

# Imaging and Management of Whole Body trauma

Brno may 3rd 2013

- Diagnostic and therapeutic approach to thoraco-lumbar trauma

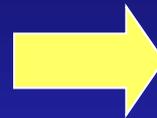
Mario Muto M.D.

- Diagnostic and therapeutic  
Neuroradiology Unit  
AORN Cardarelli Hosp.,  
Naples, Italy



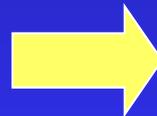
MDTC has wider indications in the initial evaluation of thoraco-lumbar polytrauma patients.

target area reconstruction:



Faster than XRay  
More sensitive  
no patient movem  
Low radiation protocol

High resolution  
MPR

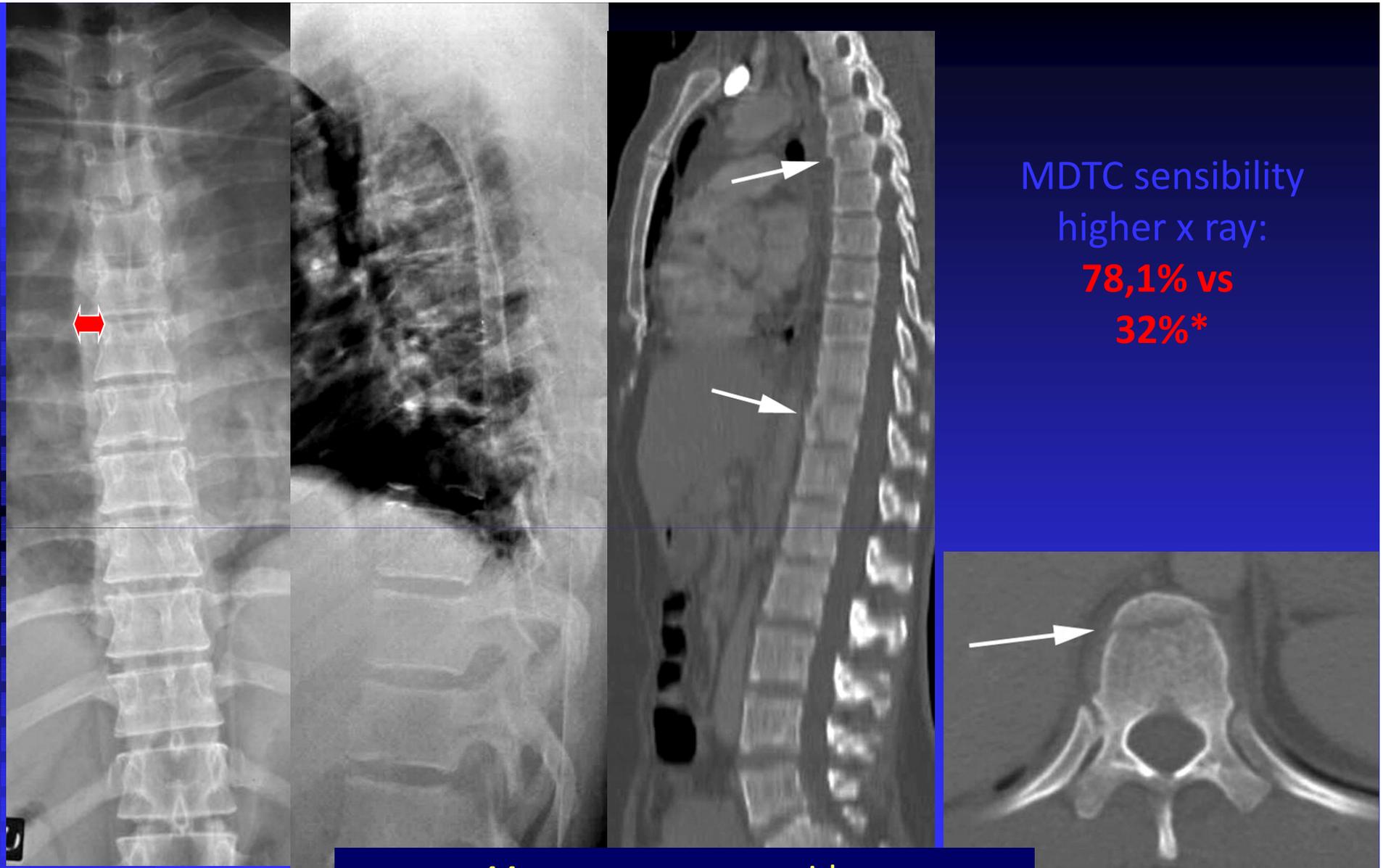


Small cortical fracture  
Sagittal alignment

Wide segment evaluation



not contiguous fracture



MDTC sensibility  
higher x ray:  
**78,1% vs**  
**32%\***

### 44 yo women car accident

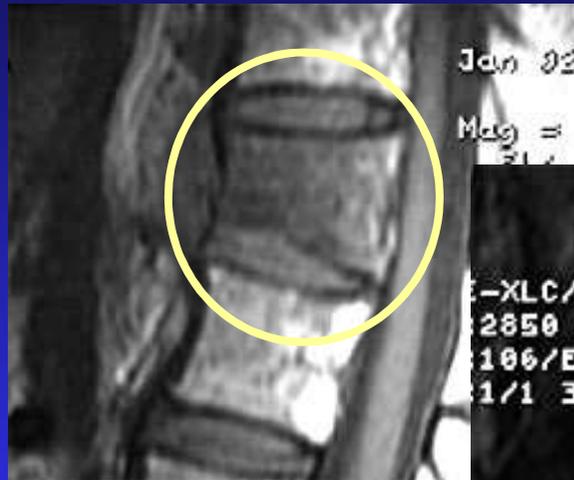


\* Wintermark M, Moushine E, Theumann N et Al. Thoracolumbar spine fractures in patients who have sustained severe trauma: depiction with multi-detector row CT. *Radiology* 2003; 227: 681-689.





# Can we predict the evolution of a VCF ?



January 2003



February 2003



May 2003

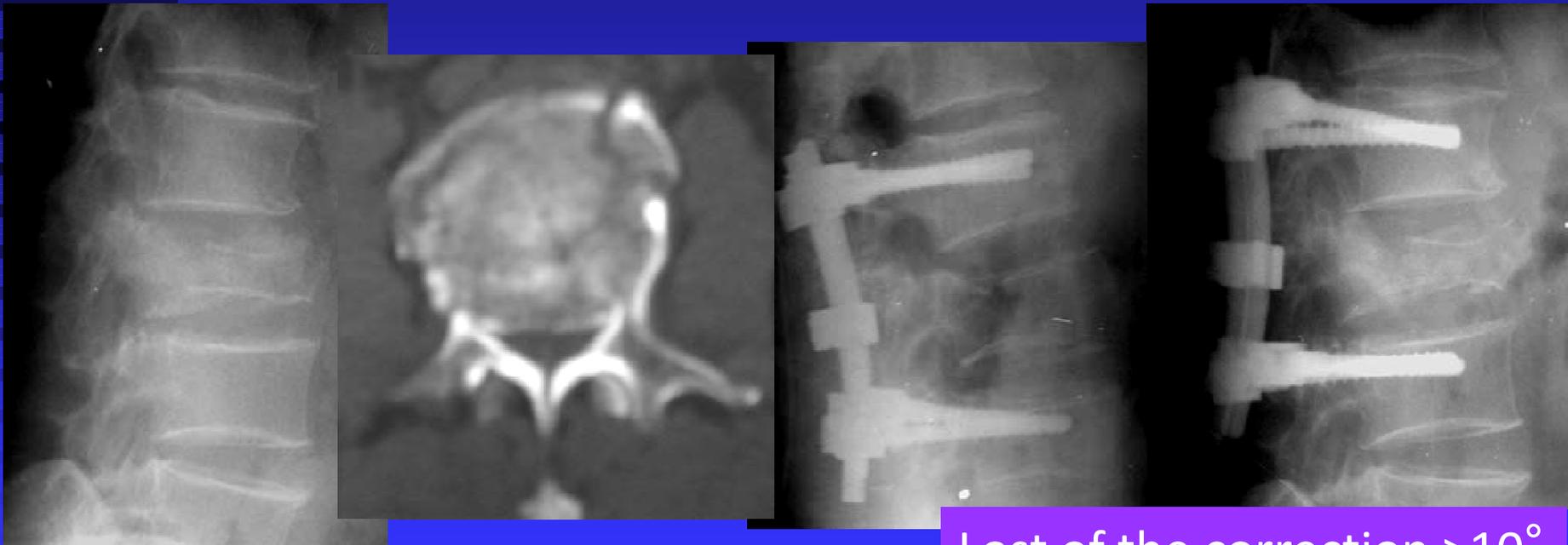
Up to now does not exist a gold standard  
about burst fracture therapy to prevent progressive kyphosis

### Short Posterior fixation

Are quite popular due to their easy positioning , brief surgical time and  
low morbidity

but 9-54% present failure or worsening of the kyphosis \*\*

T-L Junction\*\*\*



Lost of the correction  $>10^{\circ}$



\* Koller H Acosta F et Al *Eur Spine J* 2008; 17:1073-1095.

\*\* Alvine GF, Swain JM et Al. *J Spinal Disord Tech* 2004; 17(4) : 251-264.

\*\*\* Altay M Ozkurt B et Al. *Eur Spine J* 2007; 16: 1145-1155.

- Vertebral trauma is a common condition that can determine major and minor complications.
- Multiple classification have been published in the past trying to establish stable and unstable fractures, surgical and not - surgical fractures, related to the three or four columns theory.
- The common therapy for not surgical not unstable fractures includes bed rest, analgesic medical treatment and orthosis devices.

## ■ Spine trauma classification

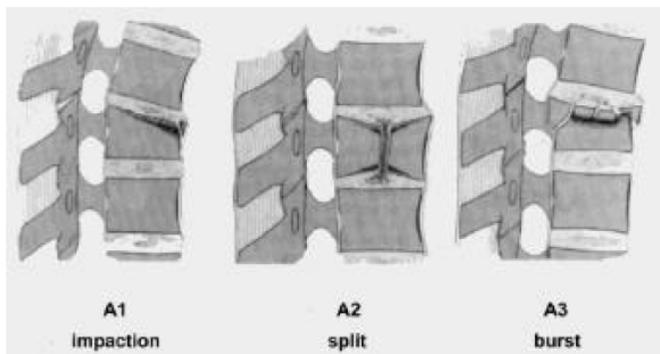
- Nicoll
- Holdsworth
- Whitesides
- Louis
- Roy - Camille
- McAfee
- Ferguson and Allen
- Magerl
- Patel
- Aebi

M  
A  
G  
E  
R  
L  
C  
L  
A  
S  
S

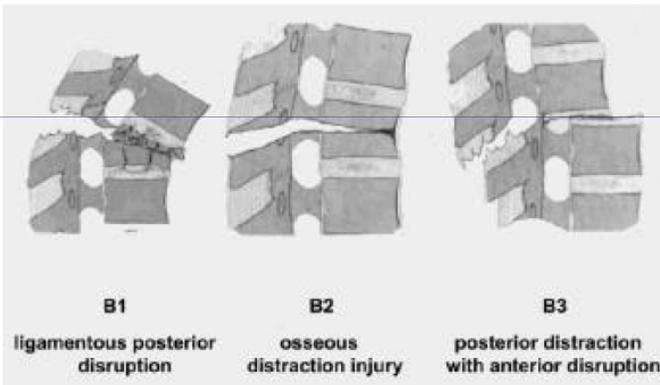
A compression injury	A1 Impaction fracture	A1.1 end plate impaction A1.2 wedge impaction A1.3 with collapse
	A2 Split fracture	A2.1 sagittal A2.2 coronal A2.3 pincer
	A3 Burst fracture	A3.1 incomplete A3.2 burst/split A3.3 complete
B Distraction injury	B1 Post.lig.lesion	B1.1 with disc disruption B1.2 with type A fracture
	B2 Post. Bony les.	B2.1 transverse bi-column B2.2 with disc disruption B2.3 with type A fracture
	B3 Ant. Disc rupture	B3.1 with subluxation B3.2 with spondilolysis B3.3 with post dislocation
C Rotation injury	C1 Type A with rotation	C1.1 with wedge C1.2 with split C1.3 with burst
	C2 Type B with rotation	C2.1 B1 with rotation C2.2 B2 with rotation C2.3 B3 with rotation
	C3 rotational shera inj.	C3.1 slice fracture C3.2 oblique oblique

