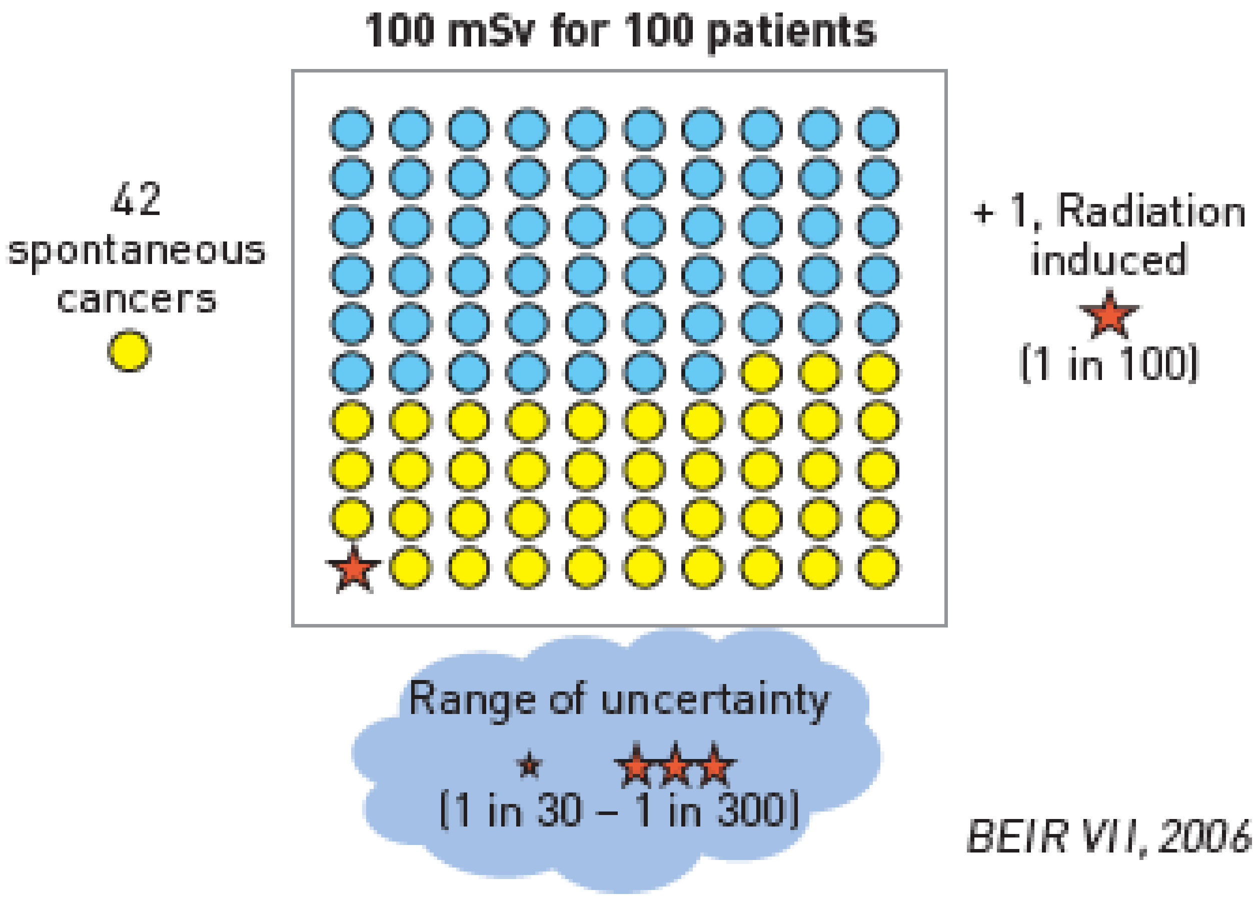
Figure 7


100 mSv for 100 patients
42
spontaneous
cancers
+ 1, Radiation
induced
(1 in 100)
Range of uncertainty
(1 in 30 – 1 in 300)
BEIR VII, 2006

2 tipos de Protección Radiológica

1) *Ocupacional*
2) *Del paciente*

2 tipos de Protección Radiológica

1) Ocupacional

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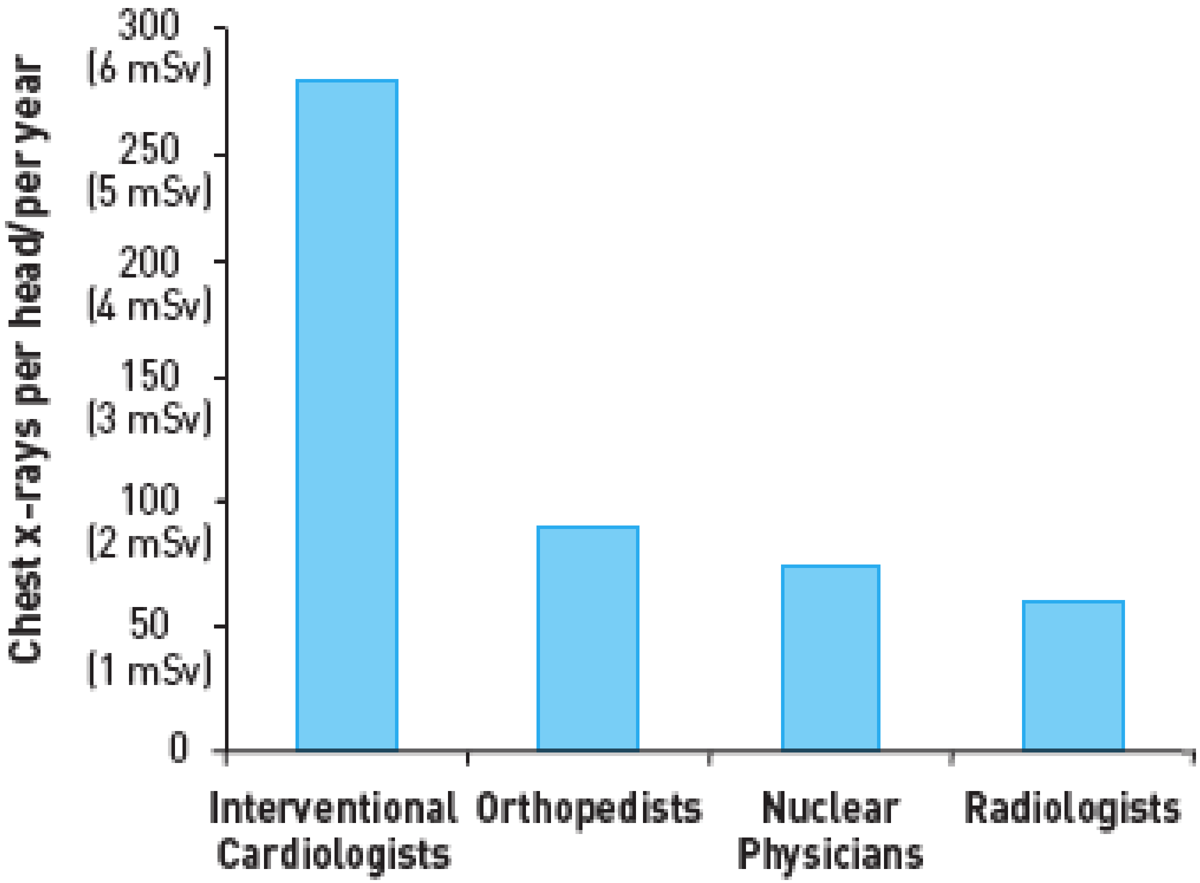
Figure 12



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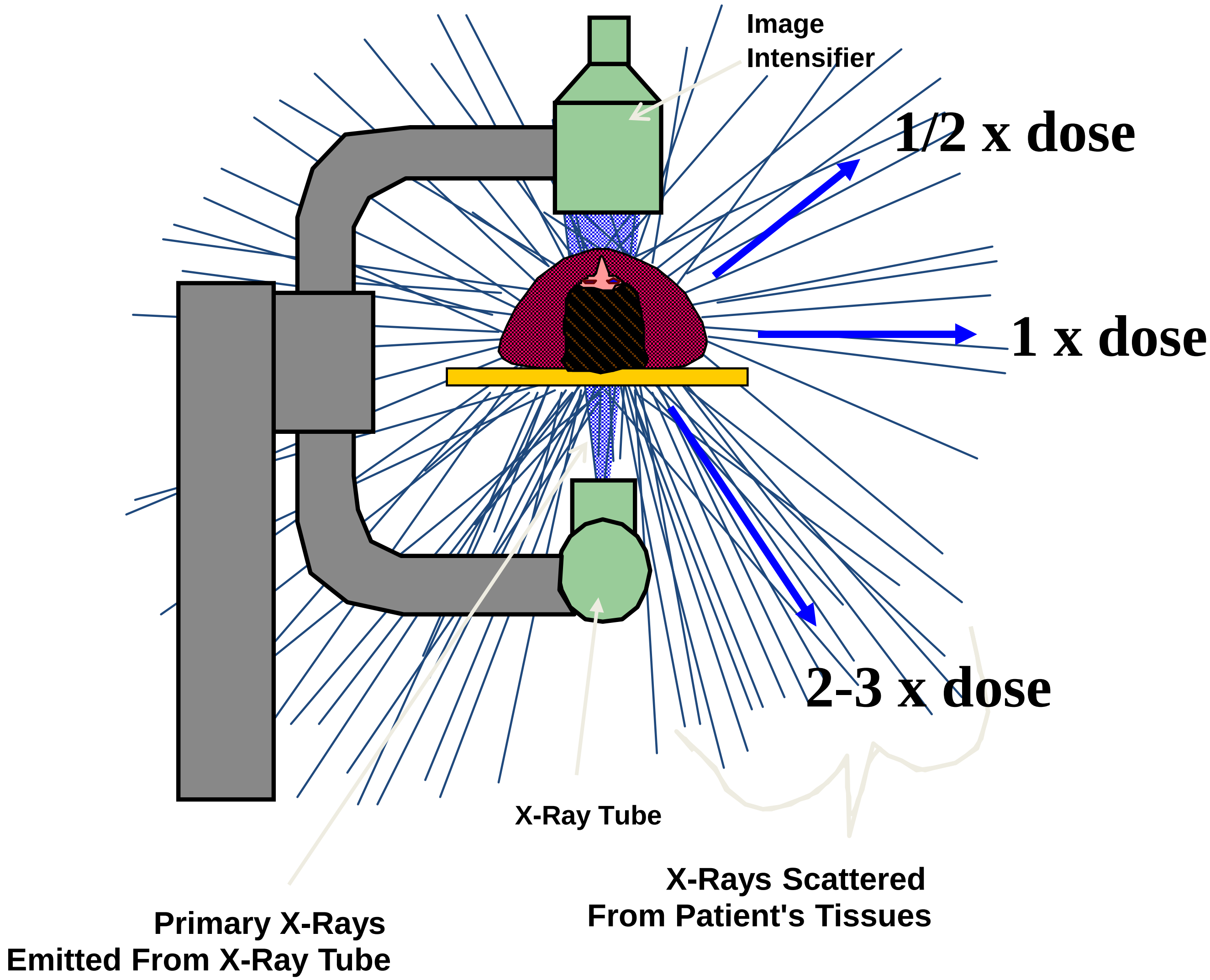
Objetivo de la Protección Radiológica

"Obtener el máximo beneficio del uso de las radiaciones ionizaciones, evitando la aparición de efectos colaterales para nosotros y nuestros pacientes"

Criterio ALARA

"La dosis debe ser lo más baja razonablemente posible"

Radiation Pattern



EDUCATIONAL CONTENT ENDORSED BY EAPCI,
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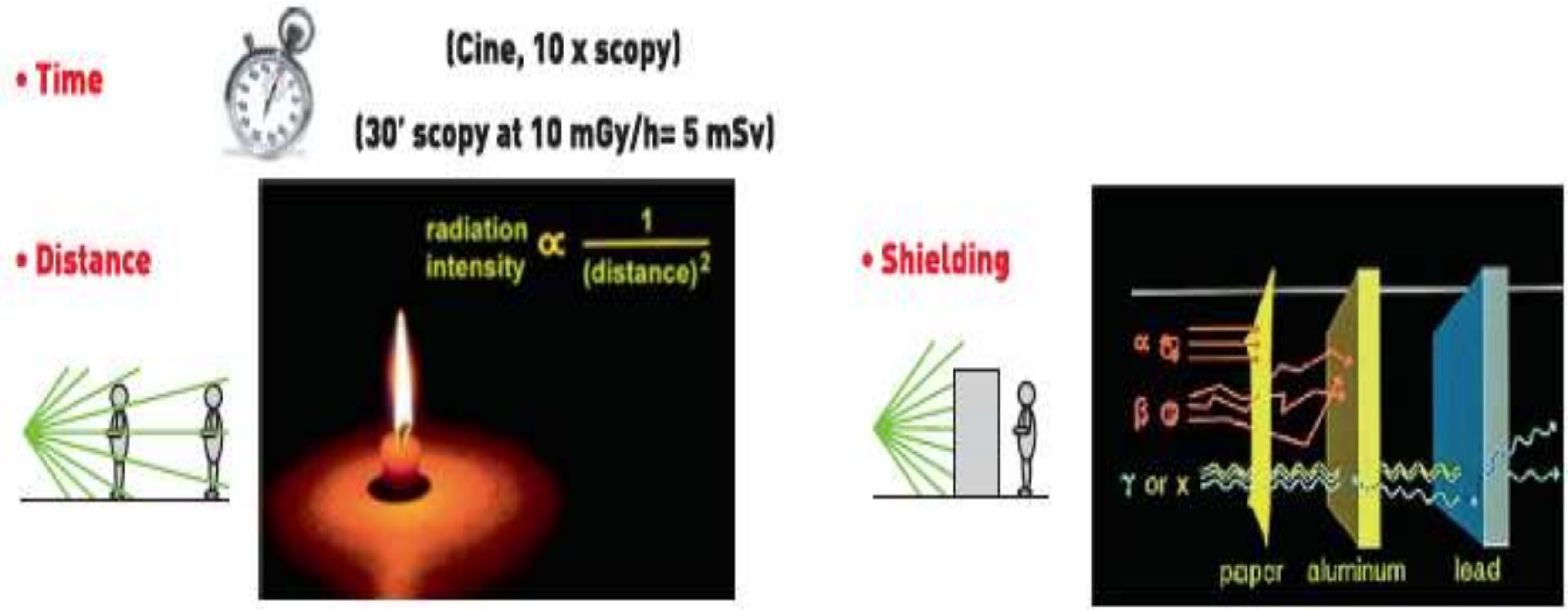
Figure 15



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Protección Radiológica Ocupacional

- Factores dependientes del paciente.
- Factores dependientes de la técnica radiológica.
- Factores dependientes del equipo radiológico.