# Classificazione Magerl

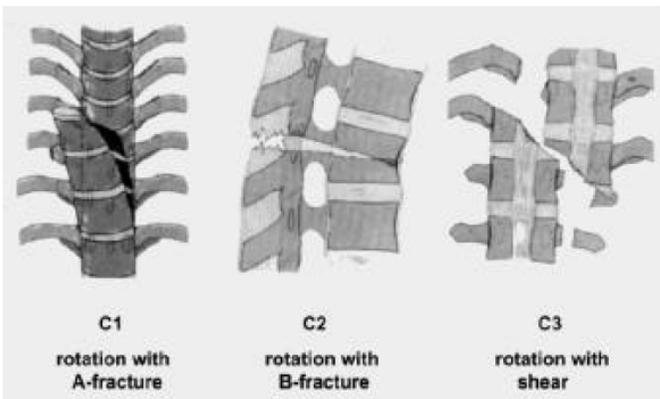
Compression



Distraction

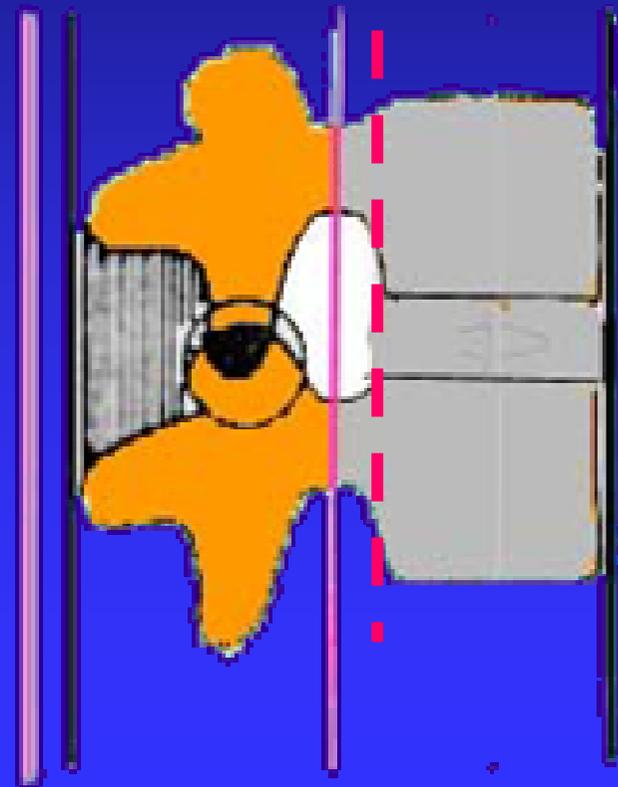
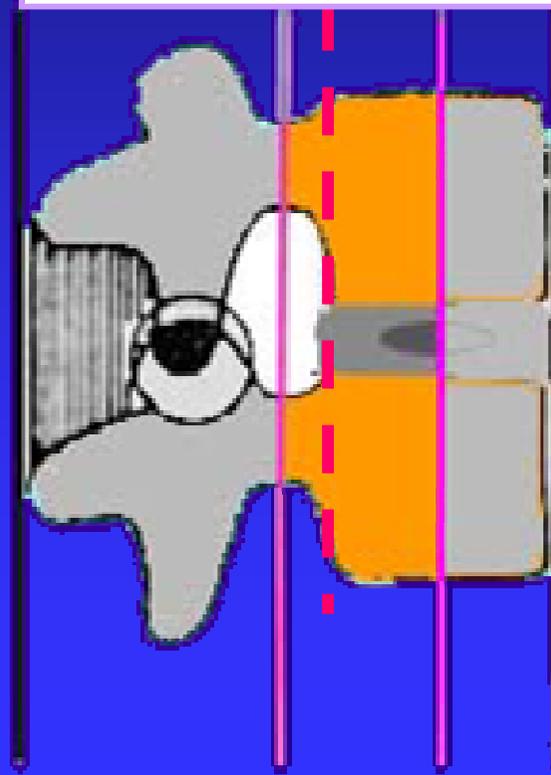
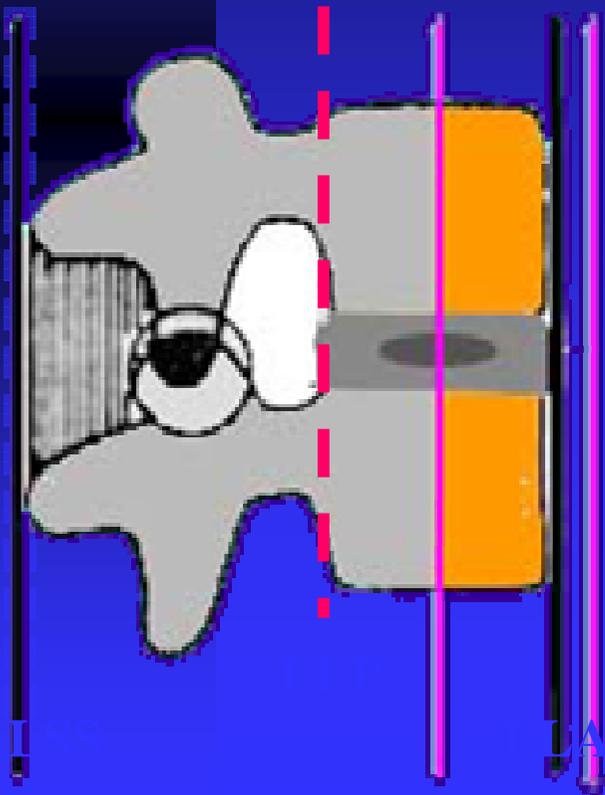
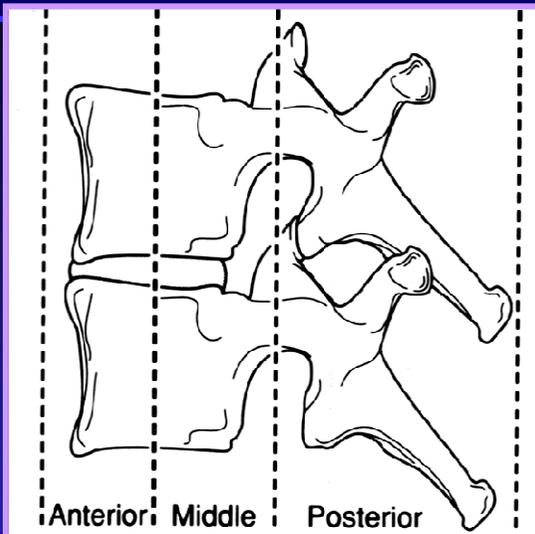


Rotation



	sagittal	frontal	axial superior	axial inferior
A.1.1				
A.1.2				
A.1.3				
A.2.1				
A.2.2				
A.2.3				
A.3.1				
A.3.2				
A.3.3				

# THREE COLUMNES DENIS theory



- Schofer MD and coll
- Comparison of KP and VP in the treatment of fresh vertebral compression fracture.
- Arch Orthop Surg 2009 may
  
- Pflugmacher R and coll
- Balloon KP combined with posterior instrumentation in the treatment of burst fracture of the spine: 1 year results.
- J Orthop trauma 2009 feb 23, 126-131
  
- Knavel EM and coll
- VP for the treatment of traumatic non osteoporotic compression fractures
- AJNR 2009 feb 323-327
  
- Muto M and coll
- VP and KP: friends or foes?
- Radiol Med 2008 dec,113(8), 1171-1184

- J Neurosurg Spine. 2009  
Mar;10(3):201-6. Thoracolumbar spine trauma classification: the Thoracolumbar Injury Classification and Severity Score system and case examples.
- Patel AA, Dailey A, Brodke DS, Daubs M, Harrop J, Whang PG, Vaccaro AR; Spine Trauma Study Group. Departments of Orthopaedic Surgery, University of Utah School of Medicine, Salt Lake City, Utah 84108, USA.

- **CONCLUSIONS:** By addressing both the posterior ligamentous integrity and the patient's neurological status, the TLICS system attempts to overcome the limitations of prior thoracolumbar classification systems. The TLICS system has demonstrated both validity and reliability and has also been shown to be readily learned and incorporated into clinical practice.

- Eur Spine J. 2010 Mar;19 Suppl 1:S2-7.  
Epub 2009 Oct 23.
- Classification of thoracolumbar fractures and dislocations. Aebi M.
- MEM Research Center for Orthopaedic Surgery, Institute for Evaluative Research in Orthopaedic Surgery, University of Berne, Switzerland.

- This classification is based on three major groups:
- A = isolated anterior column injuries by axial compression,
- B = disruption of the posterior ligament complex by distraction posteriorly, and group
- C = corresponding to group B but with rotation.

- There is an increasing severity from A to C, and within each group, the severity usually increases within the subgroups from .1, .2, .3.
- All these pathomorphologies are supported by a mechanism of injury, which is responsible for the extent of the injury.
- The type of injury with its groups and subgroups is able to suggest the treatment modality.

# VP-KP Vertebral compression fracture

- Porotic lesions
- Metastasis
- Hemangioma
- Trauma (KP)
  
- acute , subacute and chronic clinical symptomatology.
  
- *VP and KP as PAIN THERAPY to improve life quality.*
  
- *Asymptomatic patient with VCF fracture is not an indication to the treatment.*

## *Incidence of FCV in EU*

### Vertebral augmentation: VP-KP

- Incidence: **438.750** for year  
(117 / 100.000)
- Simple cement injection in VP and balloon or mechanical assisted cement injection in KP .

# diagnostic algorithm

acute pain



Standard X-Ray



MR (STIR T2)

spongius oedema

hemangioma

traumatic frac(CT)



VP

normal



no VP

metastasis



NM CT



VP

**Position statement on Percutaneous augmentation : a consensus statement developed by the American Society of Interventional and Therapeutic Neuroradiology, Society of Interventional Radiology , American Association of Neurological Surgeons, and American Society of Spine Radiology.**

**AJNR 28, 1439 - 43, sept 2007**

- **Rationale , PVA vs medical therapy**
- **Quality of life**
- **Complications**

# Conclusions

- Vertebral augmentation technique with VP and KP are medically appropriate therapy for the treatment of vertebral compression fractures refractory to medical therapy and performed with correct medical indications.

# Contraindications

- Absolute
- Painless compression fractures
- Systemic and local infection
  
- Relative
- Uncorrected coagulopathy
- Epidural tumor
- Posterior vertebral wall destruction or disruption
- Complete vertebral collapse

# Target of kyphoplasty

- 1) Vertebral height restoration to reduce kyphotic angle
- 2) Reduce rates of complications

UNDERLINE THE IMPORTANCE TO PERFORM THOSE  
PROCEDURE WITH HIGH QUALITY ANGIO SUITE

- Lower thoracic and lumbar applications
- More invasive compared to VP, often general anesthesia
- Not suggested in multiple levels cementoplasty
- More expensive vs VP
- In our experience for traumatic fracture , major indications is kyphoplasty

# Indications

- Fractures not older than 2-3 weeks in all patients; younger the fractures better are the results and easier is the treatment. Different in young and old patient
- Today different type of systems can be use to perform KP with low and normal density cement injection or osteoconductive material.
- We consider to be treated Magerl A1 and selected A2 and A3 fractures



874 NCH URG F/77y  
31-56 D11-L2  
17.50 mm

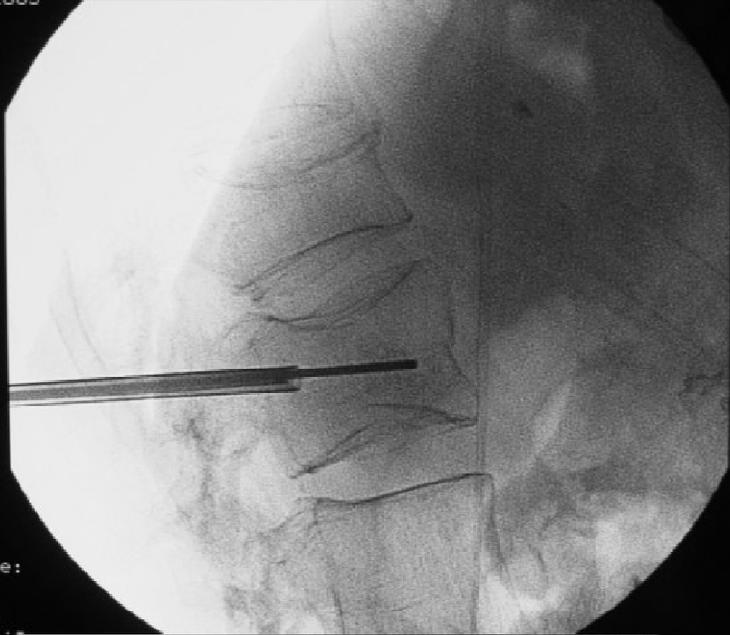
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Philips Mx800CH URG F/77y  
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D11-L2  
mm  
SC 1  
SW

A.O.R.N. CARDARELL  
Philips Mx8000 Dua  
17 Sep 2003 11:07:11.11  
50 mm  
SC 180.0 mm  
SW 3.20 mm

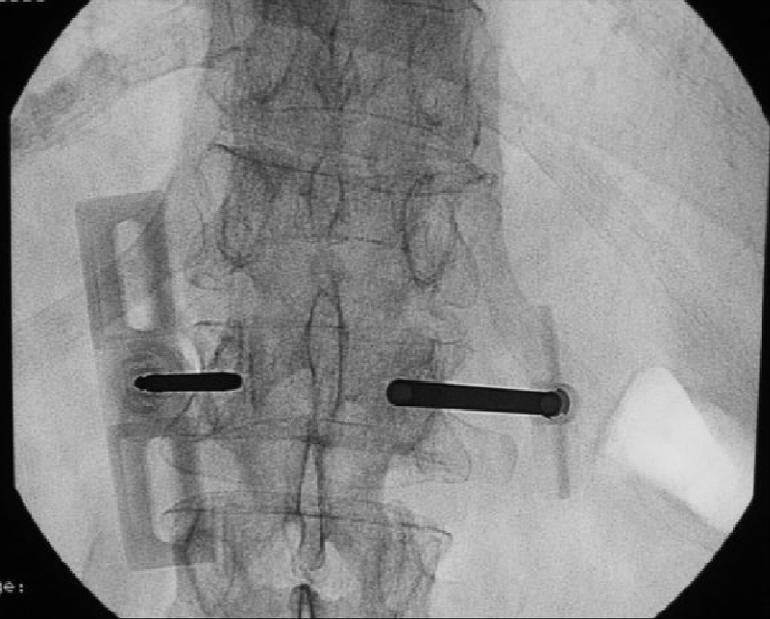
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SC 180.0  
SW 2.00



05-2003



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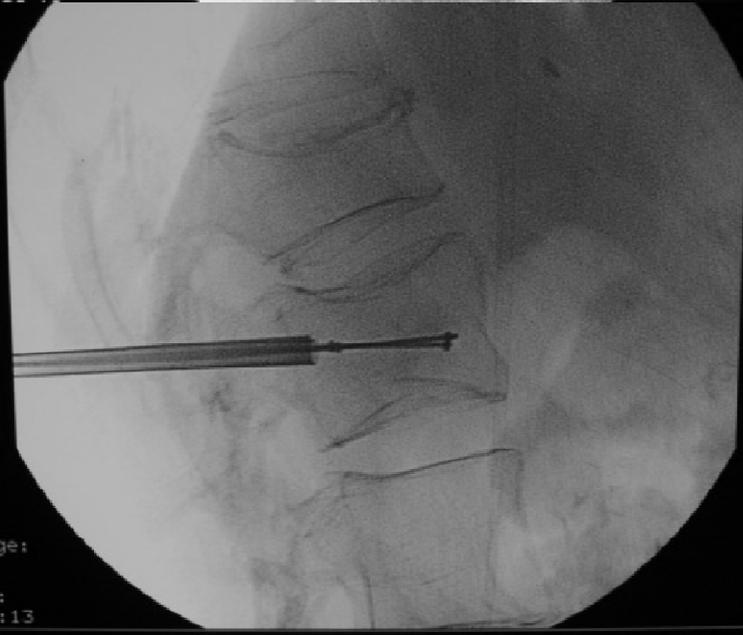


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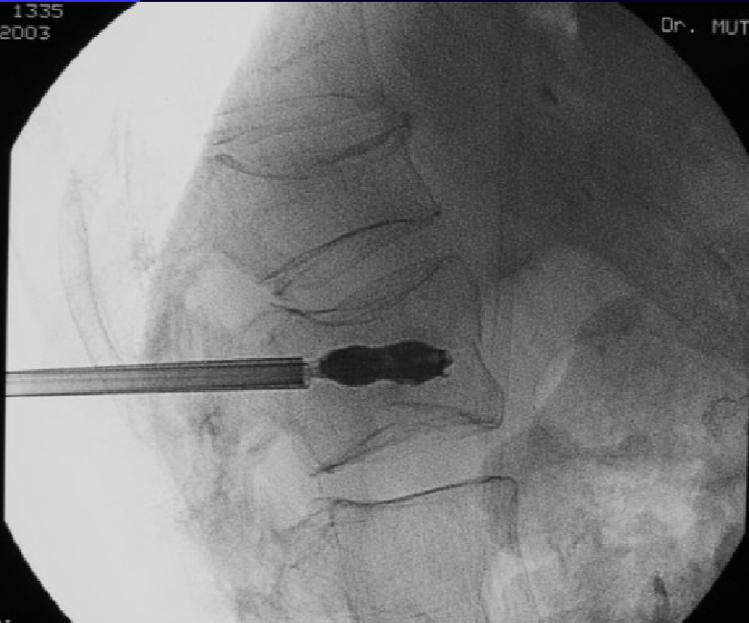
Dr. MUTO Mar



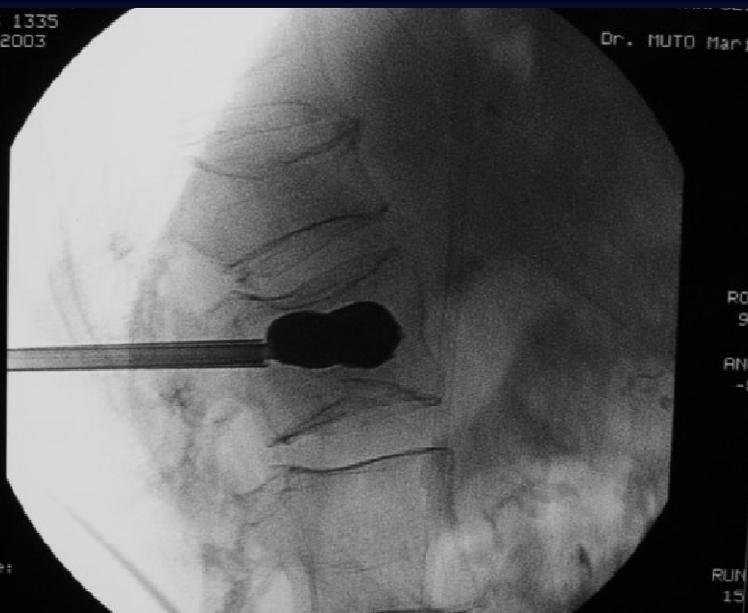
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2003

Dr. MUTO Mario  
URG 1335  
09-2003



ROT  
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ANG  
-8



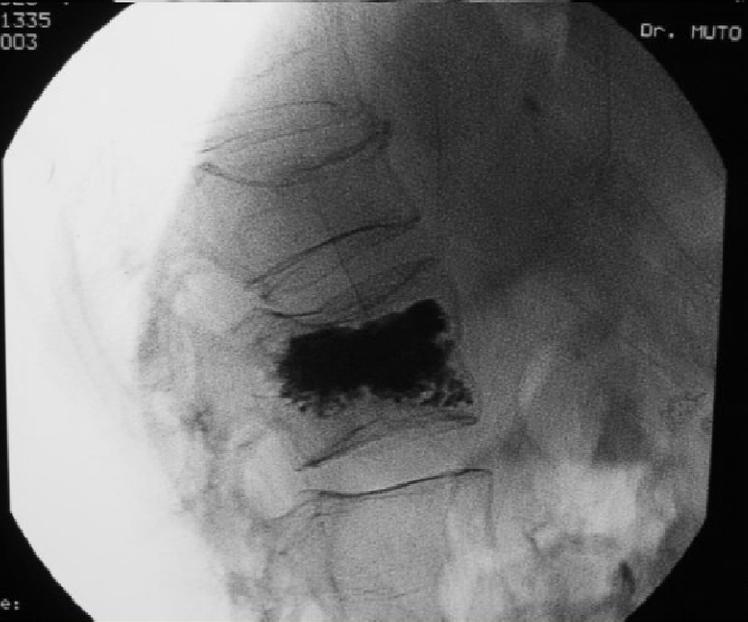
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Dr. MUTO Mario  
URG 1335  
27-09-2003

Dr. MUTO Mario  
URG 1335  
09-2003



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T-image:  
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ROT

-640.80 mm

NRX F

Philips Mx8000 Dual M

SC 168.0 m4711-48

29 Sep 2003 13:07:0 4

SW 3.20 m-644.40 mm

SC 168.0 mm

SW 3.20 mm



X F  
1133-2 RIC SAG  
00 mm

Philips Mx8000 mm  
29 Sep 2003 13:03

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SW 3.0

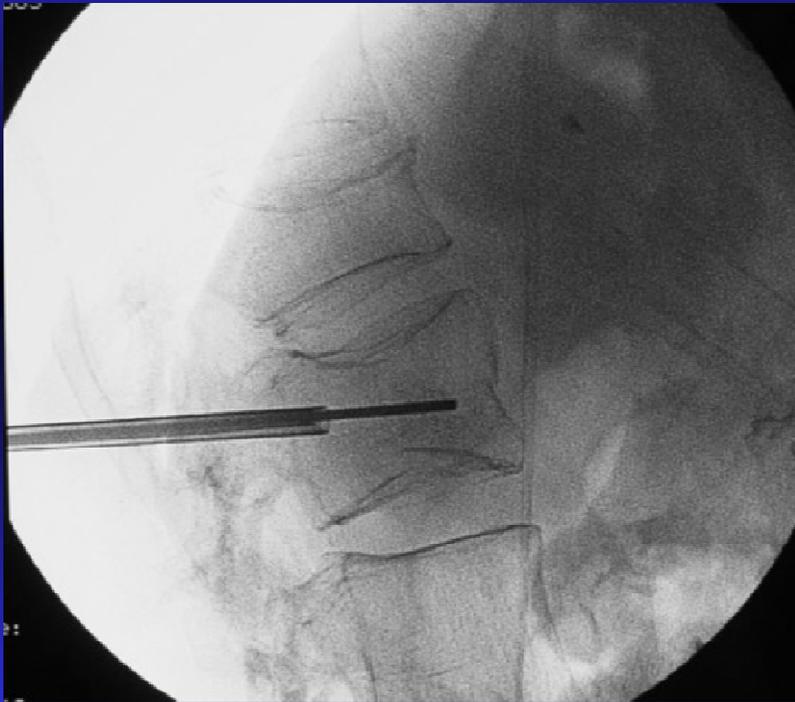
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SW 3.00 mm

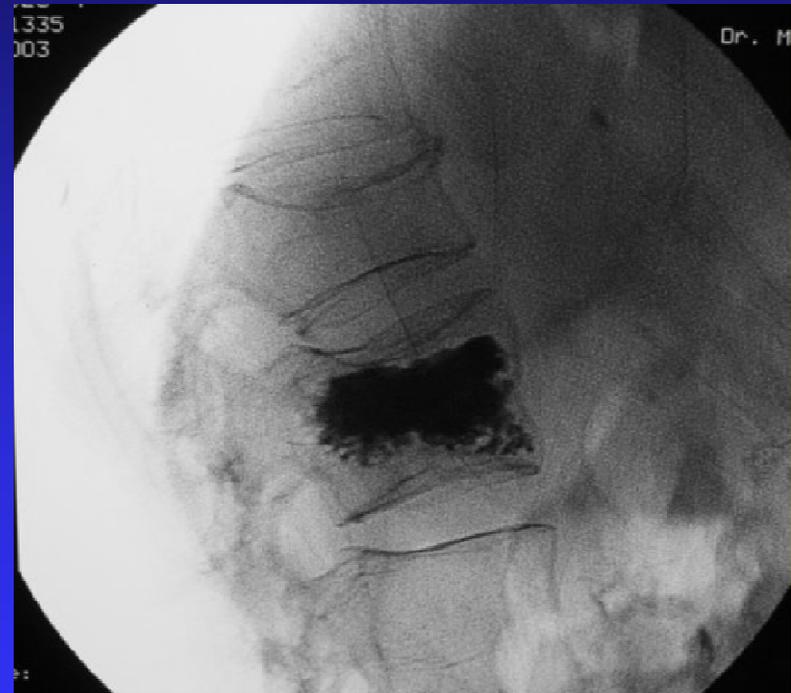


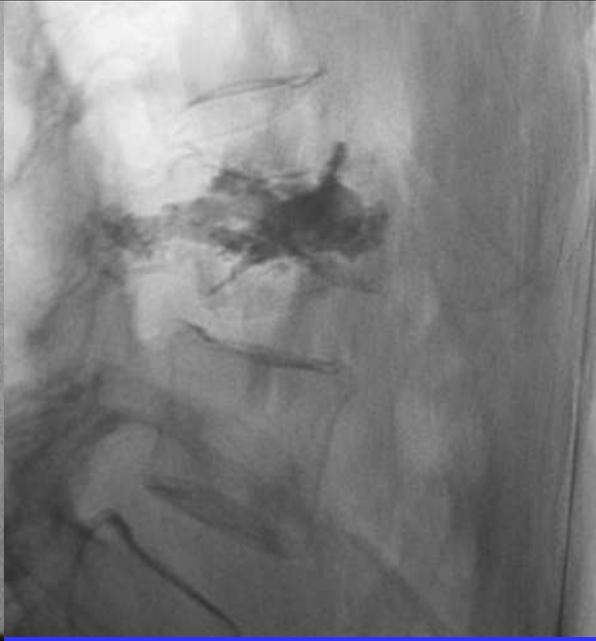
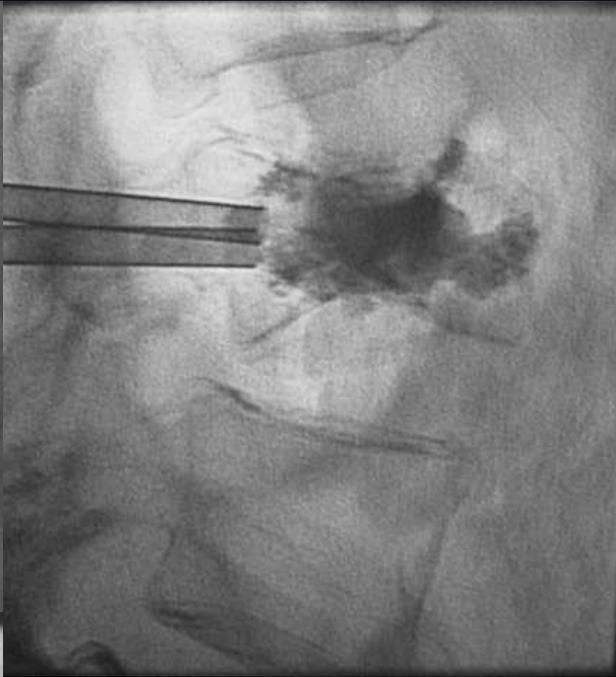
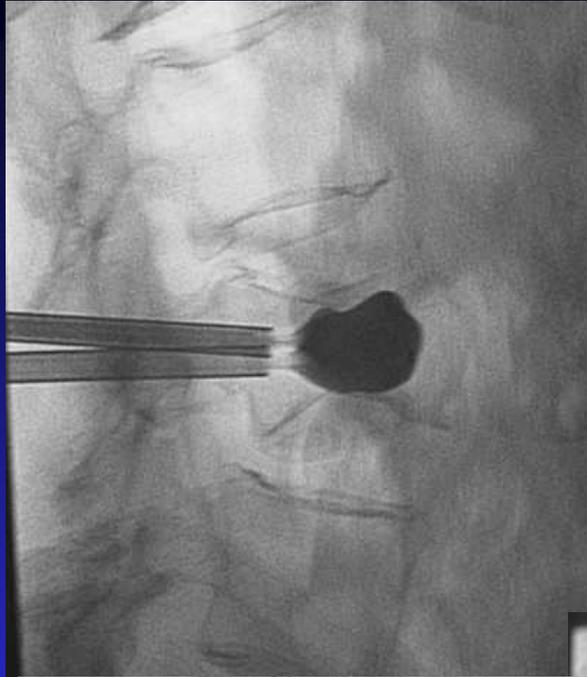
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W1 1730