Factores dependientes del paciente

1) Pacientes complejos

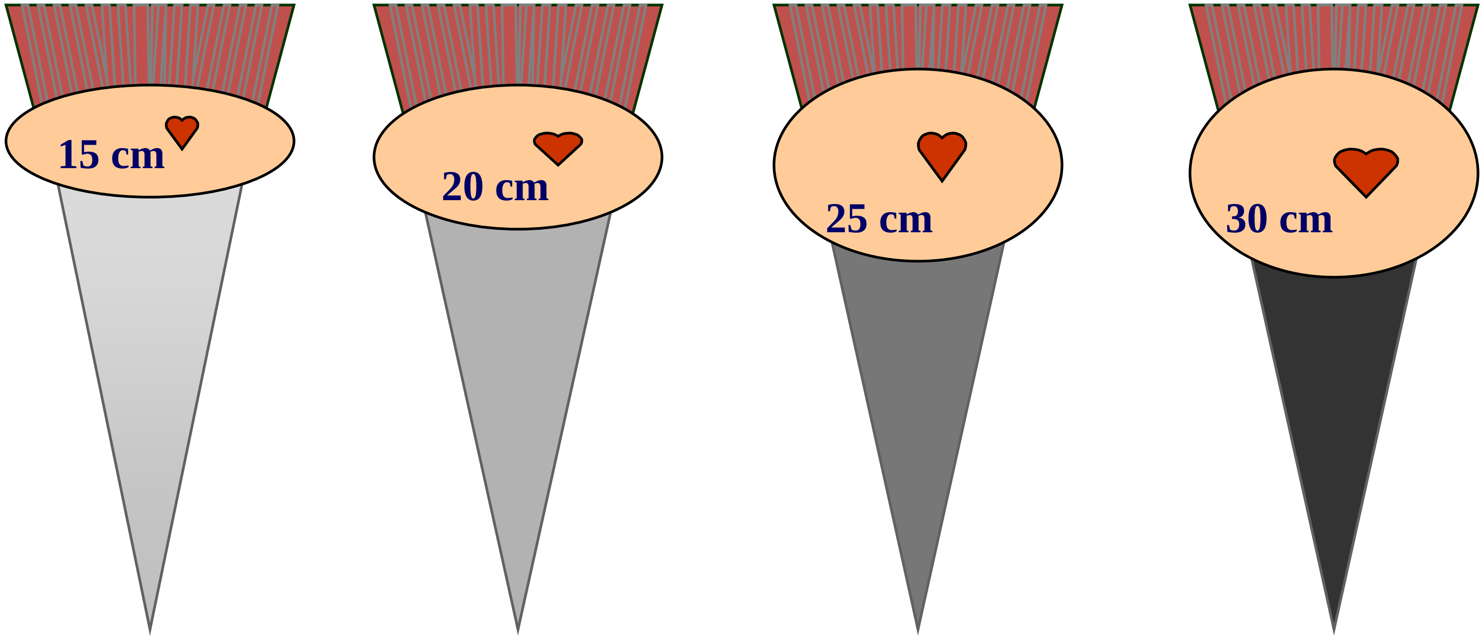
2) Procedimientos complejos


PACIENTE COMPLEJA¡¡¡¡¡¡

Factores físicos y el control de la radiación

Mayor espesor de tejido absorbe más radiación, por lo tanto debe usarse mucha mas radiación para poder penetrar un paciente obeso.

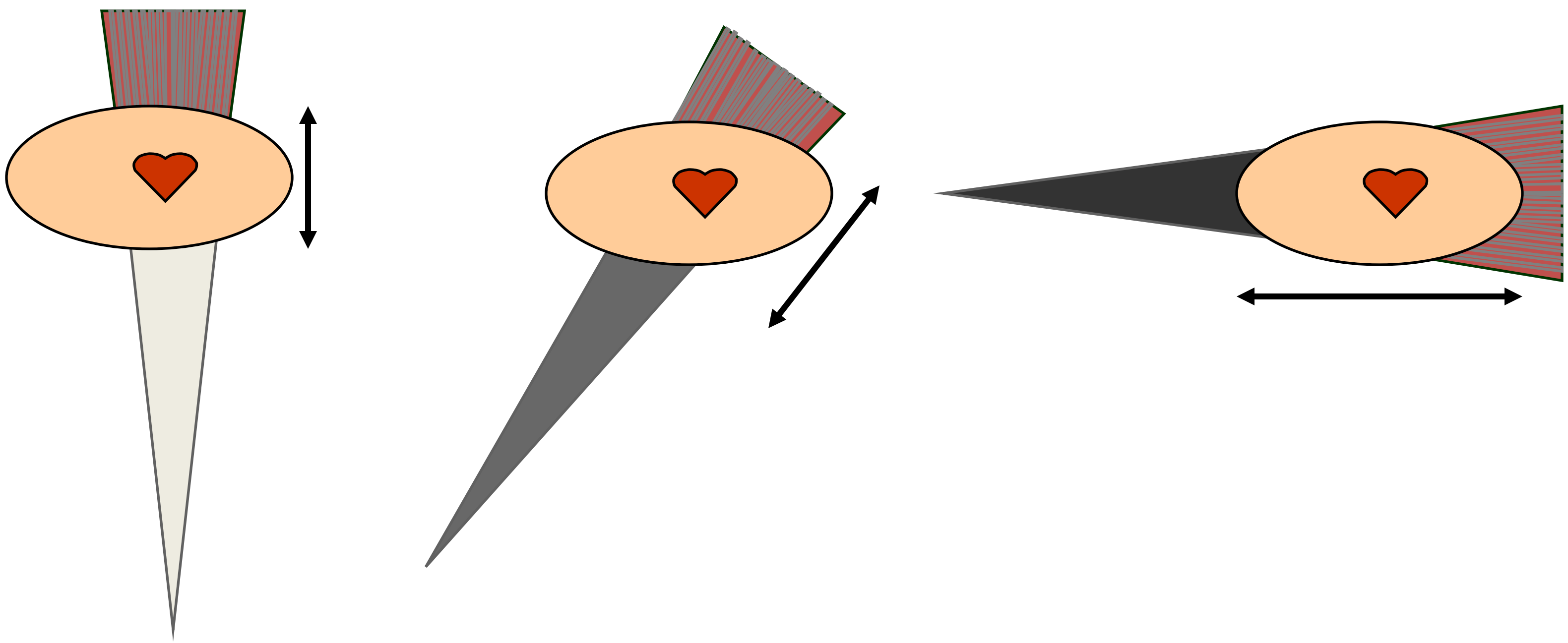
El riesgo de piel es mayor para pacientes obesos.



DEP = 1 unidad	DEP = 2-3 unidades	DEP = 4-6 unidades	DEP = 8-12 unidades
Ejemplo: 2 Gy	Ejemplo: 4-6 Gy	Ejemplo: 8-12 Gy	Ejemplo: 16-24 Gy

Factores físicos y el control de la radiación

Mayor espesor de tejido absorbe más radiación, proyecciones muy inclinadas requieren más radiación. El riesgo de la piel es mayor con ángulos pronunciados!



Procedimientos complejos

- Oclusiones crónicas
- Enfermedad difusa
- Lesión de bifurcación
- Lesiones ostiales.
- Tortuosidad excesiva
- Procedimientos híbridos

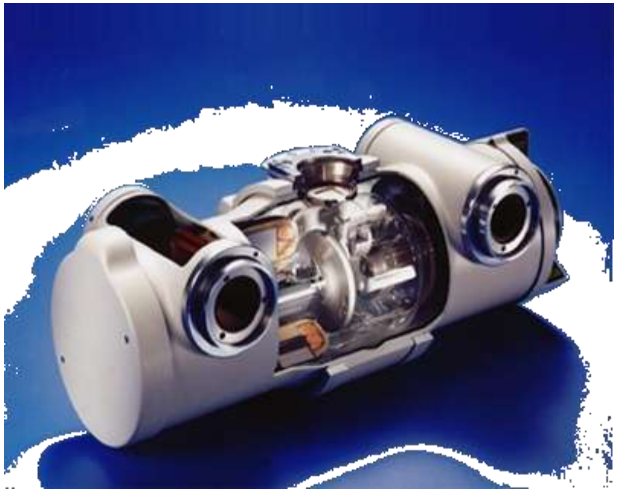
Factores dependientes de la Técnica Radiológica

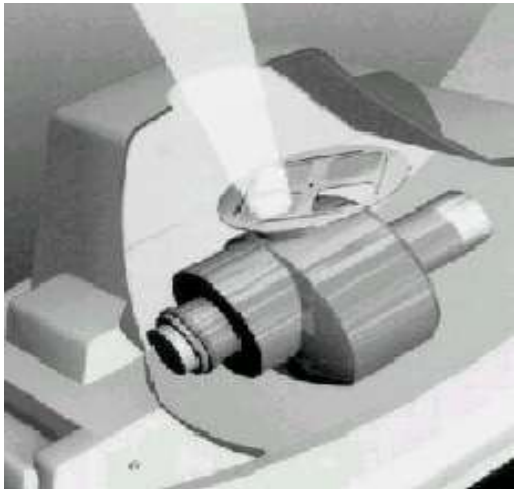
- Filtros
- Colimación
- Angulaciones
- Altura de la mesa
- Distancia a la fuente y al intensificador
- Fluoro vs. Cine

FILTROS

Filtración añadida

- La incorporación de una filtración adicional en el haz de rayos X (Cobre o Aluminio) reduce el número de fotones de baja energía y como consecuencia, reduce la dosis en la piel del paciente.