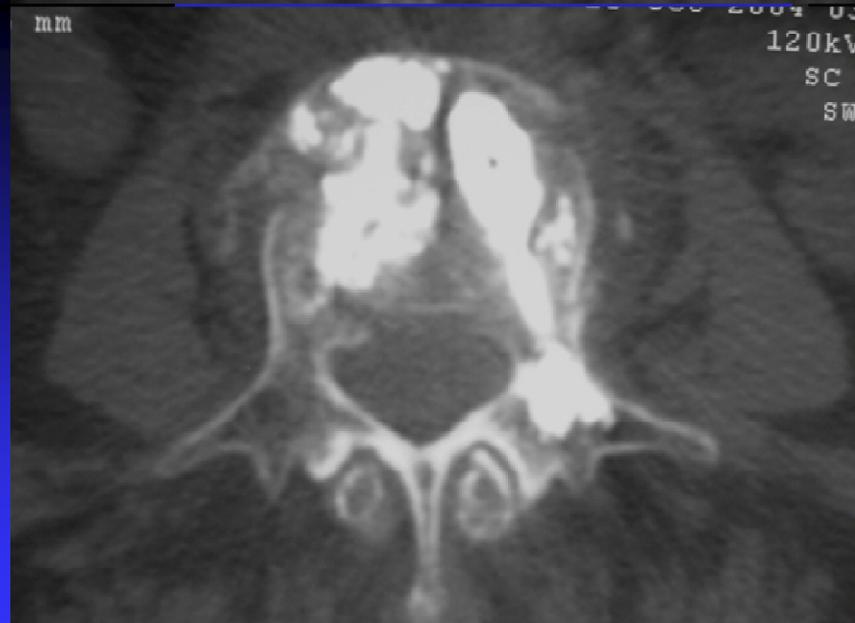
Before



After



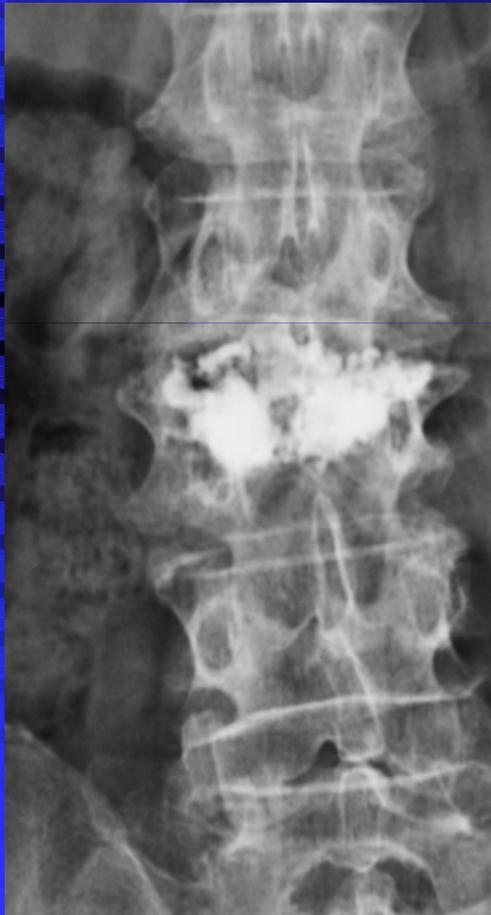




# Follow-up at 2 years

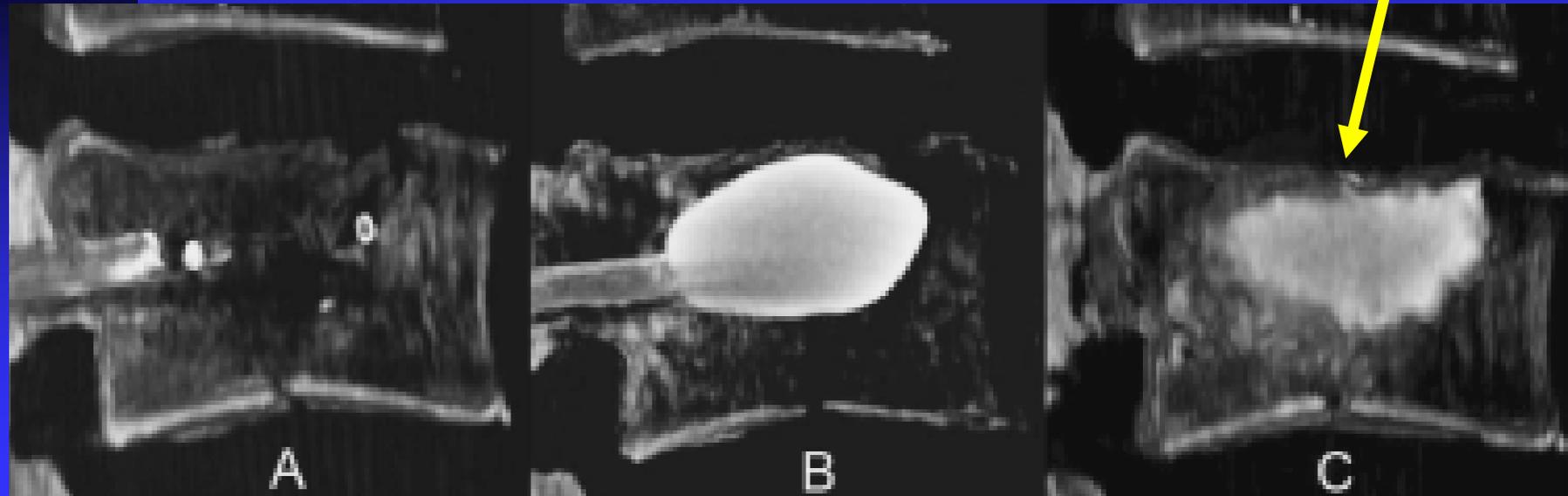
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07

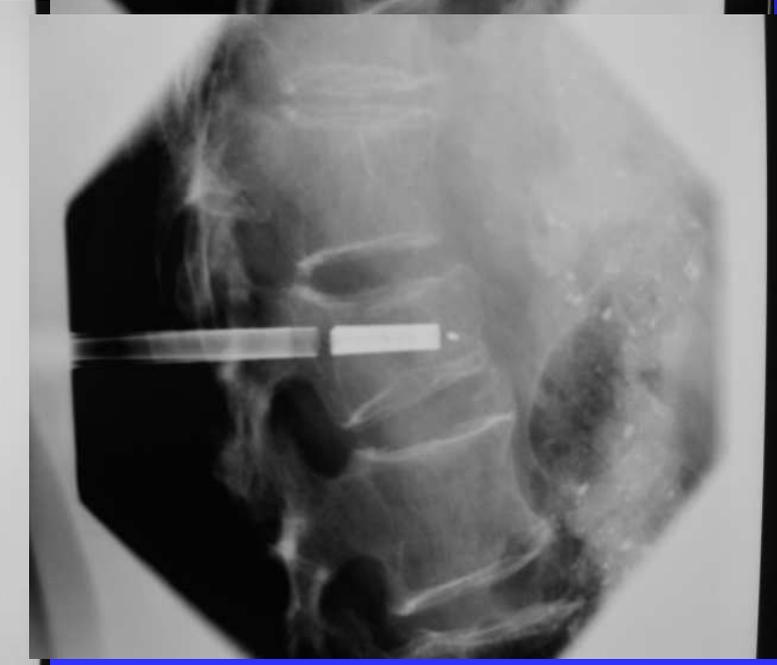
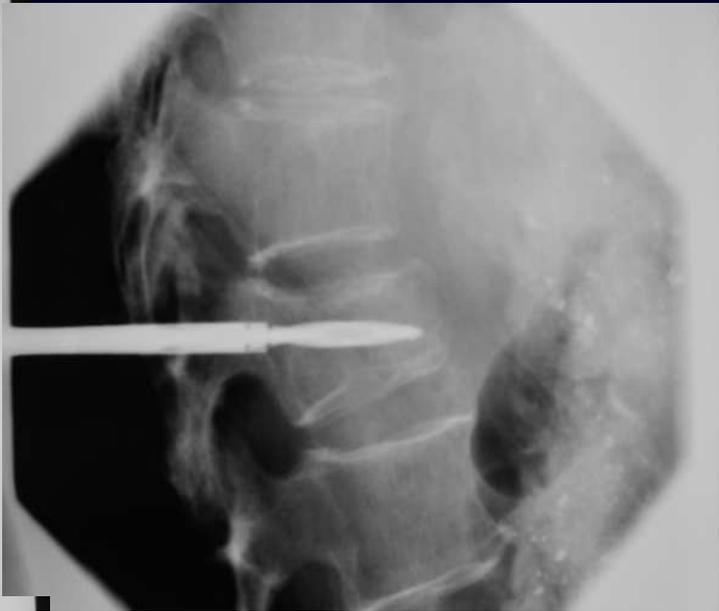


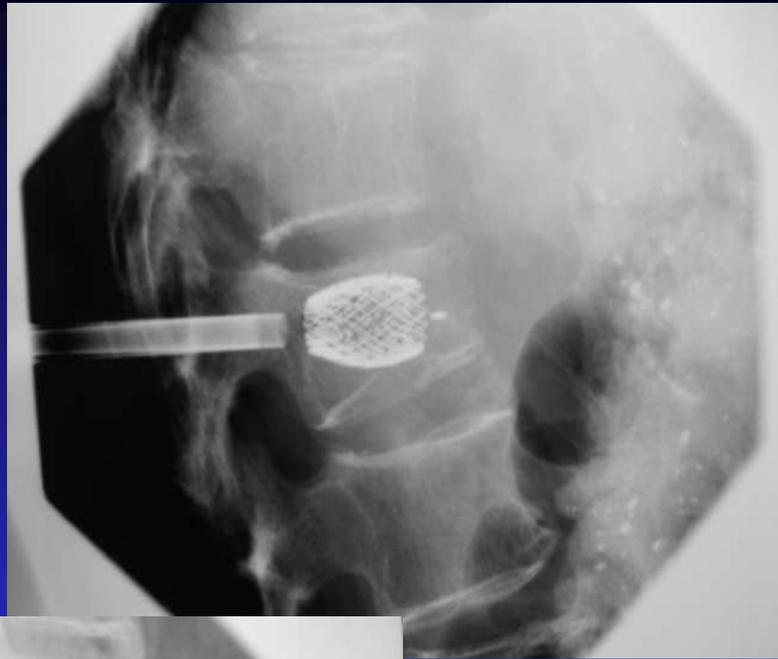
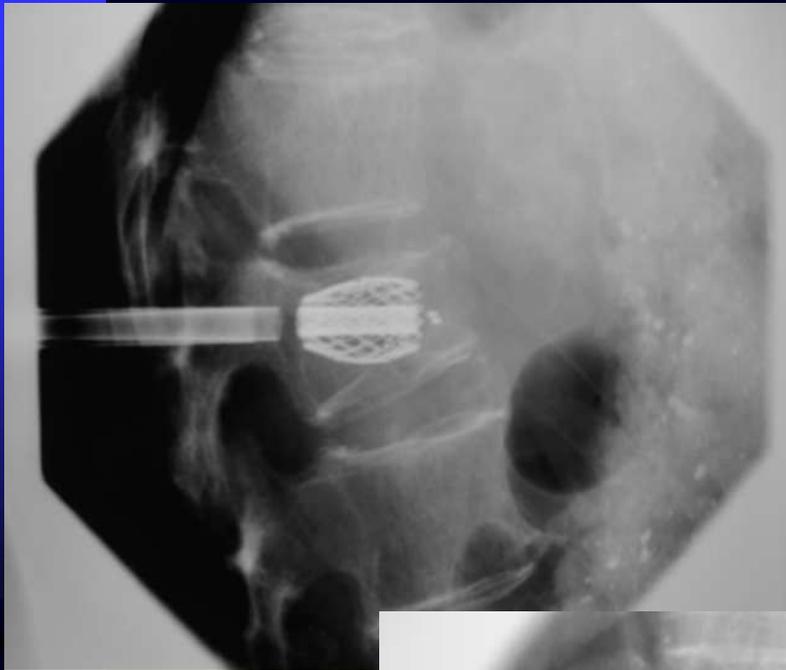
# Durability of Fracture Reduction

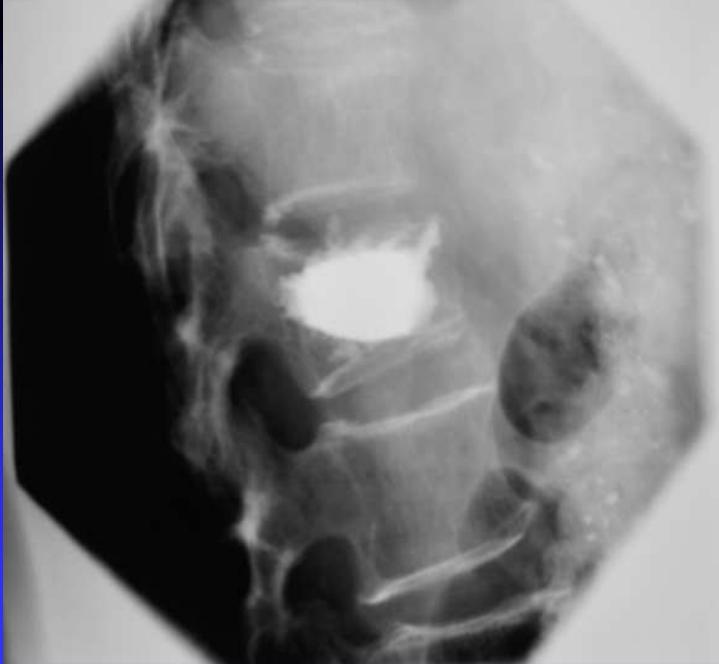
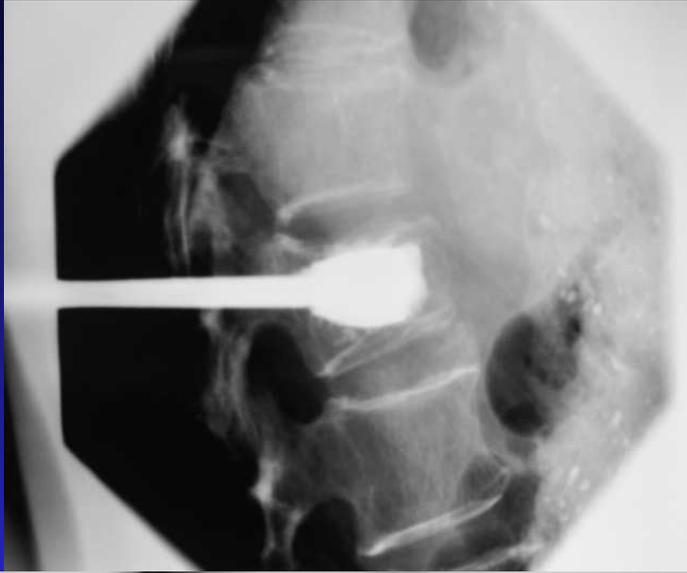
- Verlaan et al (Spine 2005)
- Reduction of endplate fractures was not maintained



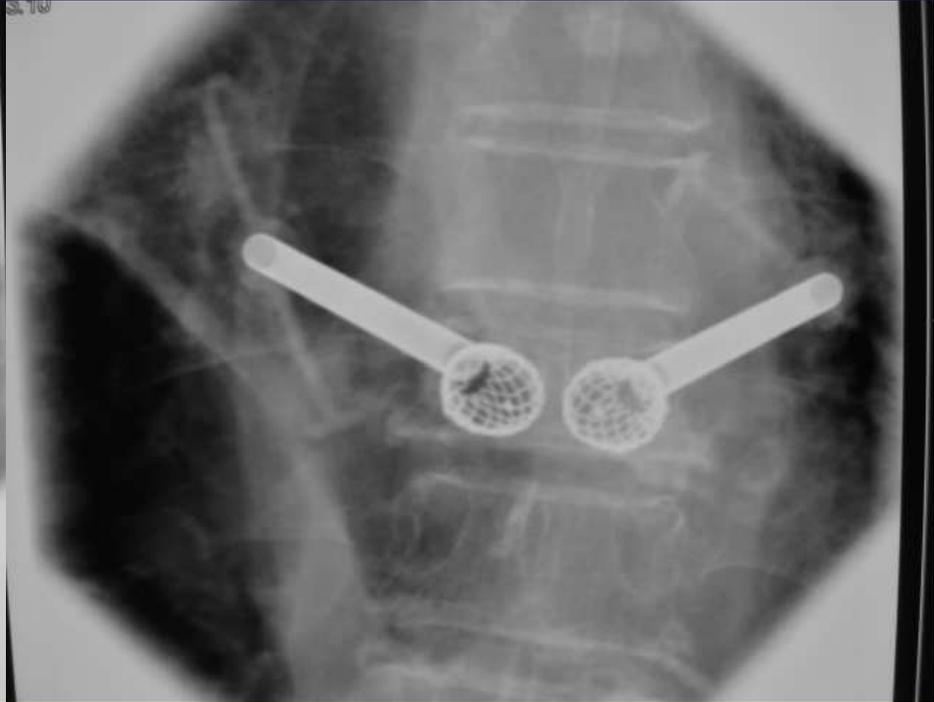
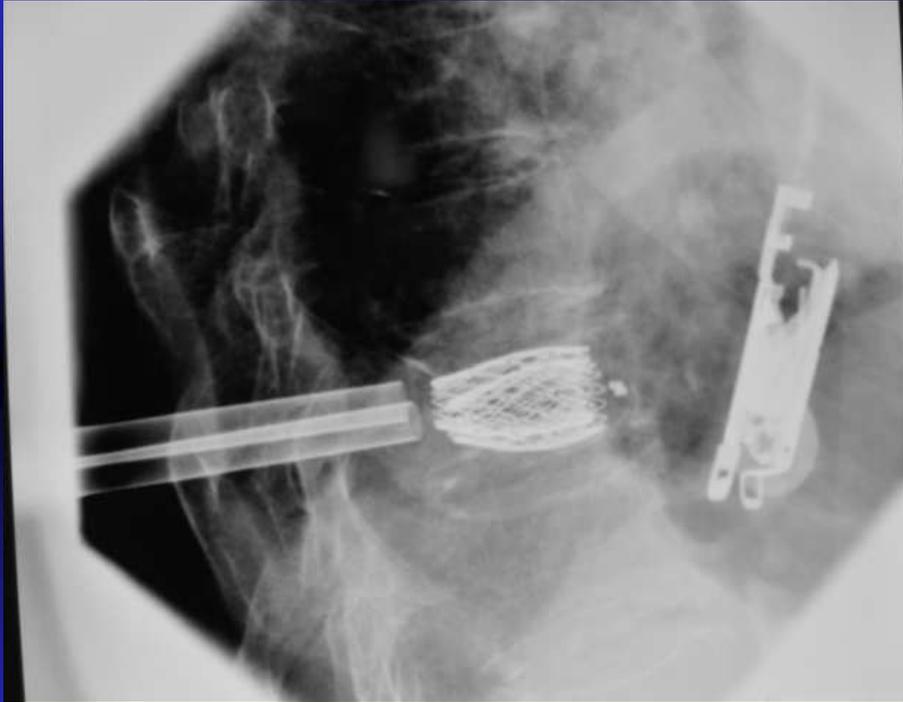