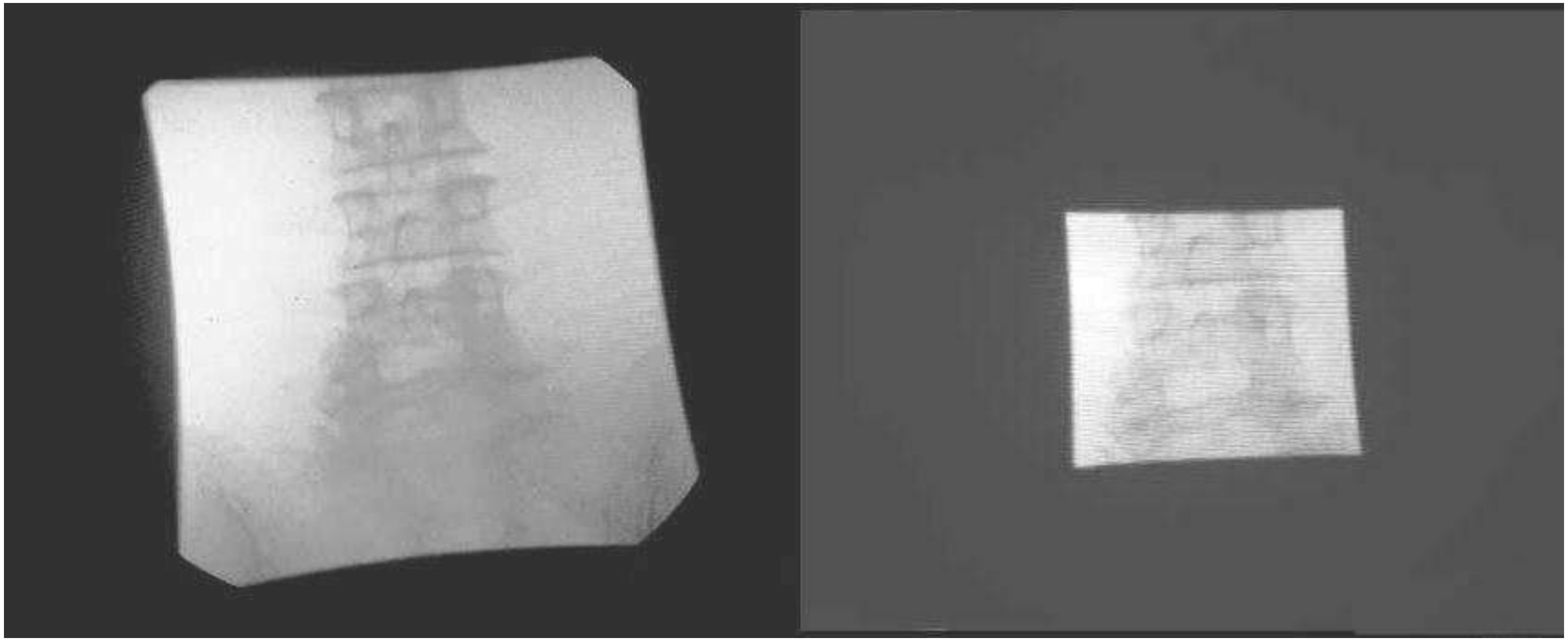




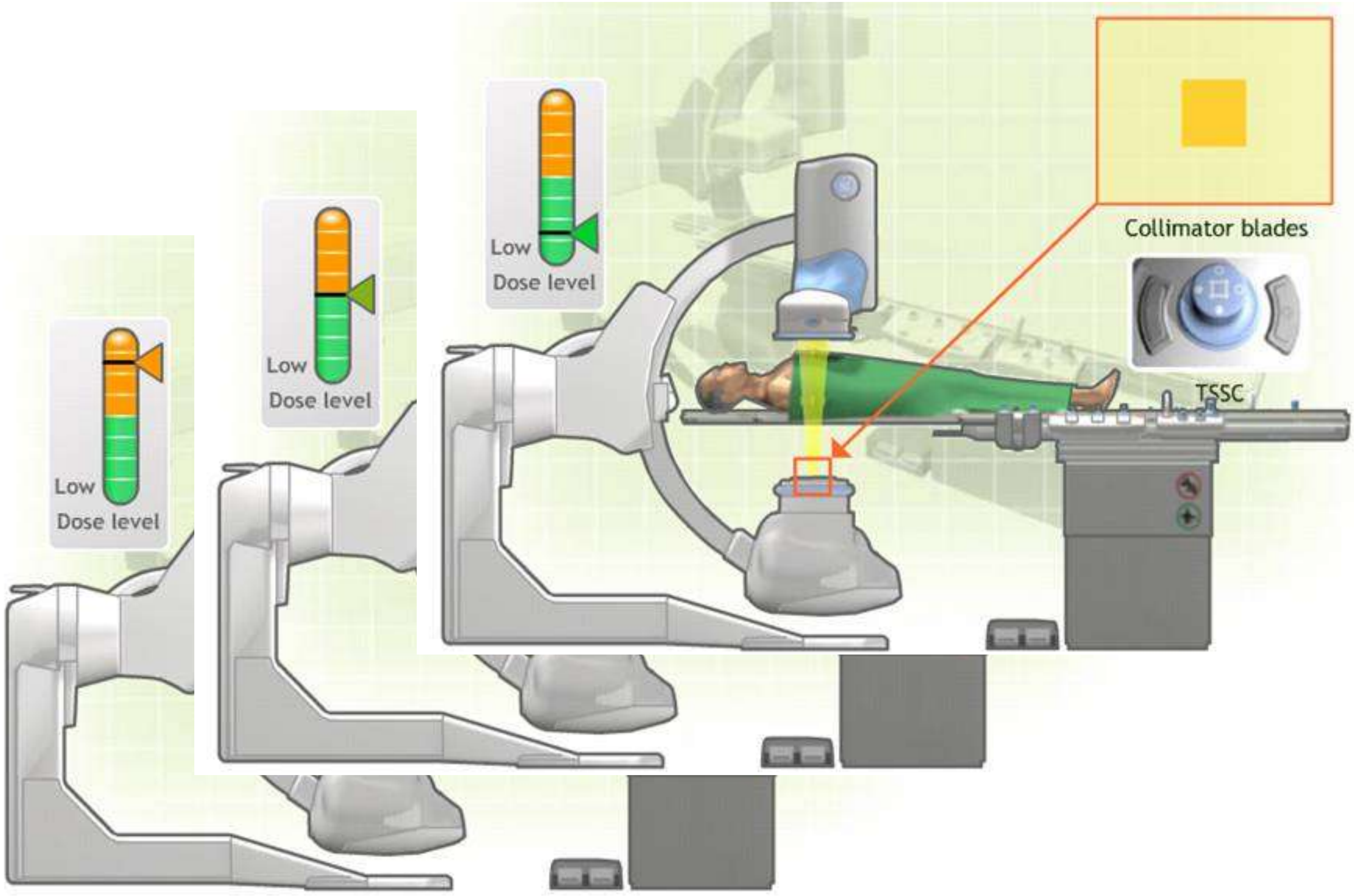

PHILIPS

COLIMACIÓN

- Mejora la imagen y disminuye la radiación dispersa.
- Restringe el haz al área de interés.

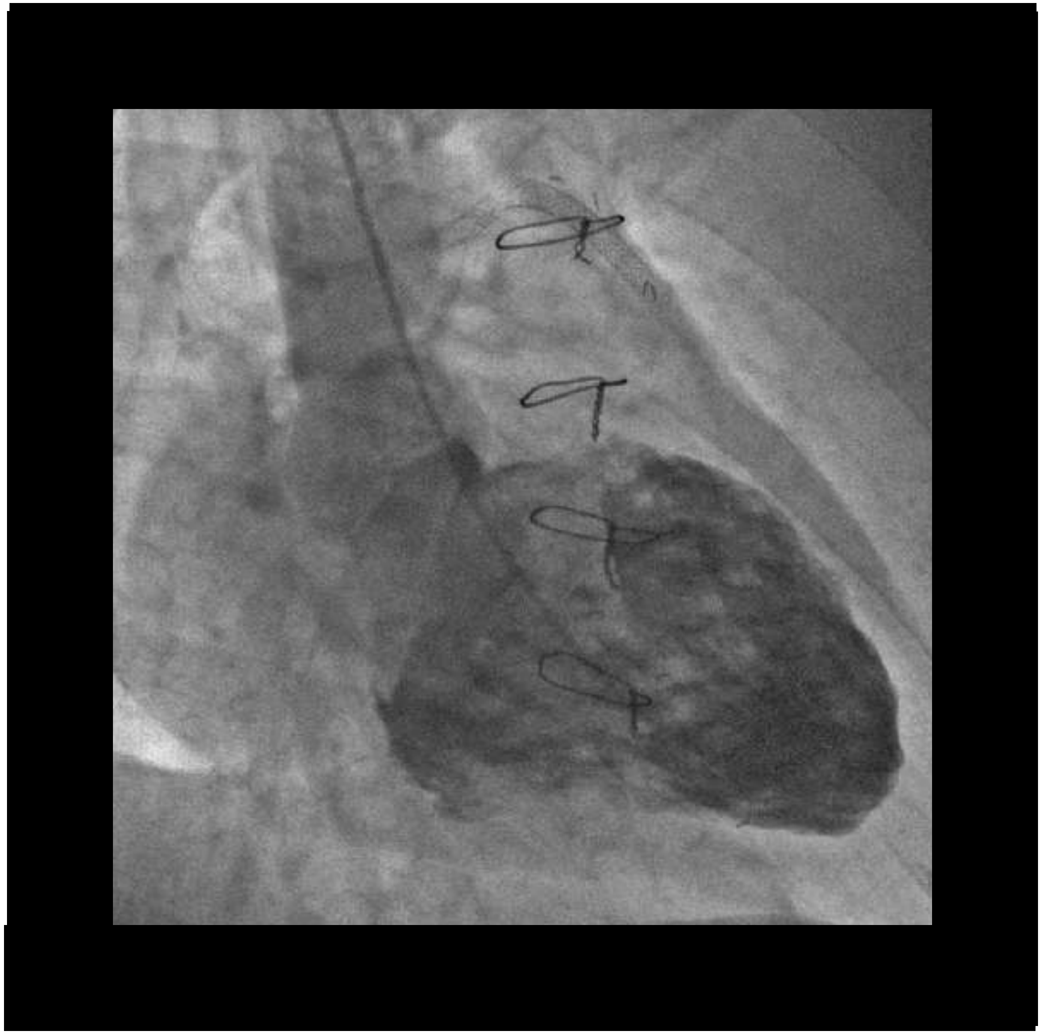


Collimation



Collimators use in INNOVA to reduce exposure

FOV 20

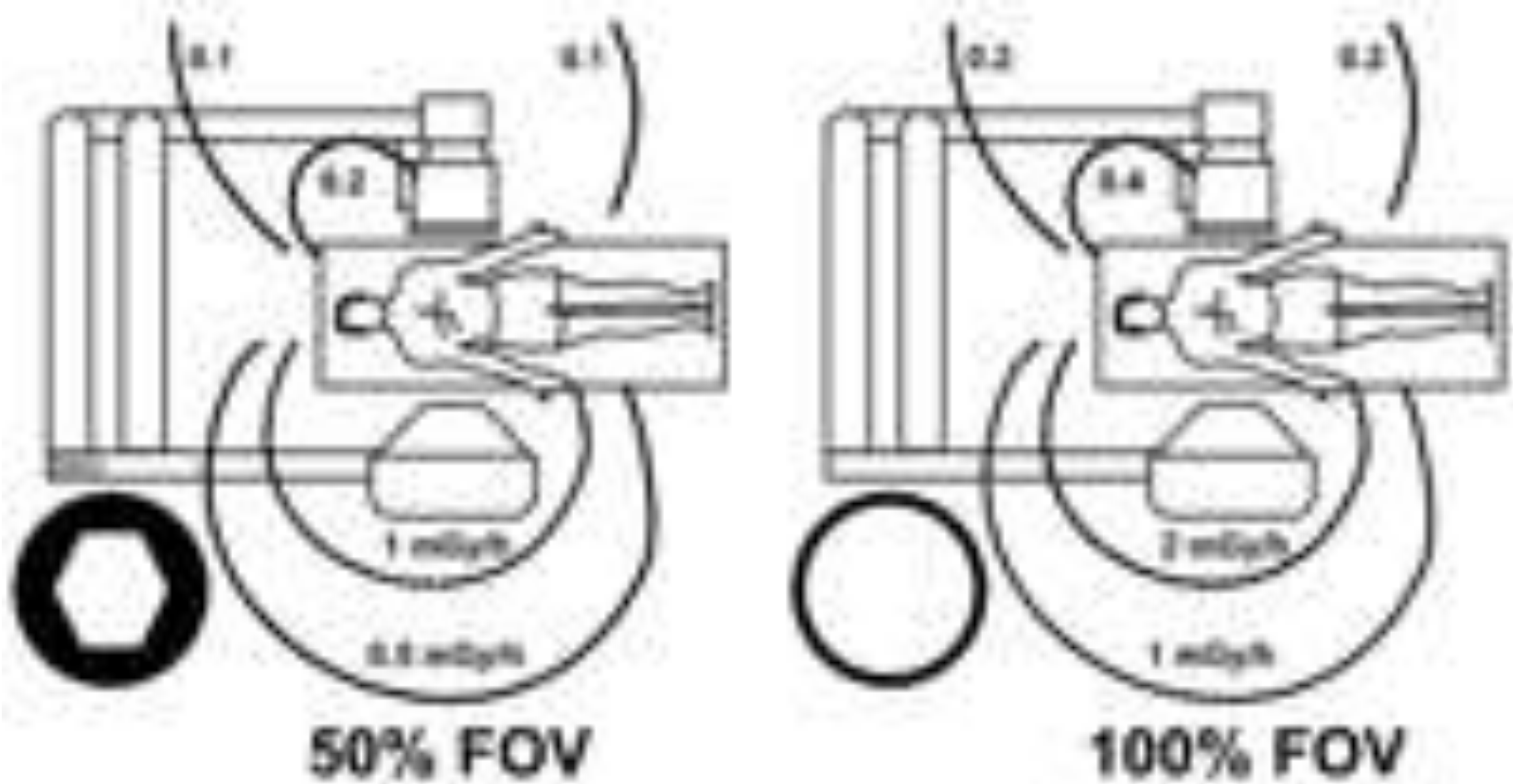


Collimators use in INNOVA to reduce exposure

FOV 15

dose reduction 25%

Efecto de la colimación sobre la dosis

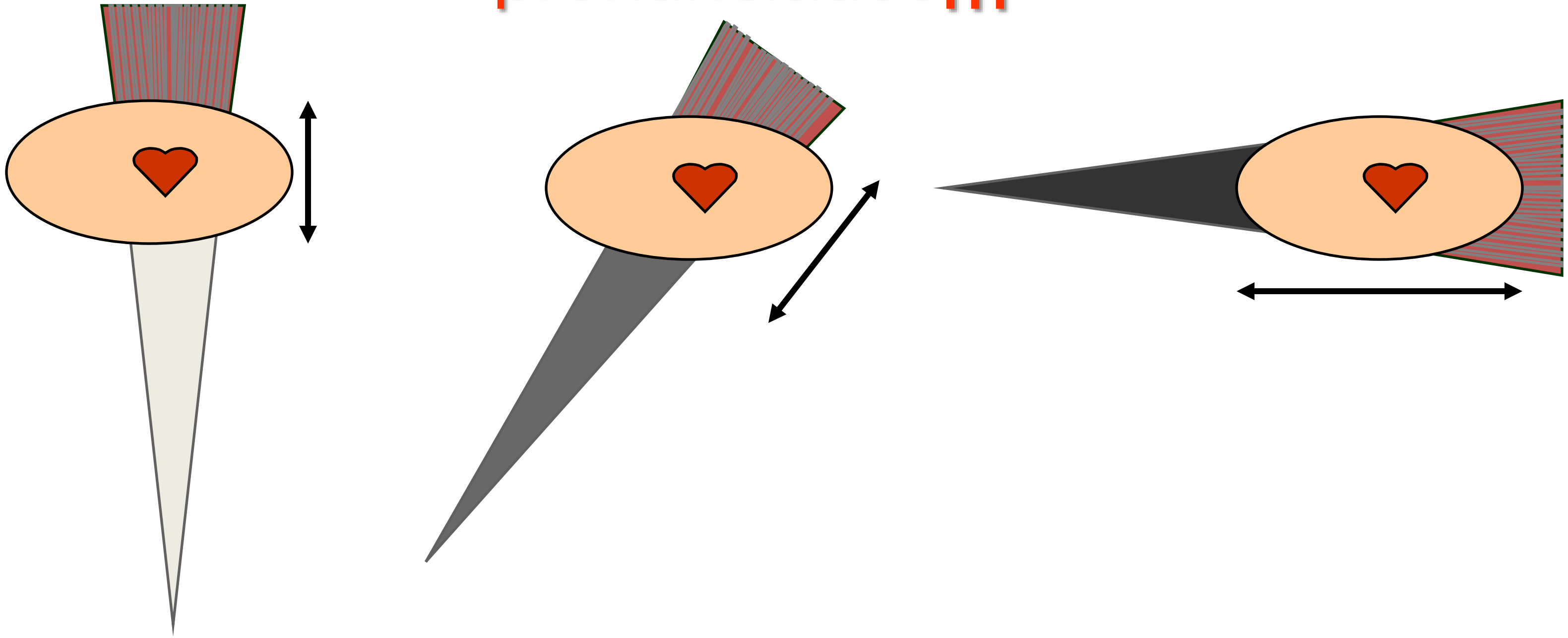


ANGULACIÓN

Factores físicos y el control de la radiación

Mayor espesor de tejido absorbe más radiación, proyecciones muy inclinadas requieren más radiación.

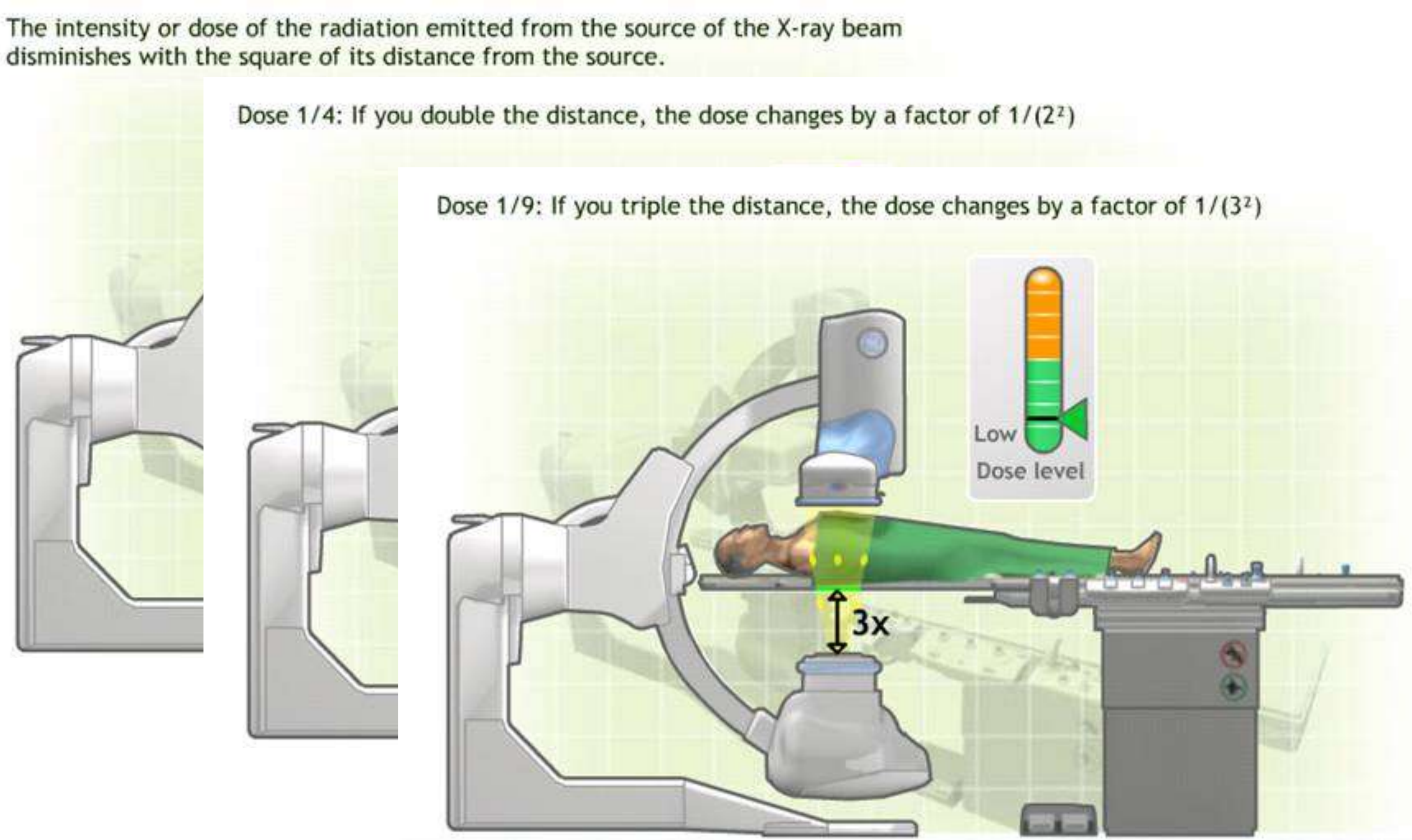
El riesgo de la piel es mayor con ángulos pronunciados¡¡¡



Diferentes angulaciones del brazo en C, pueden modificar la tasa de dosis dispersa en un factor 5

ALTURA DE LA MESA

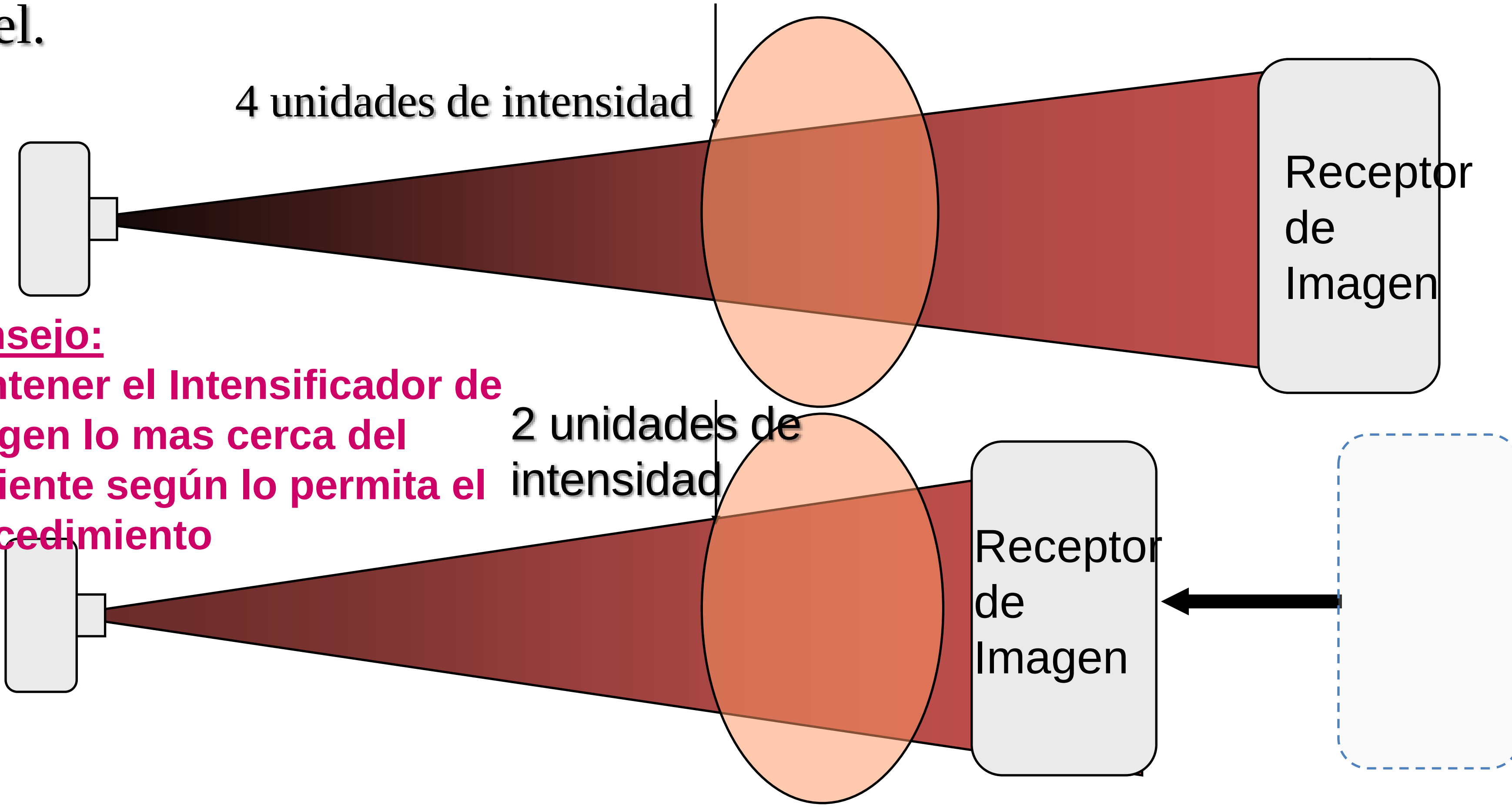
Distance between patient and detector



DISTANCIA FUENTE-DETECTOR DE IMAGEN: SID (105 cm)

Factores físicos y el control de la radiación

Acercando eñ receptor de imagen al paciente reduce la tasa de la radiación a la salida del tubo y por lo tanto reduce la tasa de dosis en la piel.