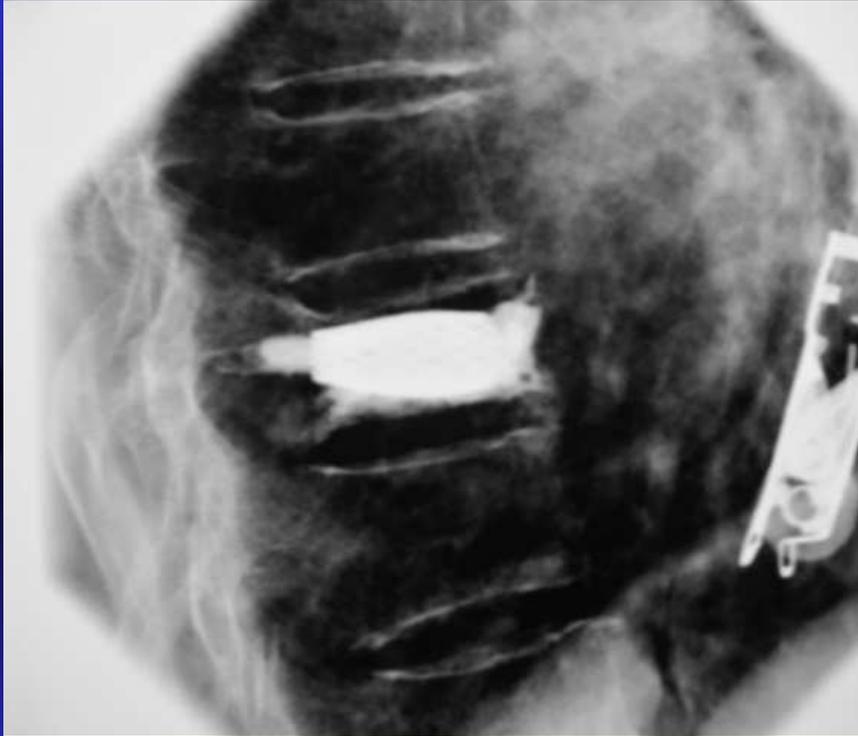




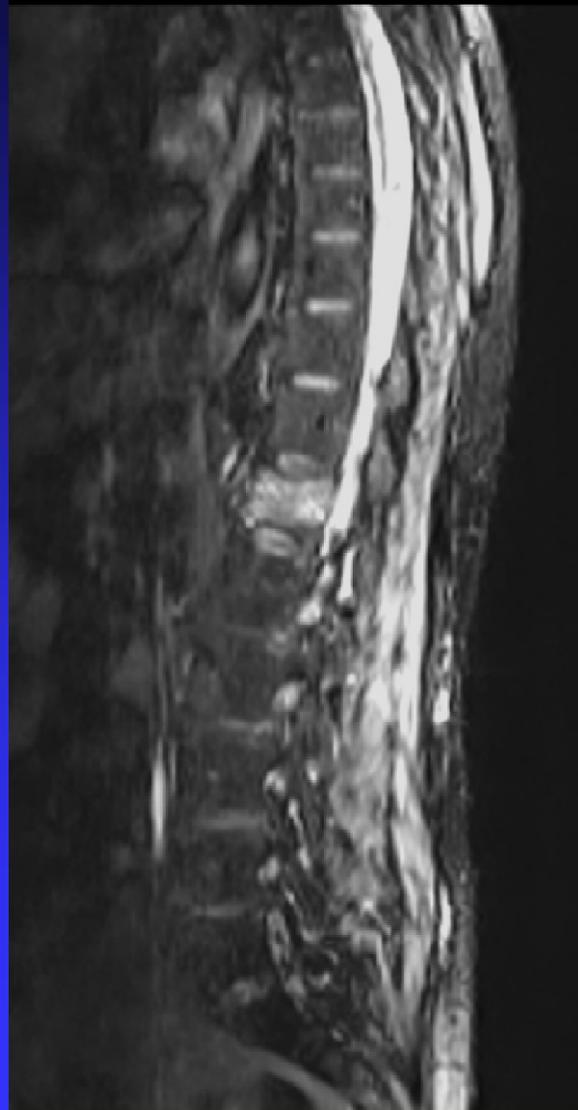




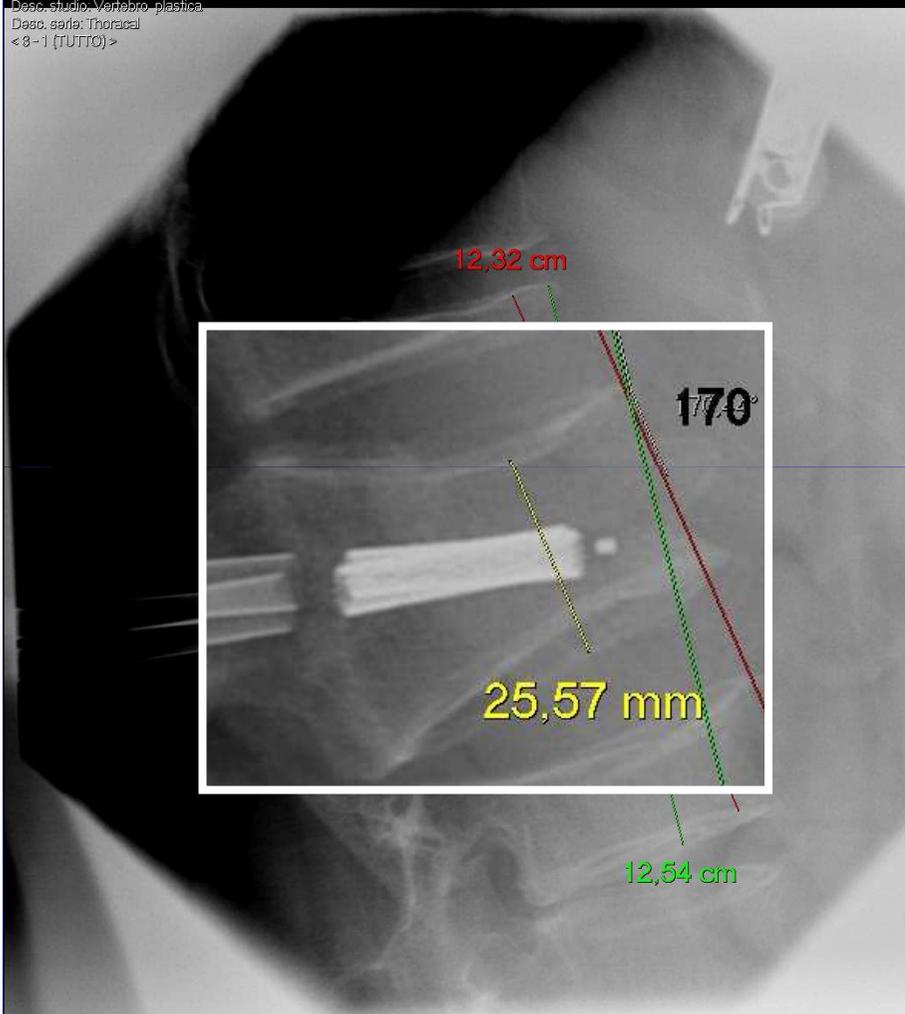




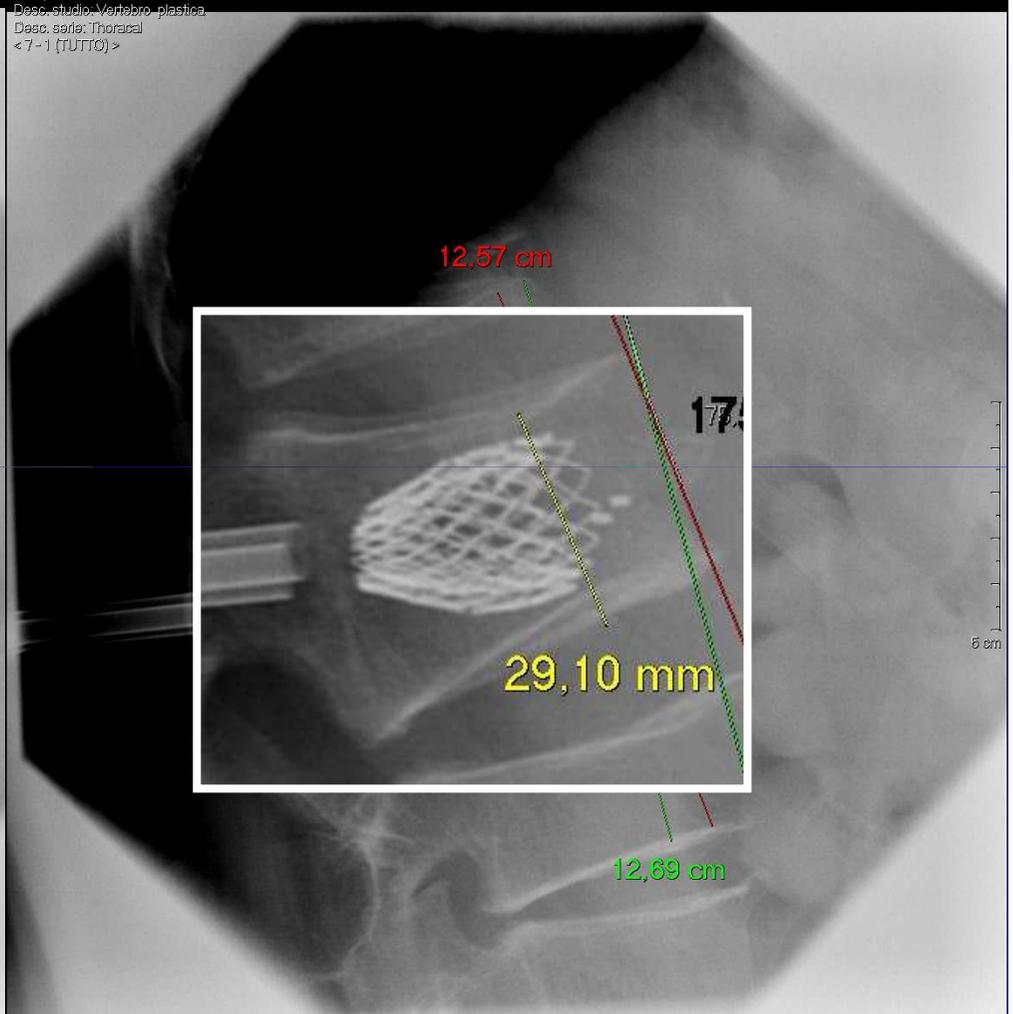
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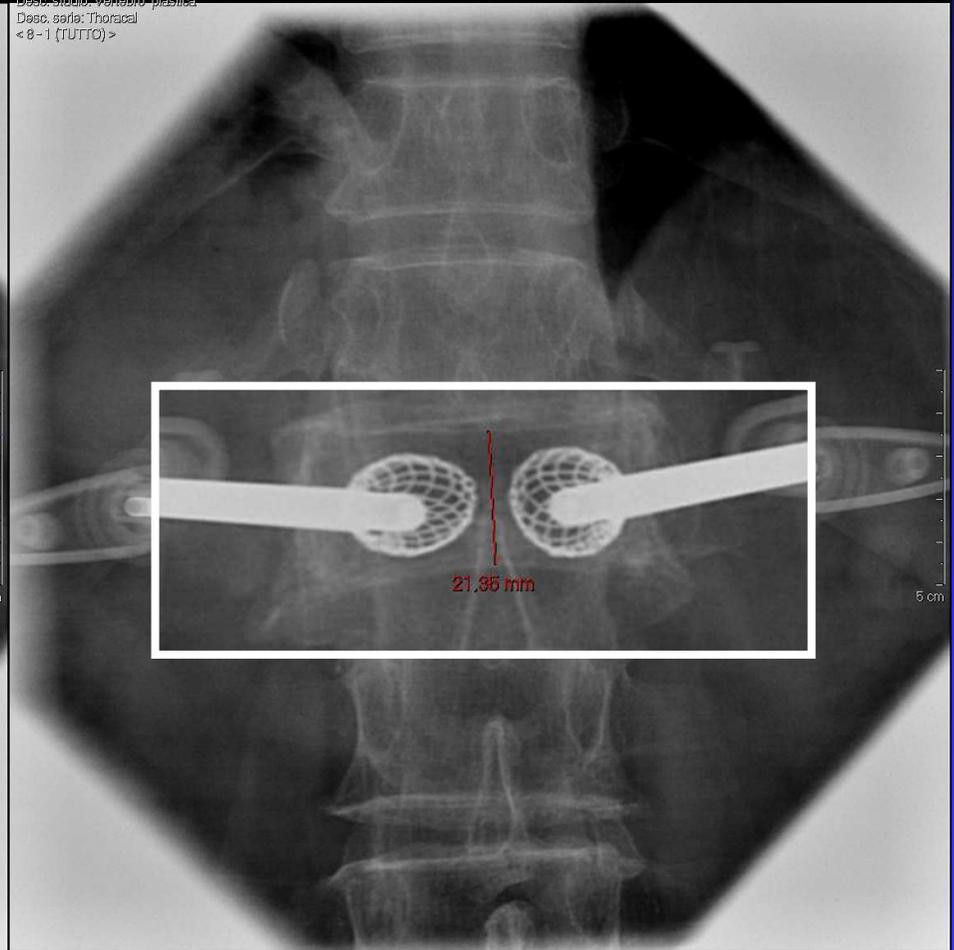
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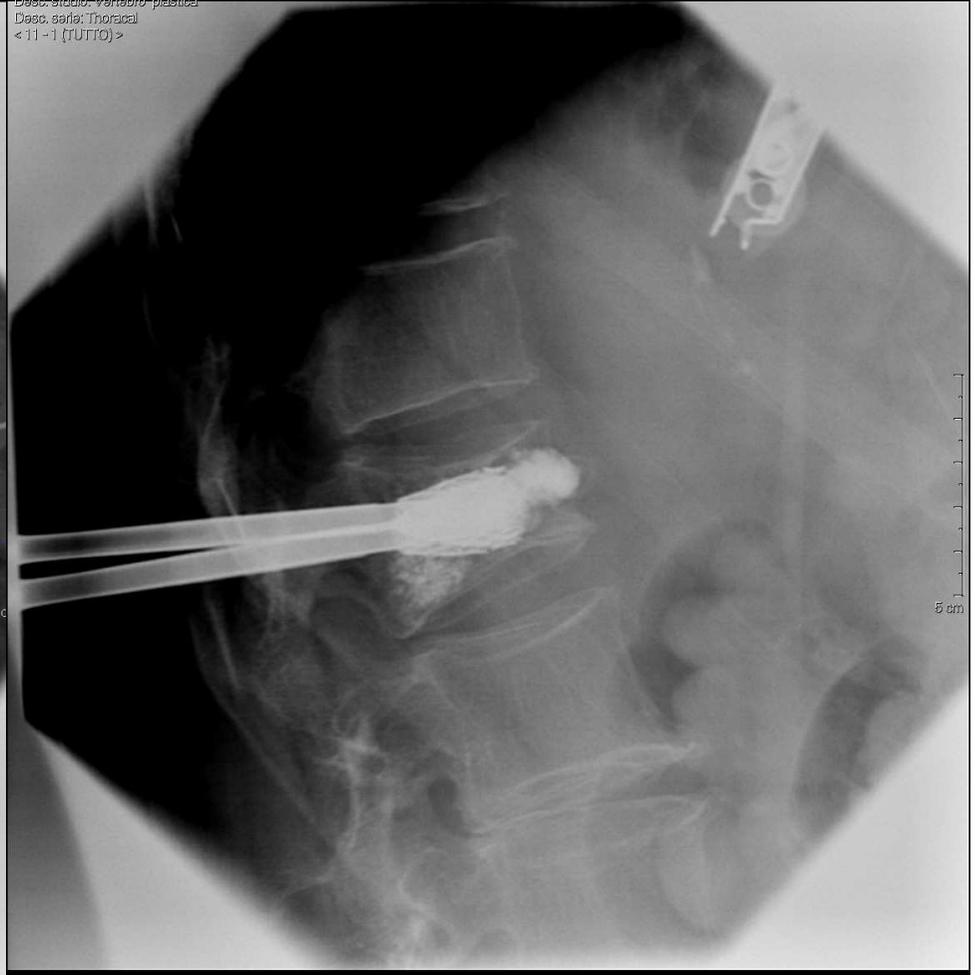
C 2048  
W 4096 3.90 RAO / 9.10 CAU

C 2048  
W 4096

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Desc. studio: vertebro-plastica  
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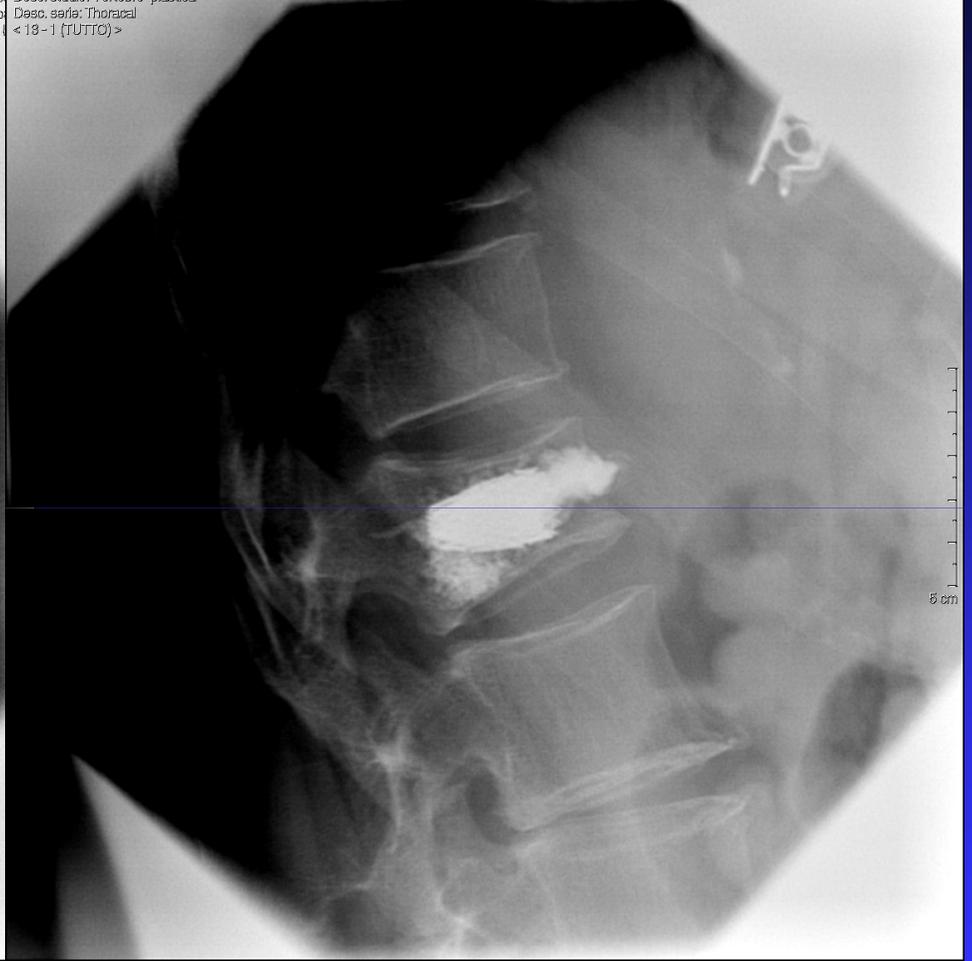