<u>Consejo:</u>
Mantener el Intensificador de Imagen lo mas cerca del paciente según lo permita el procedimiento

MAGNIFICACIÓN
TIPOS DE RADIOSCOPIA
FLUORO vs. CINE

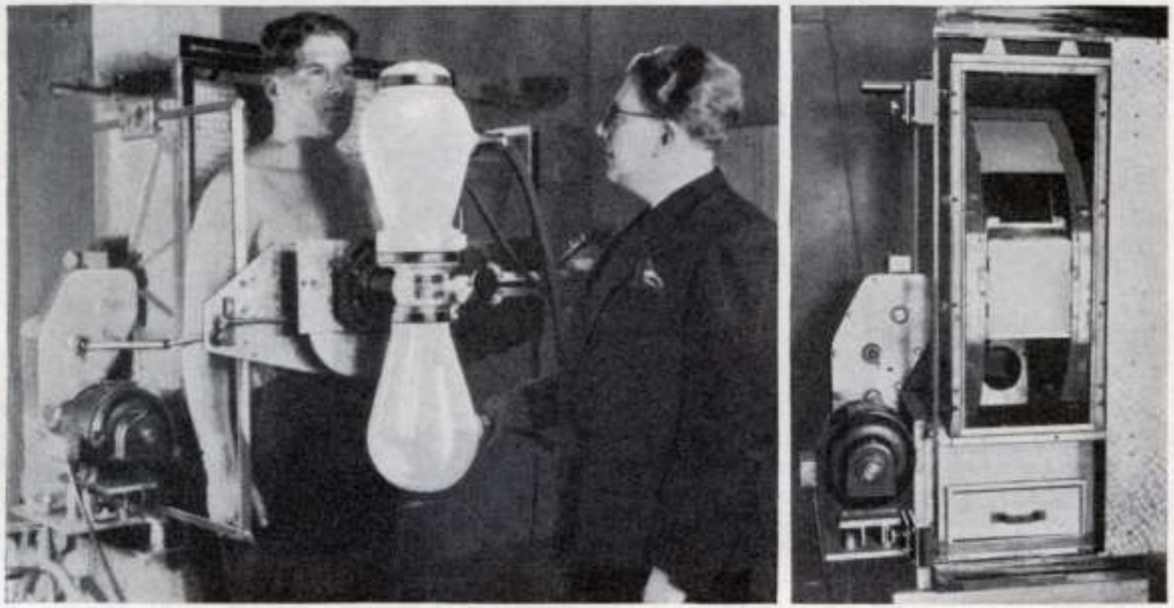
Campo de visión

	Tamaño del intensificador	Dosis relativa
	**12" (32 cm)**	**100**
	**9" (22 cm)**	**150**
	**6" (16 cm)**	**200**
	**4,5" (11 cm)**	**300**

A MAYOR DOSIS ➤ MENOR RUIDO

Un minuto de cine

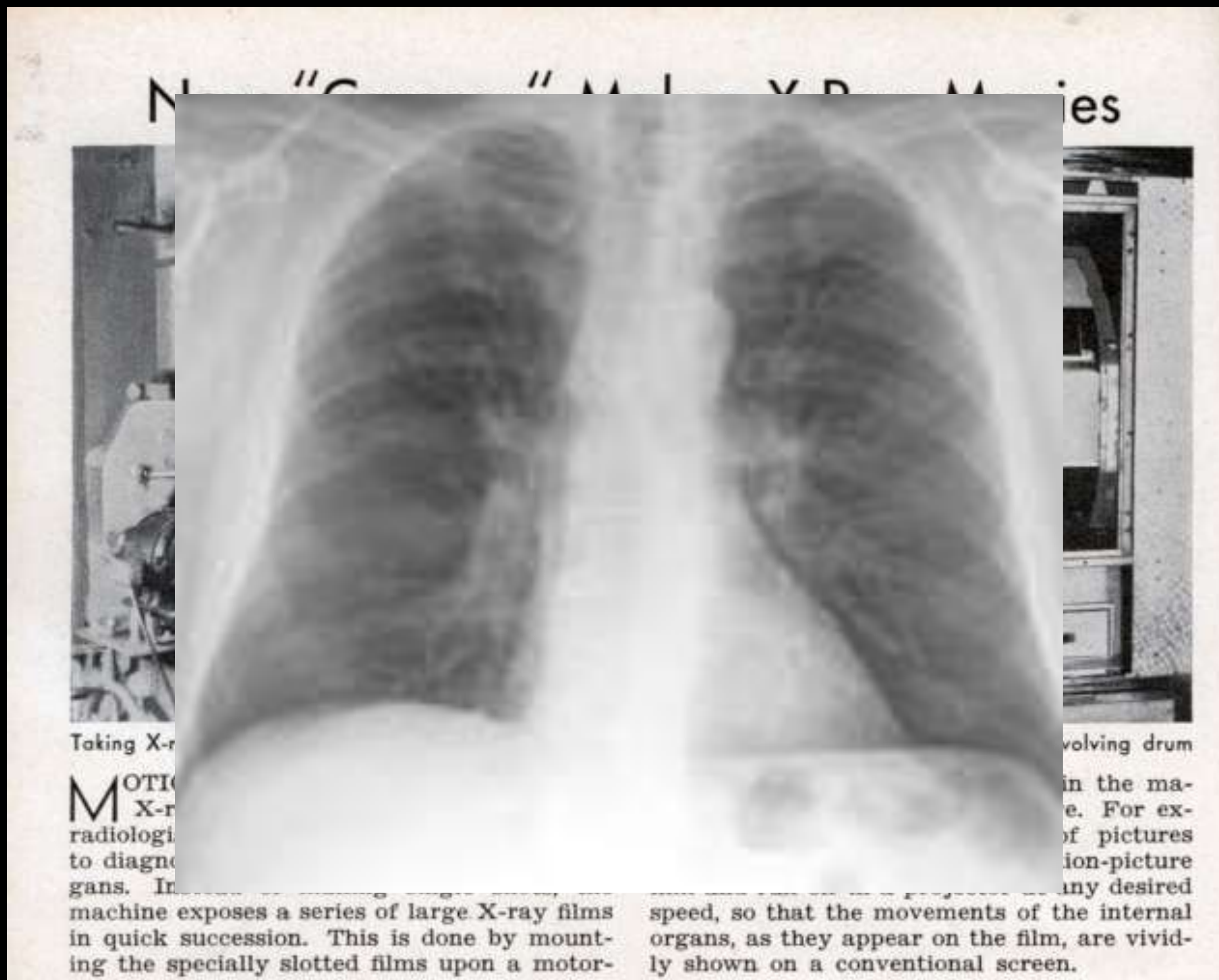
New "Camera" Makes X-Ray Movies



Taking X-ray movies of a patient. Right, view of film-carrying mechanism showing plates on revolving drum

MOTION pictures made with a rapid-fire X-ray "camera" devised by a Belgian radiologist will help physicians to study and to diagnose the ailments of moving body organs. Instead of making single shots, the machine exposes a series of large X-ray films in quick succession. This is done by mounting the specially slotted films upon a motor-driven revolving drum, seen within the machine in the right-hand view above. For examination, the resulting sheaf of pictures may then be transferred to motion-picture film and run off in a projector at any desired speed, so that the movements of the internal organs, as they appear on the film, are vividly shown on a conventional screen.

Un minuto de cine



Un minuto de cine

400 Rx Tórax

FACTORES DEPENDIENTES DE LA VÍA DE ACCESO

RIVAL Program

RadIal Versus femorAL access for coronary intervention study

A randomized comparison of RadIal Vs. femorAL access for coronary intervention in ACS (RIVAL)

SS Jolly, S Yusuf, J Cairns, K Niemela, D Xavier, P Widimsky, A Budaj, M Niemela, V Valentin, BS Lewis, A Avezum, PG Steg, SV Rao, P Gao, R Afzal, CD Joyner, S Chrolavicius, SR Mehta on behalf of the RIVAL investigators

Population Health Research Institute
Health Through Knowledge
PHRI

Other Outcomes

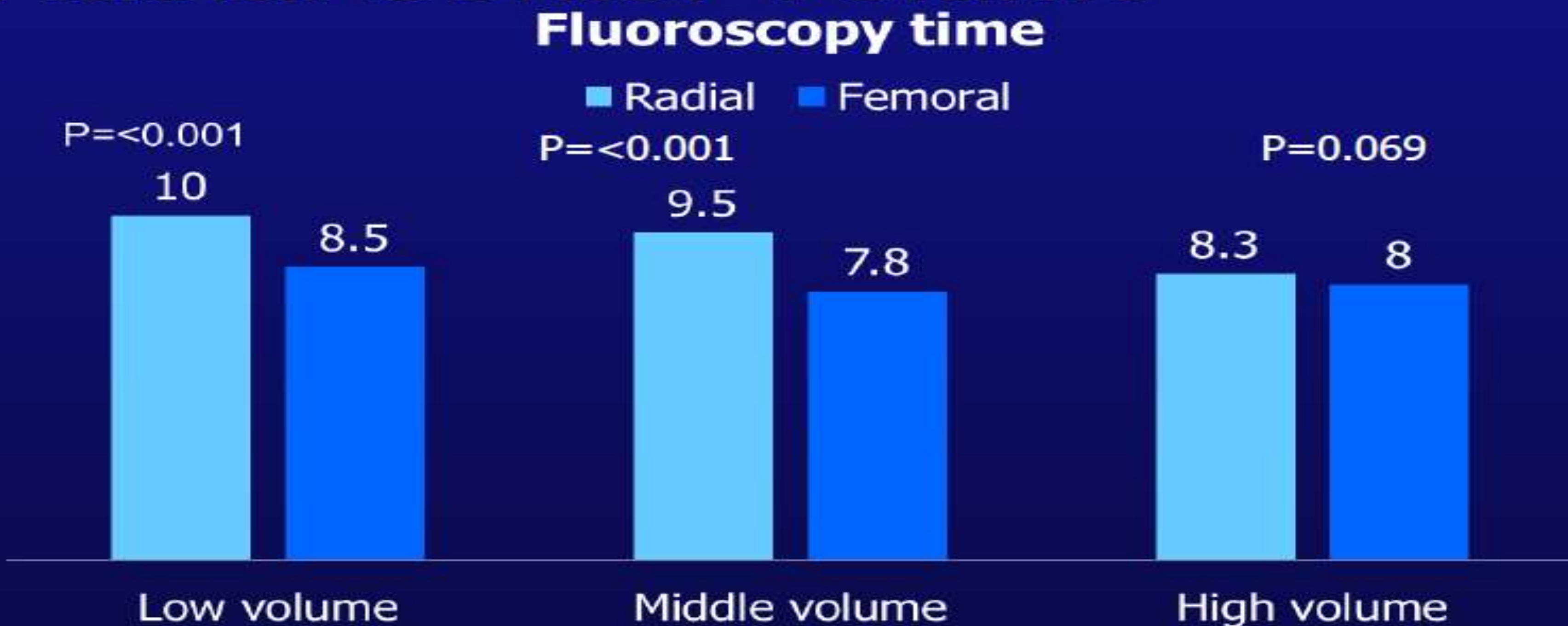
	Radial (n=3507)	Femoral (n=3514)	P
Access site Cross-over (%)	7.6	2.0	<0.0001
PCI Procedure duration (min)	35	34	0.62
Fluoroscopy time (min)	9.3	8.0	<0.0001
Persistent pain at access site >2 weeks (%)	2.6	3.1	0.22
Patient prefers assigned access site for next procedure (%)	90	49	<0.0001

- Symptomatic radial occlusion requiring medical attention 0.2% in radial group

Effect of Radial Versus Femoral Access on Radiation Dose and the Importance of Procedural Volume

A Substudy of the Multicenter Randomized RIVAL Trial

RIVAL Radiation Substudy: Radial Center Volume



Difference only present in low and middle volume Radial Centers

Estudio RADIFEMOPROC

Comparación de dosis al primer operador comparando acceso radial vs. femoral

2012

RADIFEMOPROC: Demografía

Acceso Femoral: 65 casos
Acceso Radial: 71 casos

3 casos de cross-over de Radial a Femoral.

Peso corporal acceso Femoral: 78,0 kg
acceso Radial: 79,5 kg
p=NS

RADIFEMOPROC: Resultados

Dosimetría:

Acceso Femoral: 49,9 microsieverts (DE ± 46).

Acceso Radial: 69,4 microsieverts (DE ± 52).

Aumento 39%

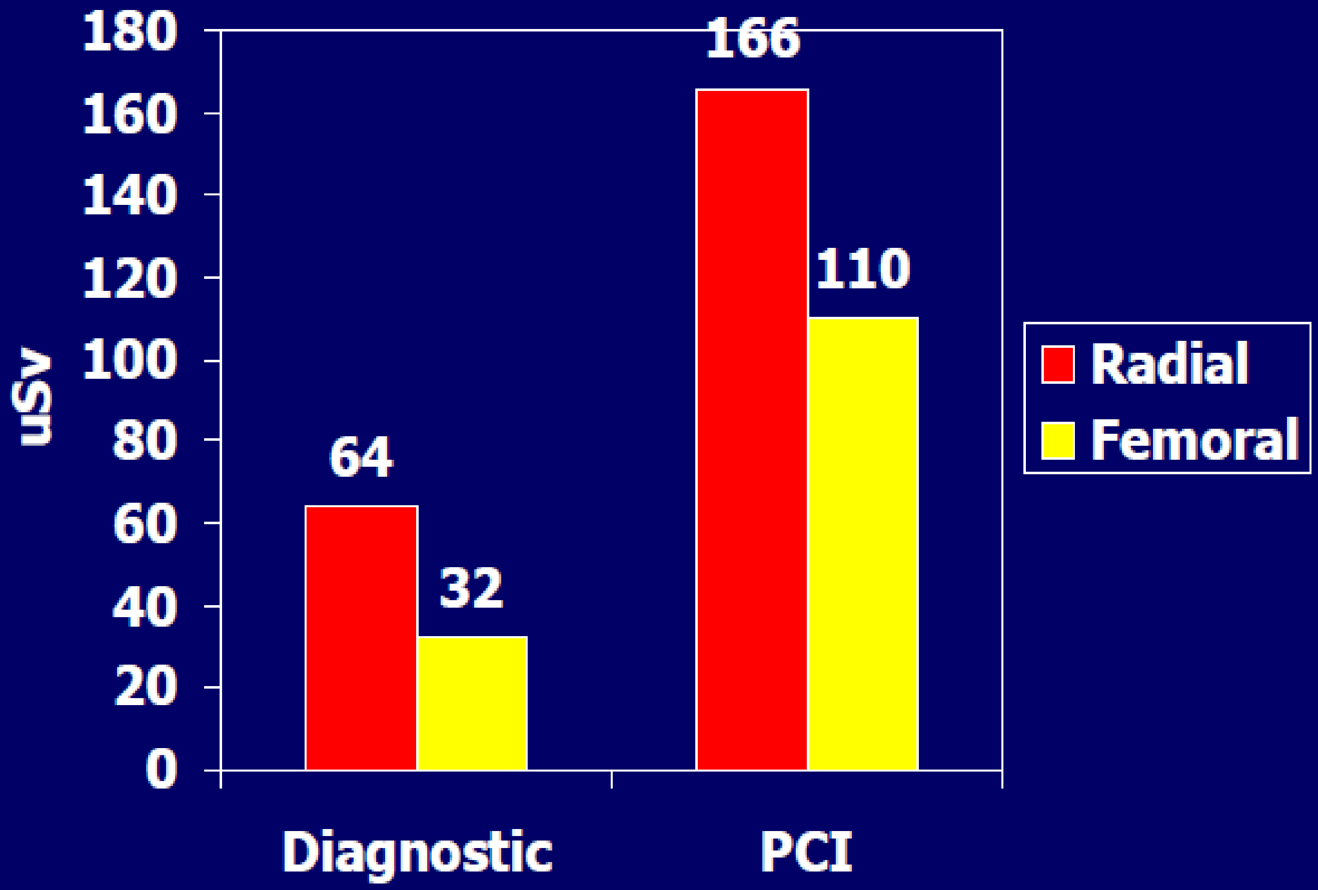
RADIFEMOPROC: Resultados

p=0,02 (test de Student a 2 colas)

Retirando el valor más alto de cada grupo (más del doble del valor anterior) la p=0,002

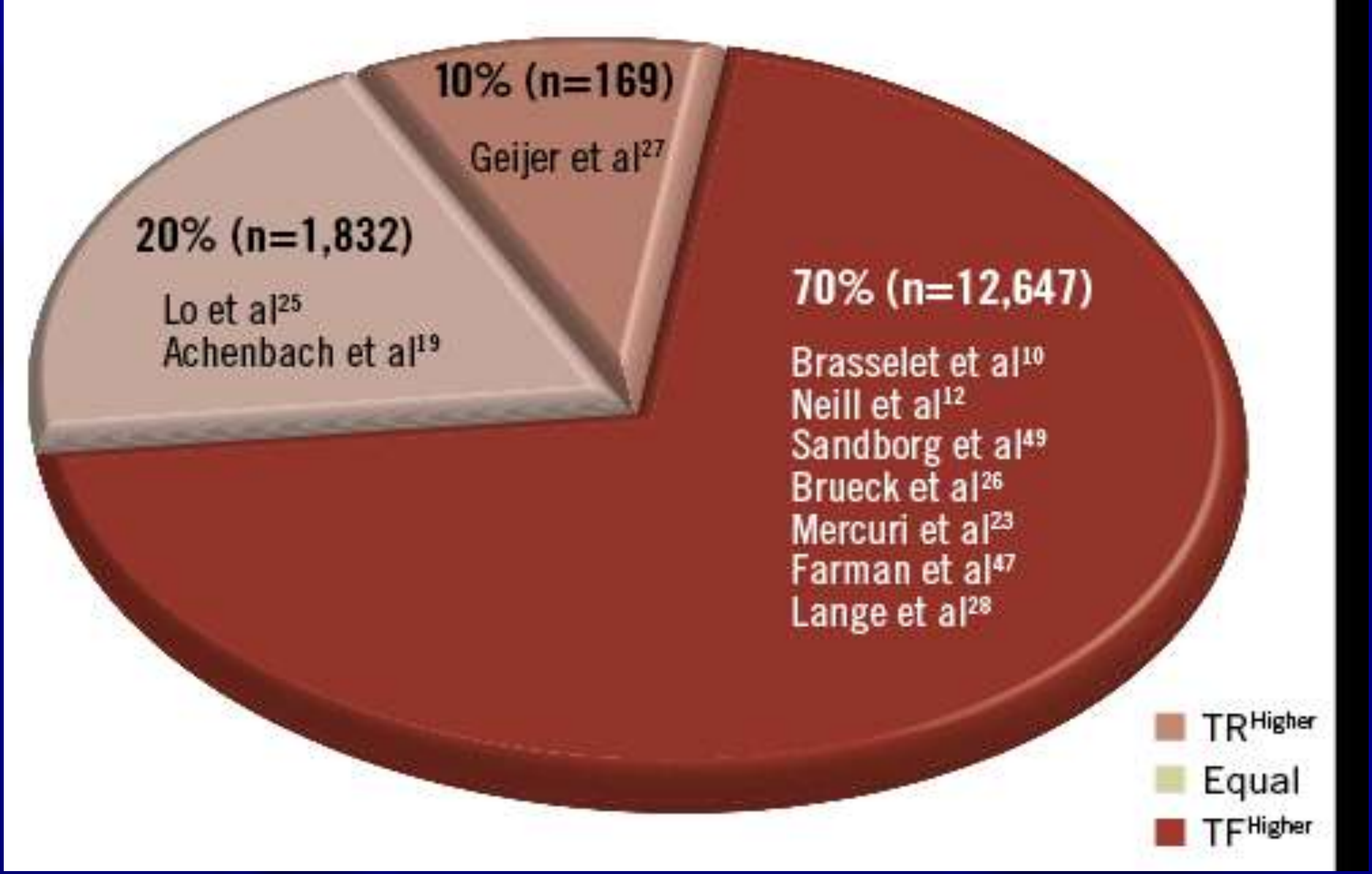
RCT of Radial vs. Femoral

Randomized single center study (n=297)

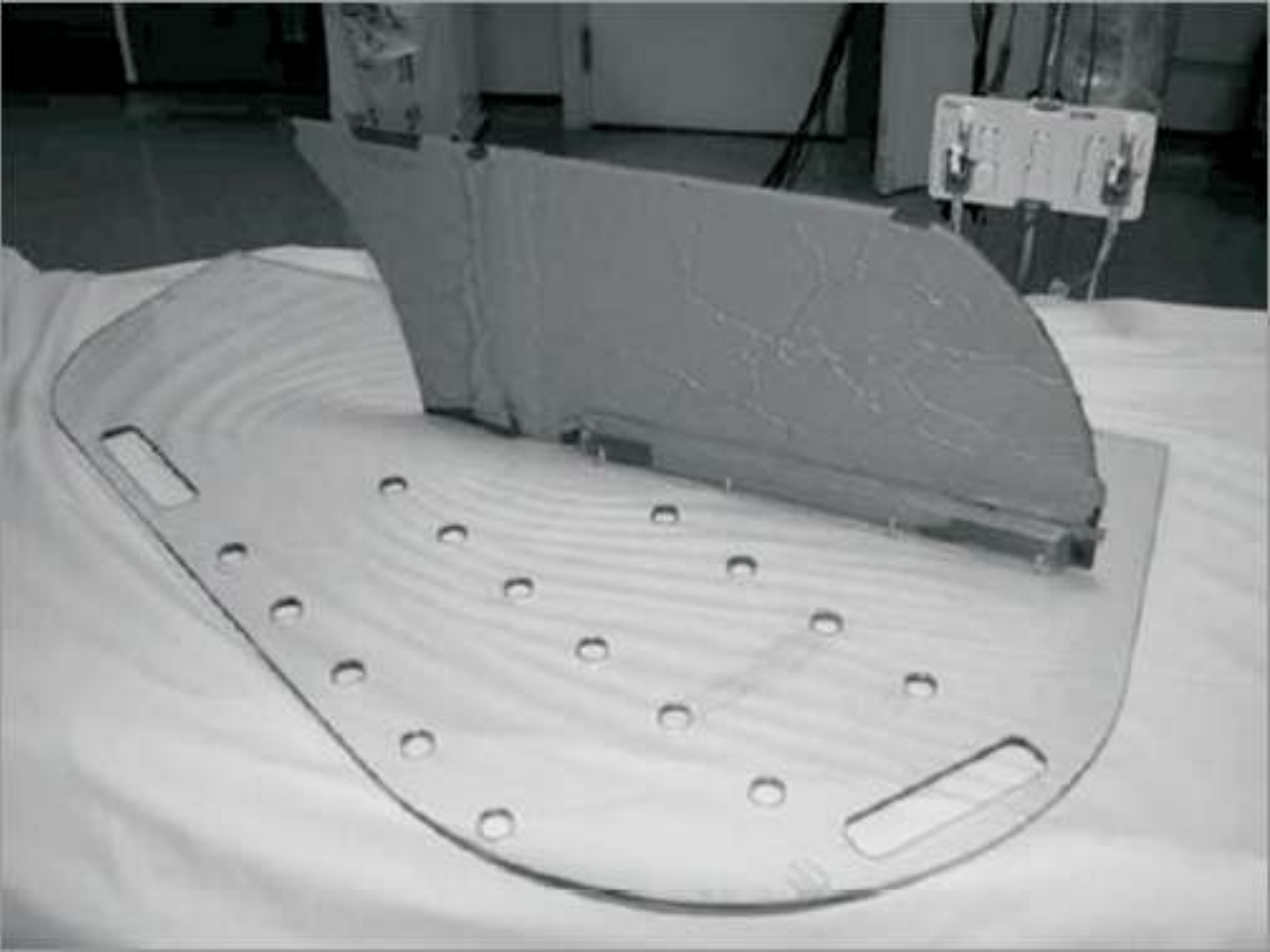


- 100% increase in radiation dose for diagnostic and 50% increase in radiation dose for PCI for cardiologist

Lange HW, et al. Cath Cardiovasc Int. 2006;67:12-16



Eurointervention, October 2013
A review of radiation exposures associated with radial cardiac catheterization
Eugene Y. Park1, BS; Adhir R. Shroff1, MD; L. Van-Thomas Crisco2, MD; Mladen I. Vidovich1*, MD



¿Cuál radial?

Derecha?

Izquierda?

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Operator Radiation Exposure and Physical Discomfort during a Right versus Left Radial Approach for Coronary Interventions: A Randomized Evaluation

UNIVERSITY of FLORIDA
College of Medicine
Jacksonville

Ambar M Patel M.D., Herman Kado M.D., Siva Suryadevara M.D., Dominick Angiolillo M.D., Martin Zenni M.D., Lyndon Box M.D., Theodore A Bass M.D., Luis A Guzman M.D.

Introduction

- The Transradial approach (TRA) is widely being adopted as the preferred method of access for coronary angiography.
- Currently, it is estimated that nearly 90% of all transradial cases are performed using right radial approach (RRA).
- This may be due to the fact that fluoroscopy suites are designed as such making RRA a more convenient approach with perceived less operator discomfort.
- Left radial approach (LRA) may have some advantages over the RRA such as decreased tortuosity and better catheter support.
- Previous studies have demonstrated a significant difference in the amount of fluoroscopy time (FT), environmental radiation exposure as well as radiation exposure to the patient comparing the two approach.
- However, little data exist showing direct operator radiation exposure and operator physical discomfort when comparing right versus left radial approach.

Study Aim

- The aim of this study is to determine a difference in direct operator radiation exposure and physical discomfort using a LRA versus a RRA.

Methods

- **Inclusion Criteria:** All patients that presented to catheterization lab for diagnostic angiography and percutaneous coronary intervention (PCI) between July 1, 2011 and October 31, 2012 that were considered appropriate by the operator to undergo a TRA.
- **Exclusion Criteria:** Patients with AV grafts, prior CABG surgery or ST-elevation myocardial infarction, lack of radial pulse, competitive trials, need for femoral approach for high risk interventions and physician preference.
- **Randomization process:** To prevent imbalances, patients were stratified by BMI and each operator had an independent randomization.
- **Radiation Badges:** Separate sets of Radiation dosimeter badges (RDB) were placed on external head, external thyroid and internal sternum for each operator.
- The total radiation dose obtained from RDB for each operator was adjusted based on FT of each case to obtain the actual dose/case.
- **Operator physical discomfort** (back, leg, neck pain) was surveyed and graded from 0-10 scale at two distinct time points : after vascular access and at the end of the procedure. Moderate to severe operator physical discomfort was defined as ≥ 5
- **Primary end point of the study:** Difference in total radiation dose, Head, External Thyroid and Internal Sternum between LRA vs RRA.
- **Secondary end points:** Operator physical discomfort, procedural success, fluoroscopy time (FT), scenes, total contrast, total catheters.