2.40 RAO / 10.10 CAU

C 20  
W 40.91.60 LAO / 0.00 CRA

C 2048  
W 4096

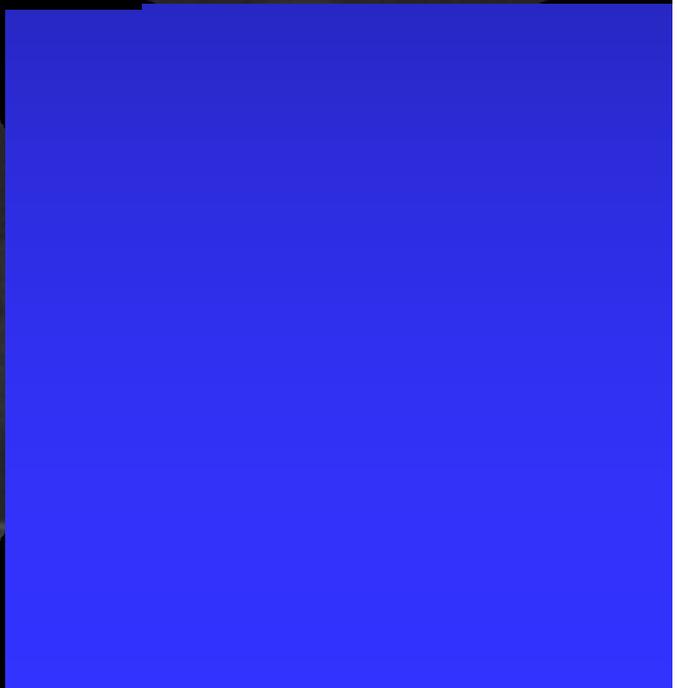
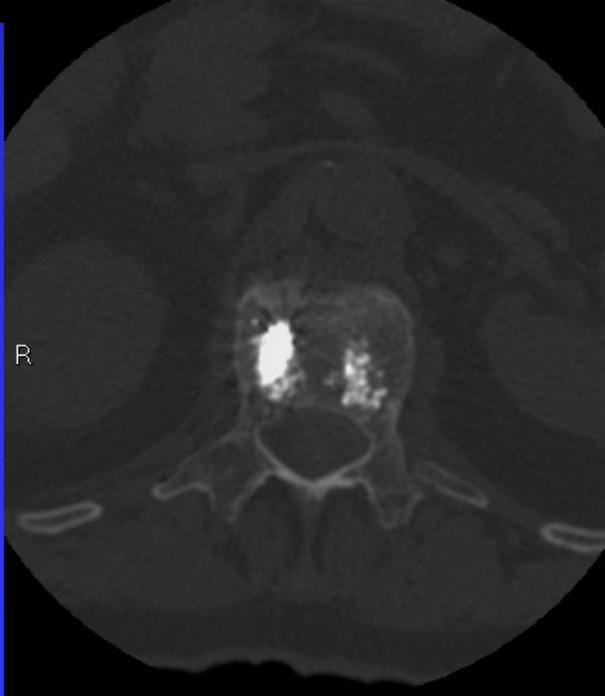
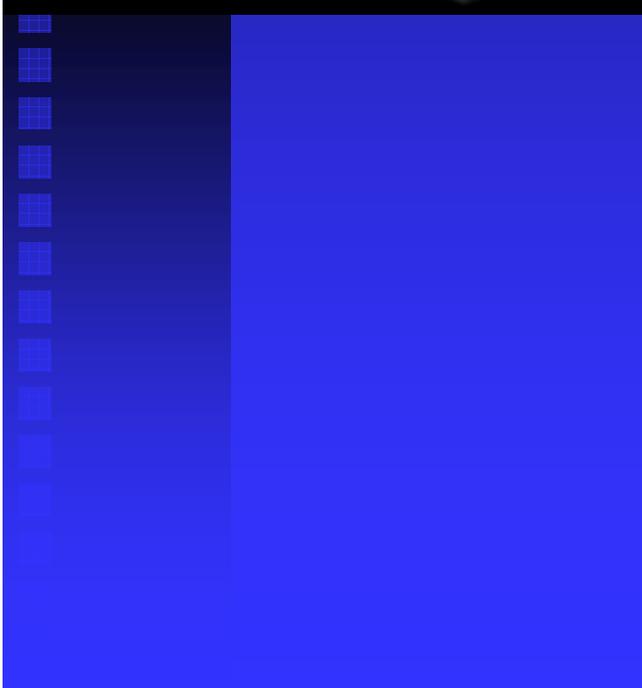
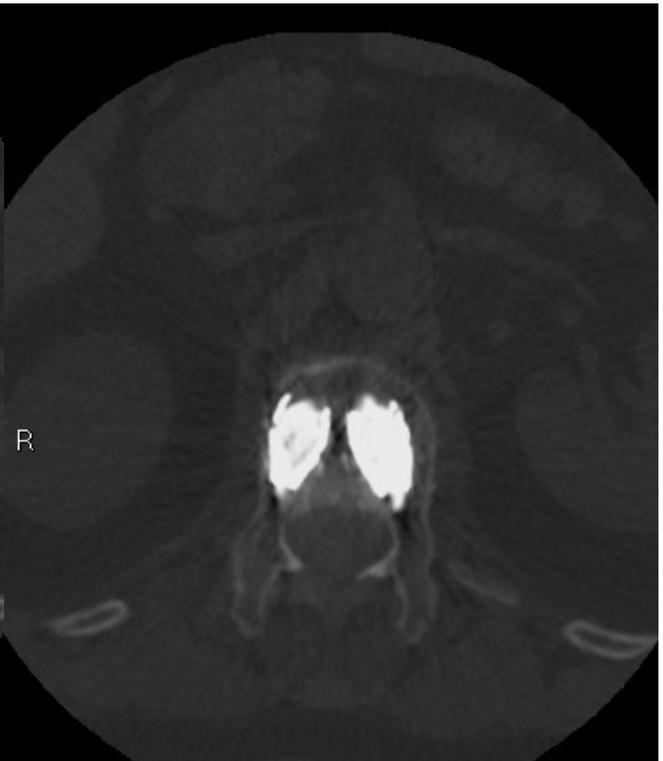
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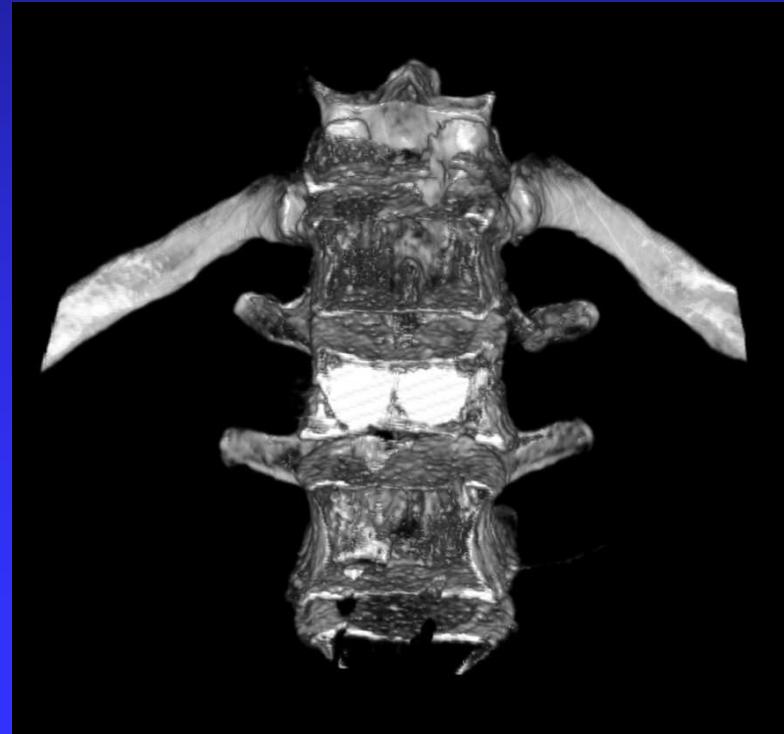


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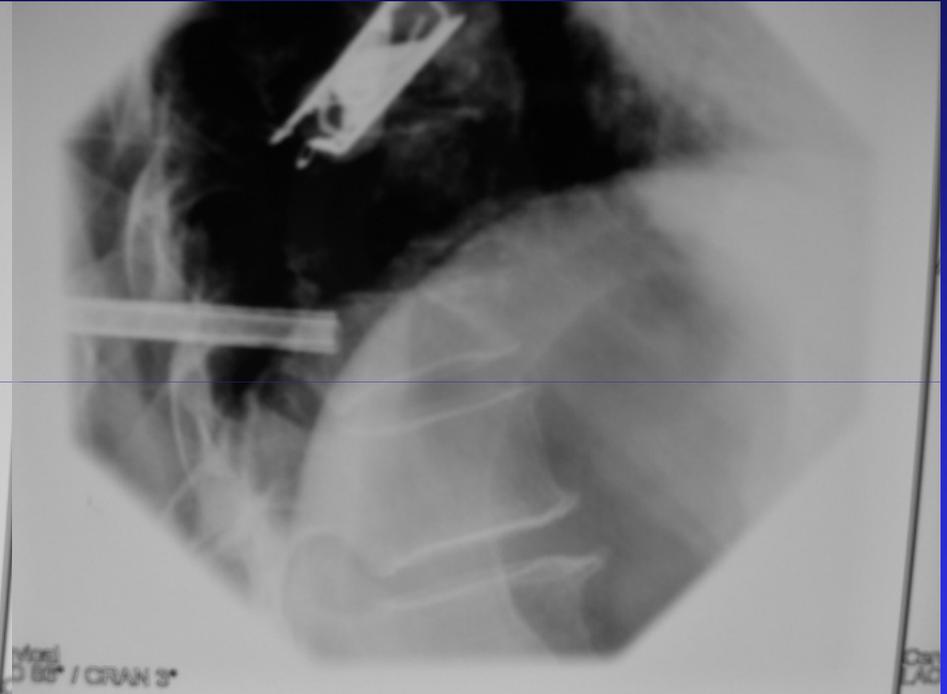
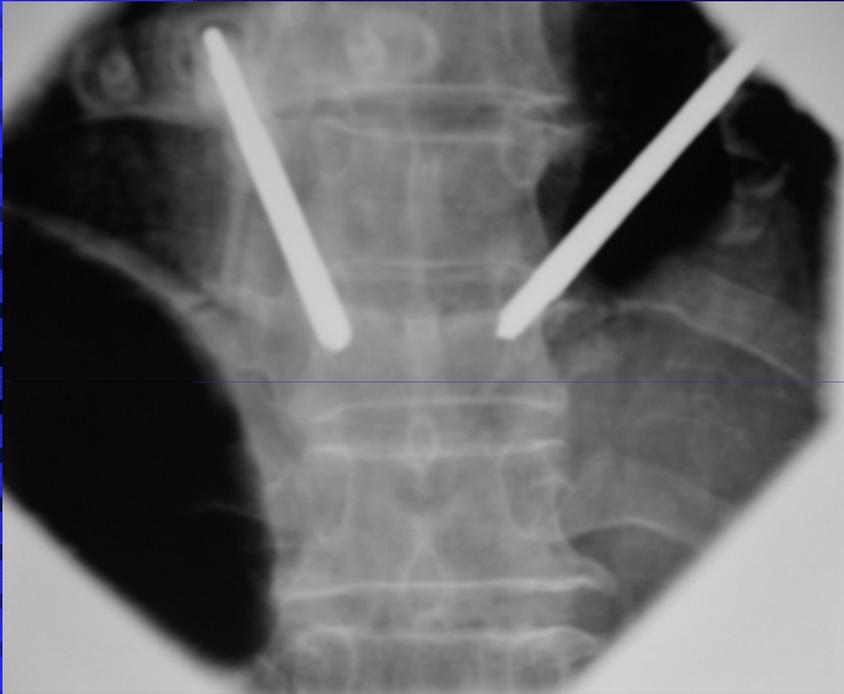
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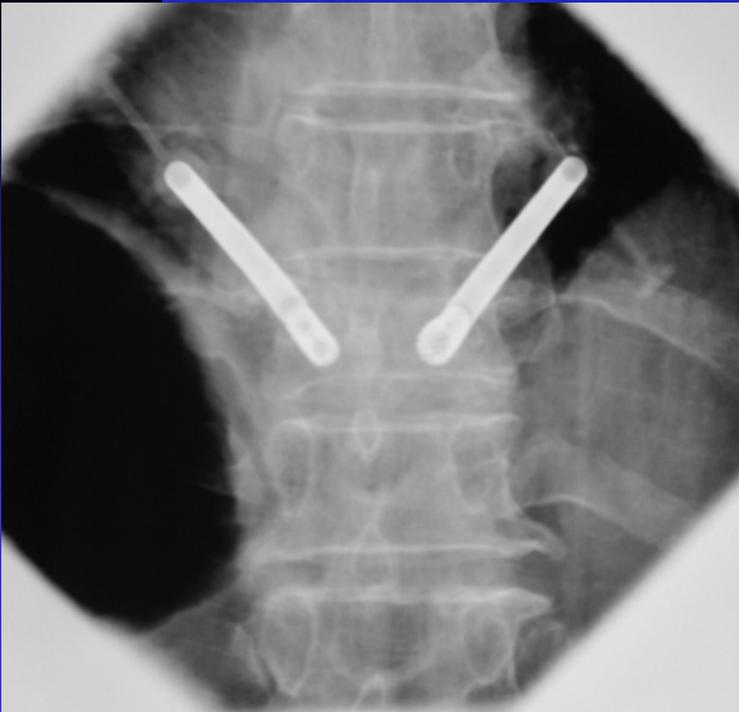
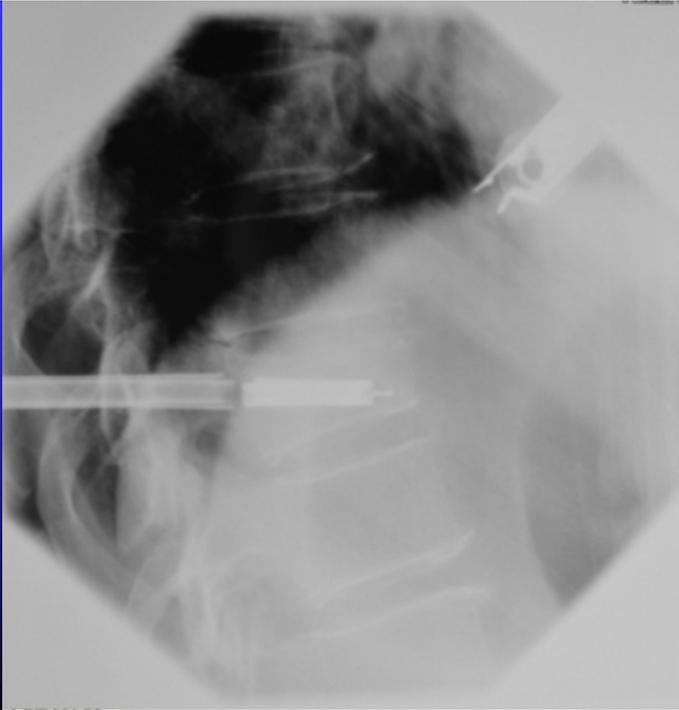