Results

Figure 1: Study Flow Diagram

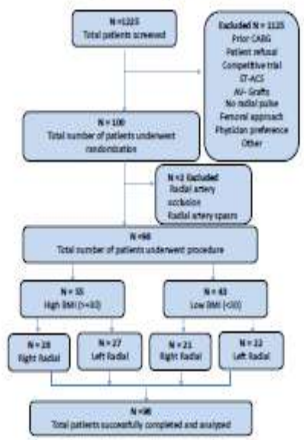


Table 1: Baseline patient demographics

	LRA(n=50)	RRA(n=50)	p-value
Age	57.97 ± 10.66	60.66 ± 8.89	0.29
BMI	31.90 ± 8.4	30.80 ± 6.6	0.49
Male	30 (61 %)	29 (59 %)	0.71
Caucasian	29 (59 %)	30 (61 %)	0.71
History of CAD	24 (49 %)	29 (59 %)	0.34
History prior PCI	18 (37 %)	24 (49 %)	0.33
History of PVD	2 (4 %)	2 (4 %)	0.98
History of CHF	3 (6 %)	6 (12 %)	0.54
Hypertension	40 (81 %)	43 (88 %)	0.52
Diabetes	25 (51 %)	27 (55 %)	0.53
Dyslipidemia	35 (71 %)	39 (79 %)	0.51
Tobacco use	27 (55 %)	31 (63 %)	0.53
Indication: ACS	25 (51 %)	30 (61 %)	0.32

Data are expressed as mean ± SD or as number (percentage).
Cardiovascular risk factors were defined as being treated before coronary angiography.

Table 2: Comparative analysis of procedural variables and radiation exposure for Left vs Right radial approach

	LRA(n=50)	RRA(n=50)	p-value
Procedural Success	48 (96%)	48 (96%)	1.00
FT (min)	10.5 ± 7.9	10.9 ± 8.0	0.82
Scenes	13.7 ± 8.5	14.4 ± 9.4	0.71
Contrast (ml)	110.1 ± 58.8	104.55 ± 60.0	0.65
Catheters	3.02 ± 1.8	2.78 ± 1.4	0.45

Table 3: Operator Radiation Exposure and BMI Left vs Right Radial Approach

BMI <30	LRA(n=22)	RRA(n=21)	p-value
External Head	8.85 ± 9.56	16.62 ± 14.31	0.04
External Thyroid	12.89 ± 12.70	31.81 ± 32.40	0.01
Internal Sternum	0.68 ± 1.15	1.57 ± 3.53	0.27
BMI >=30	LRA (n=27)	RRA (n=28)	p-value
External Head	11.37 ± 10.70	15.64 ± 13.85	0.21
External Thyroid	17.77 ± 16.34	28.94 ± 25.22	0.05
Internal Sternum	1.25 ± 1.60	1.74 ± 1.80	0.36

Figure 2: Primary Study Endpoint: Operator Radiation Exposure Left vs Right Radial Approach

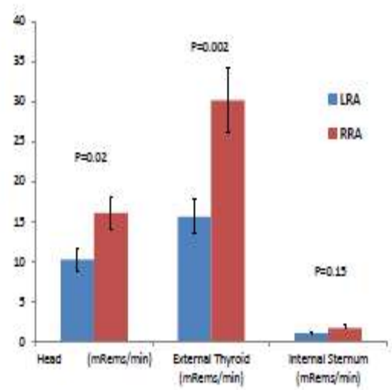
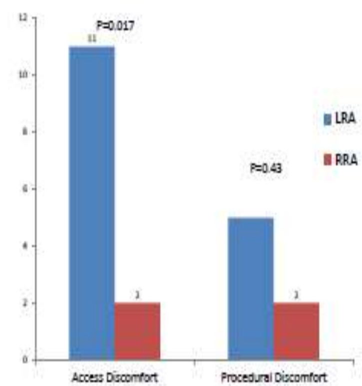


Figure 3: Operator Discomfort Left vs Right Radial Approach



Conclusions

- The procedural success of left radial approach is comparable to the right radial approach, with very similar procedural time, number of scenes and radiation exposure to the patient.
- There is a significant decrease in radiation exposure to the operator using the left radial approach.
- The decreased radiation was seen mainly in the thyroid and head area with a trend towards increased radiation exposure to the sternum
- Left radial approach is associated with more discomfort only during vascular access but none during the procedure

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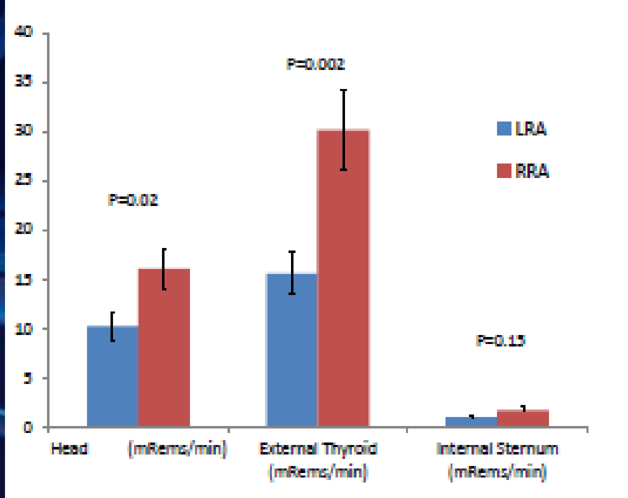

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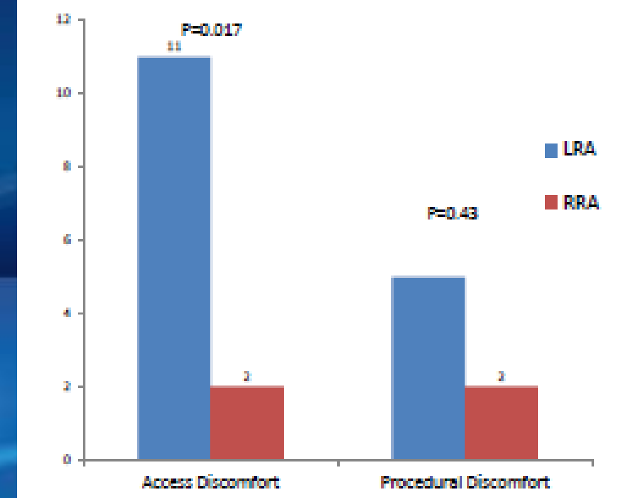

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			N	Right radial	Left radial	*p*
Right>Left (n=1,967)	Sciahbasi et al[30]	FT (sec) in patients >70 years old	1,467	168	149	0.0025
		DAP (Gycm^2) in patients >70 years old		12.1	10.7	0.004
		FT (sec) in patients <70 years old		158	138	0.048
		DAP (Gycm^2) in patients <70 years old		11.1	10.2	0.11
	Sciahbasi et al[13]	Dose (mSv) at operator thorax above apron	309	0.85	1.12	NS
		Dose (mSv) at operator thyroid		0.36	0.34	NS
		Dose (mSv) at operator shoulder		0.73	0.94	NS
		Dose (mSv) at operator wrist		2.44	1	0.002
	Hildick-Smith et al[50]	FT (min)	500	8.1	6.8	<0.05
EQUAL (n=1,240)	Larsen et al[31]	FT (min)	135	13.03	14.05	NS
		Contrast volume (mL)		200	200	NS
	Santas et al[3]	Diagnostic FT (min)	1,005	5	5	NS
	Freixa et al[32]	Diagnostic FT (min)	100	8.9	8.3	NS
		Contrast volume (mL)		105.4	95.8	NS

DAP: dose area product; FT: fluoroscopy time; min: minutes; mL: millilitres; mSv: millisievert; NS: not significant; sec: seconds

Reduction of Operator Radiation Dose by a Pelvic Lead Shield During Cardiac Catheterization by Radial Access

Comparison With Femoral Access

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Bremen, Germany

JACC: CARDIOVASCULAR INTERVENTIONS, VOL. 5, NO. 4, 2012
APRIL 2012:445–9

POLLERA FENESTRADA

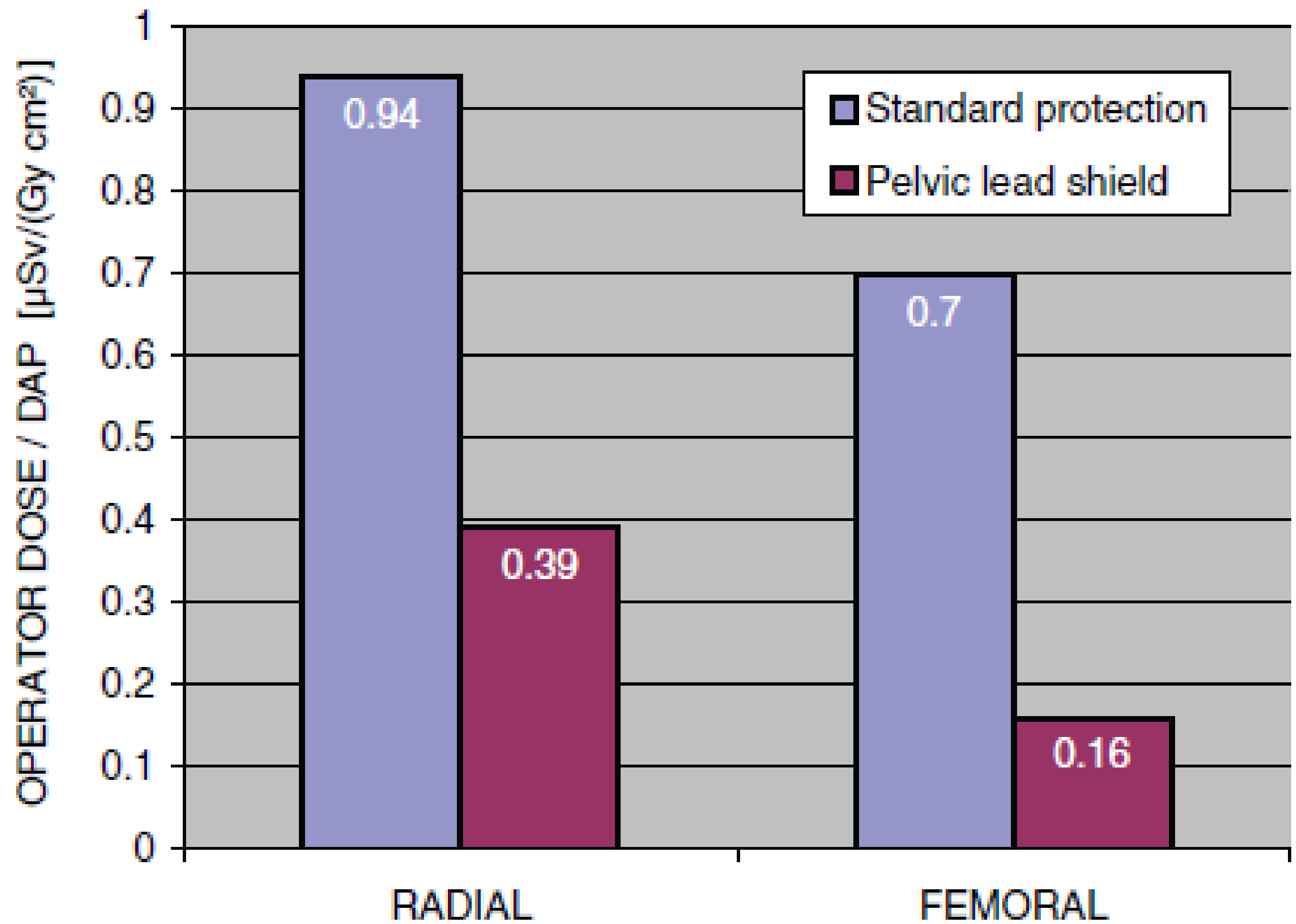
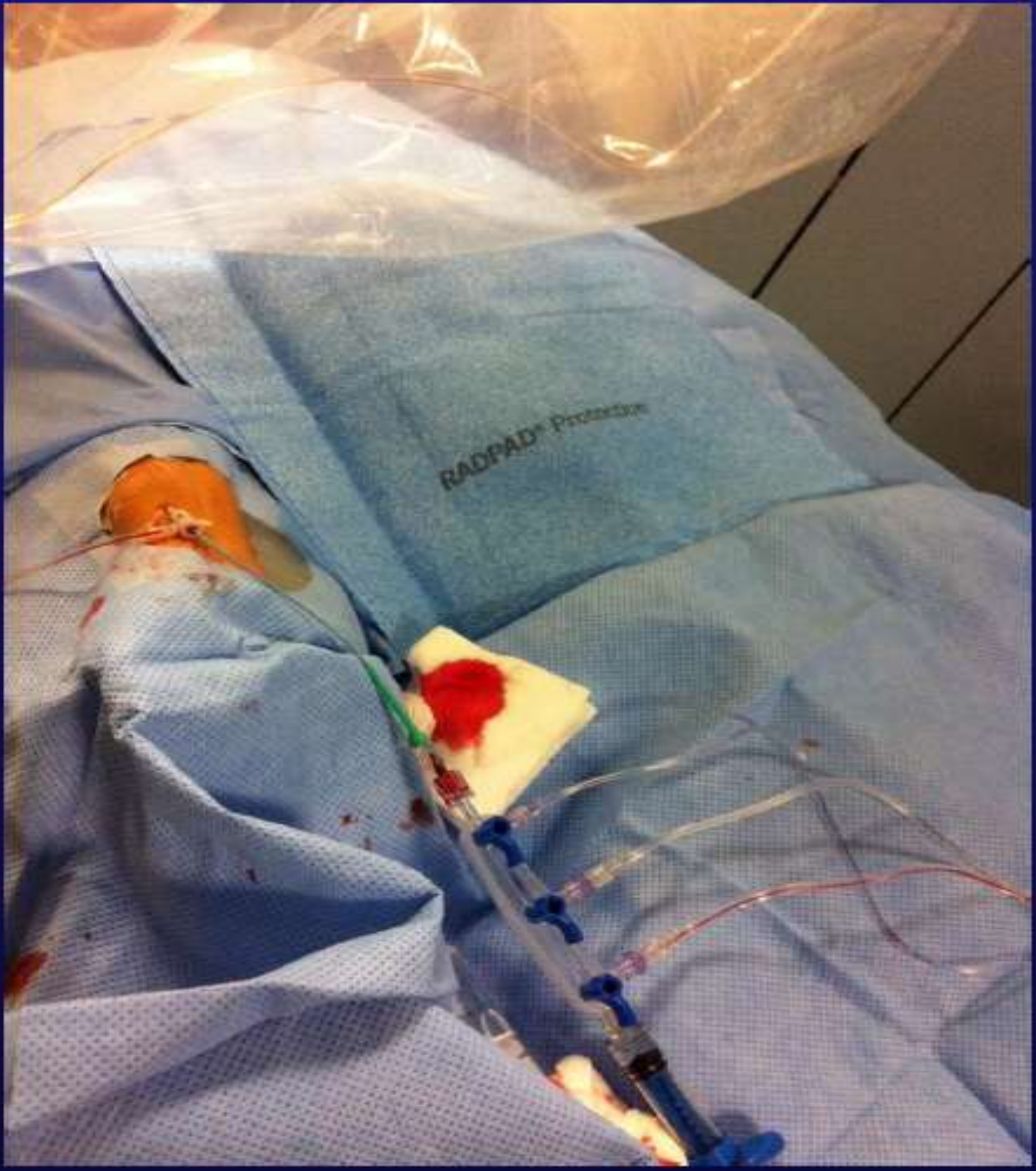


Figure 2. Effect of a Pelvic Lead Shield During Cardiac Catheterization

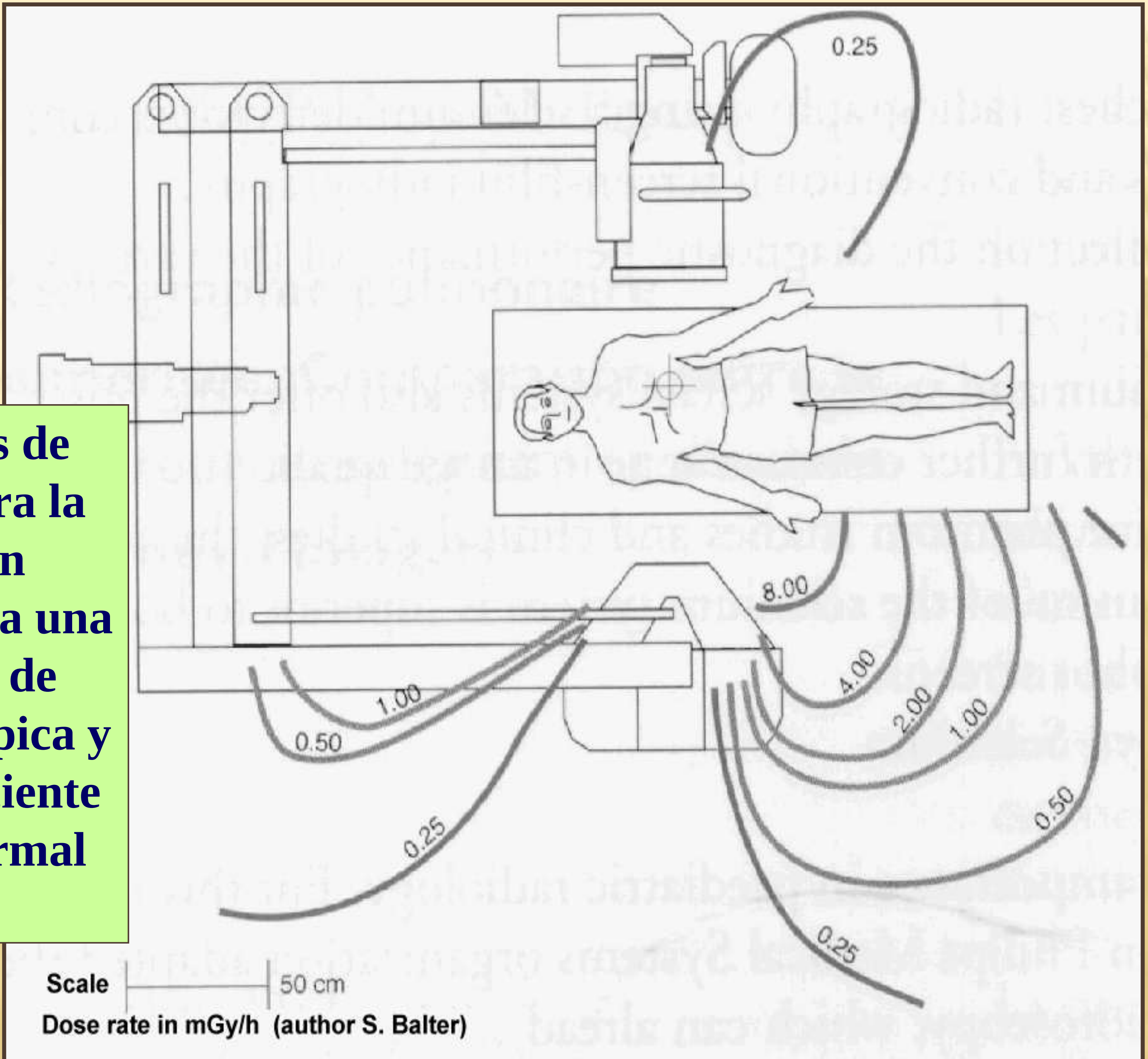
The dose-area product (DAP)-normalized radiation dose of the operator ($\mu Sv \cdot \times Gy^{-1} \times cm^{-2}$) by radial access **(left)** and femoral access **(right)**. The amount of reduction is similar for both routes.

RADPAD: Bismuth Antimony product



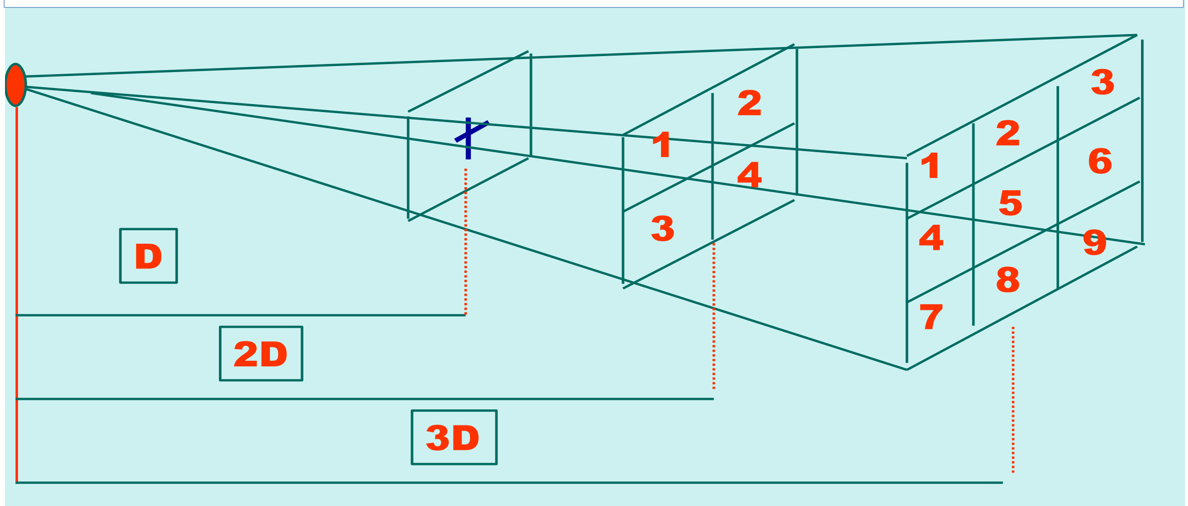
CIRCULACIÓN

Las curvas de isodosis para la radiación dispersa para una condición de operación típica y para un paciente tamaño normal



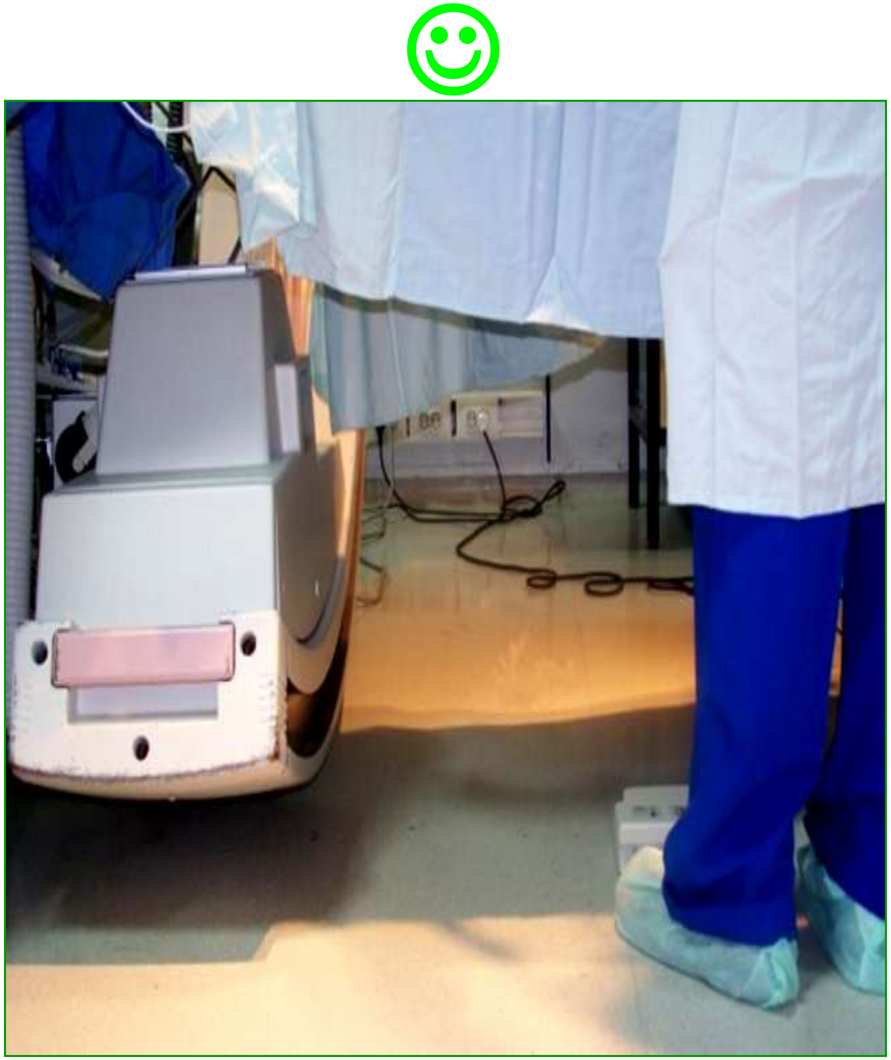
Maximize Distancia:
Ley del cuadrado de la distancia

La dosis de radiación varía inversamente con el cuadrado de la distancia



Si Ud. duplica la distancia a la fuente de rayos X, su dosis se reduce en un factor de 4 (será un 25% de la previa)

Posición respecto a la fuente



ERRORES

10 Recomendaciones

1. Trabajar con mesa alta e intensificador a 5 cm del tórax del paciente: SID 110cm.
2. Filmar y magnifique lo menos posible.
3. Minimizar el uso de proyecciones oblicuas extremas.
4. Nunca exponga sus manos y los brazos del paciente al haz.
5. Filtre, colime permanentemente.

Cambie orientación del arco. "Imagine dirección del haz".

10 Recomendaciones

6. Utilice todos las protecciones disponibles: lentes, mamparas y polleras plomadas.
7. Posibilidad de realizar en "etapas" procedimientos complejos.
8. Especial cuidado en pacientes "complejos" o "sensibles": seguimiento?
9. Dosimetría doble. Medición de dosis a determinados pacientes. Contacto con el Físico de su Hospital y con el Service.
10. "Un paso atrás".

-Dejamos de temer aquello que se ha aprendido a entender...!!!

Marie Curie.


NUEVO

SOLACI CACI '14
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Gracias por su atención¡¡¡

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