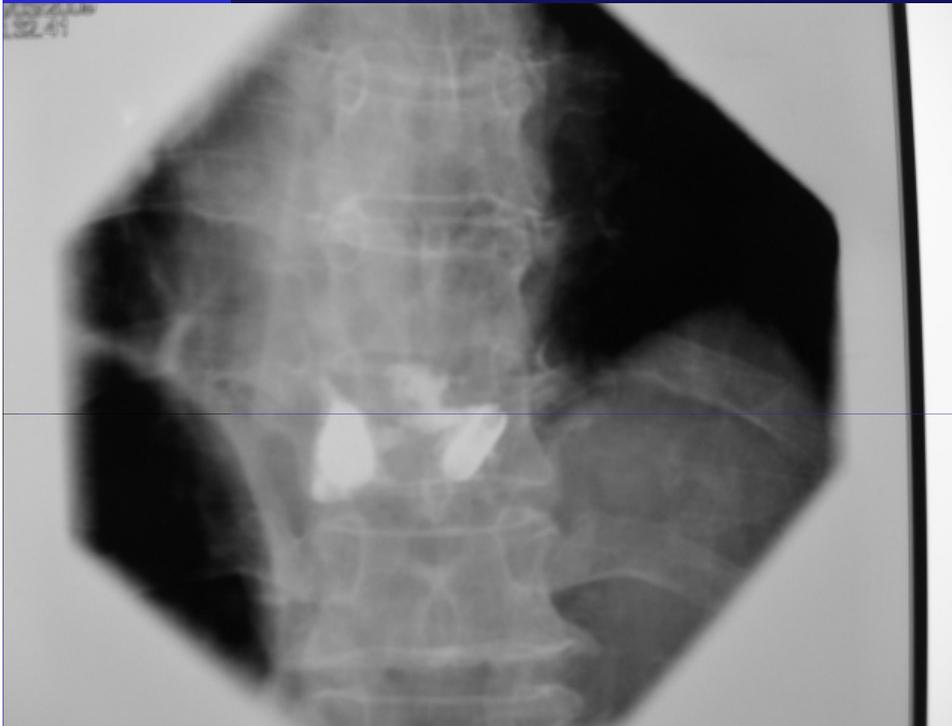
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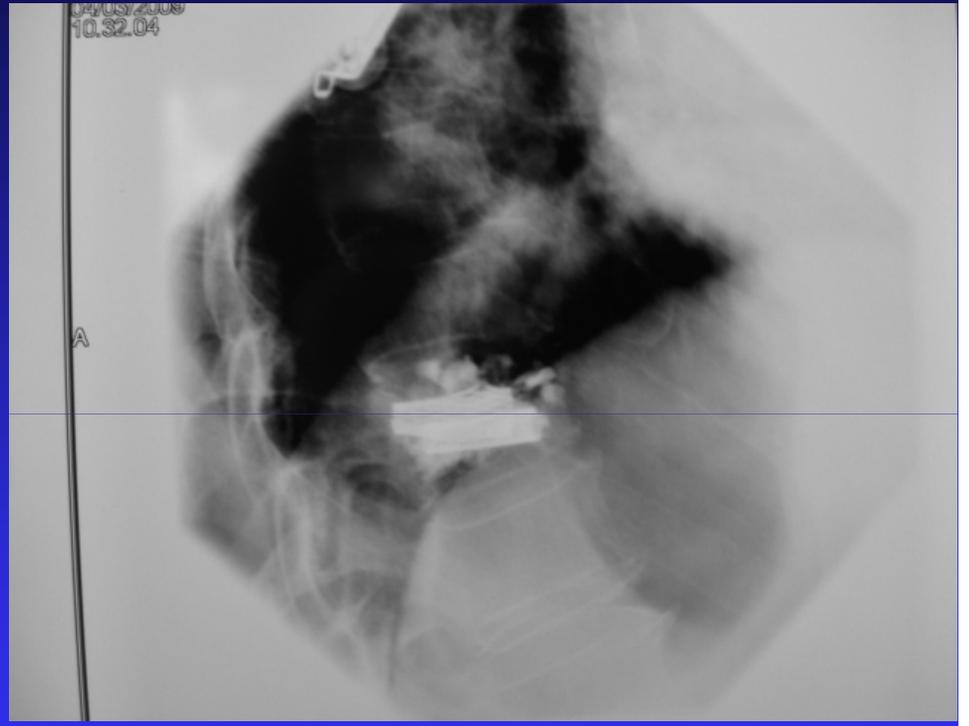


10.32.04



04/05/2008  
10.32.04

A



# New material

- Cerament
- Kryptonite
- Kyphos
- Active-Os

- Cerament Spine Support is a synthetic ceramic bone substitute which is Intended for augmentation of the vertebral body
  
- Component parts
  - ✓ CERAMENT™|CMI
    - ◆ Combined mixing and injection device
    - ◆ Pre-filled with ceramic bone substitute
  - ✓ CERAMENT™|C-TRU
    - ◆ Iodine based radio opacity enhancing component
  - ✓ CERAMENT™|DISTRIBUTOR
    - ◆ 8x1 ml syringes
  - ✓ Valve

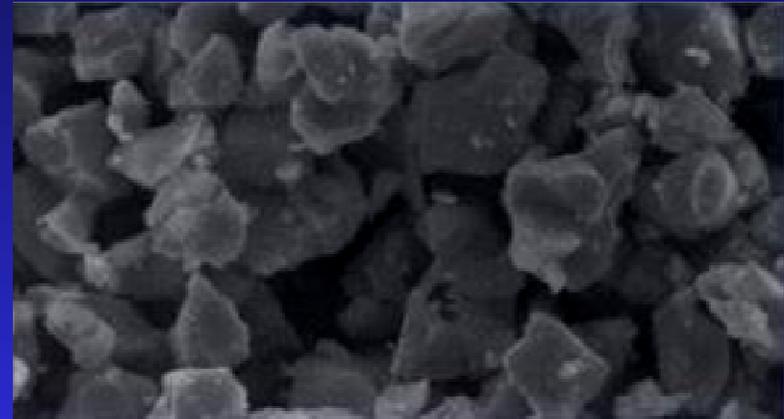


*$\alpha$ -calcium sulfate(60%)*

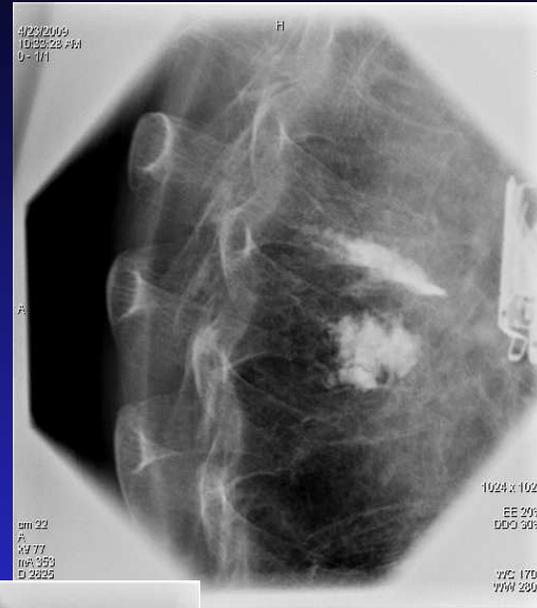
*hydroxyapatite(40%)*



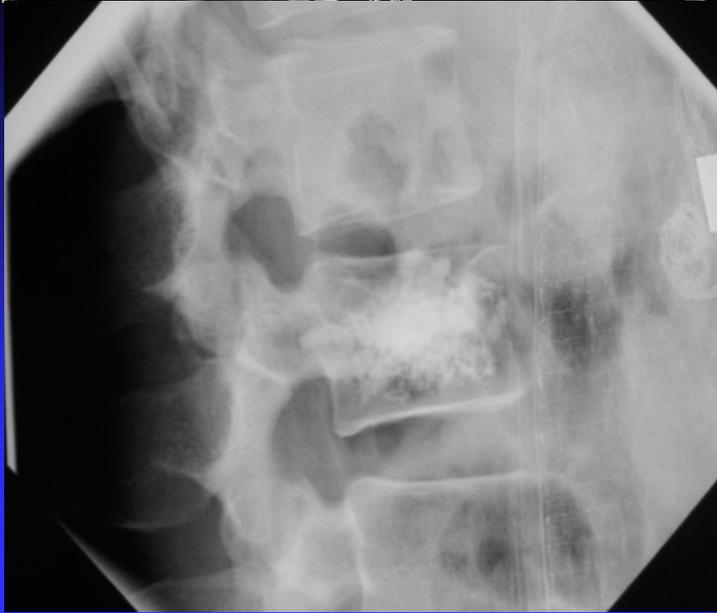
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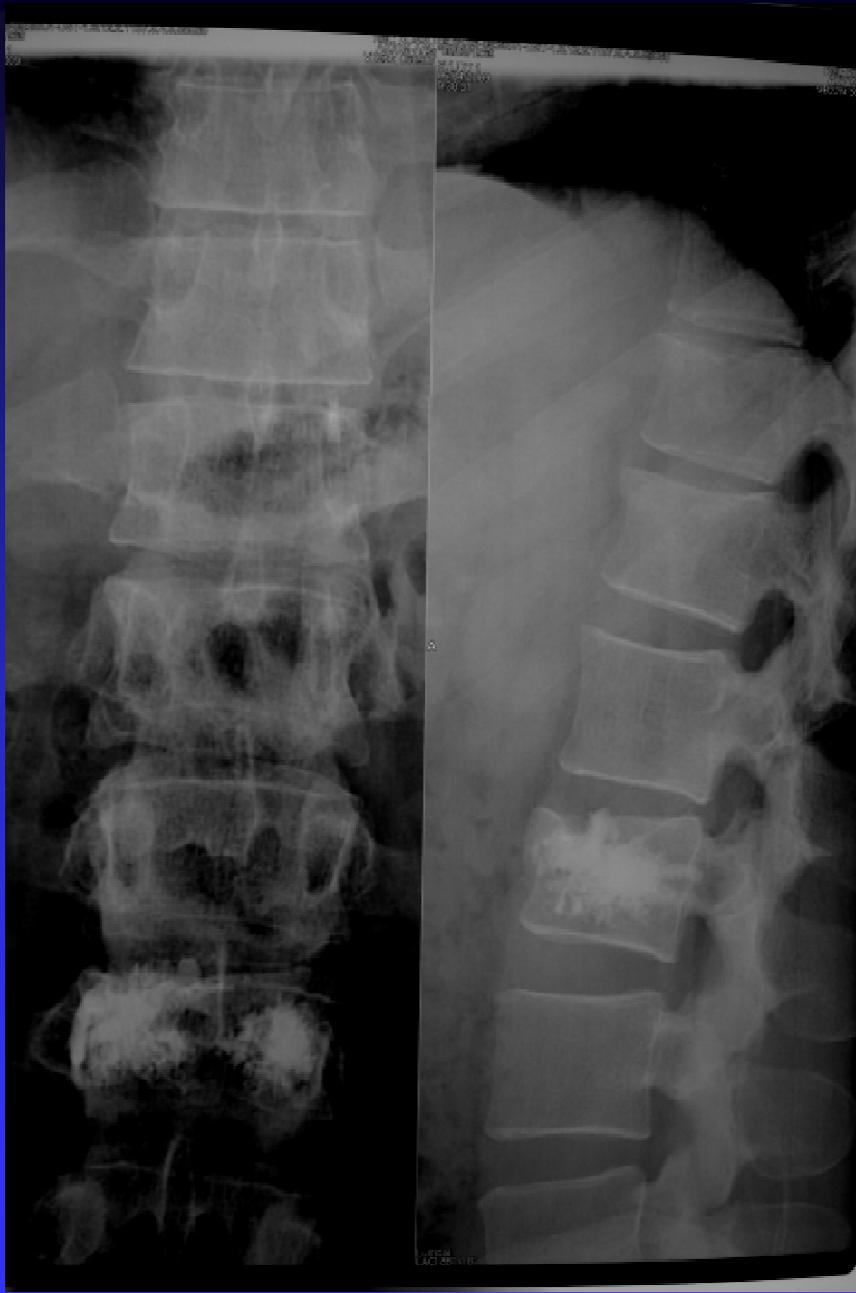








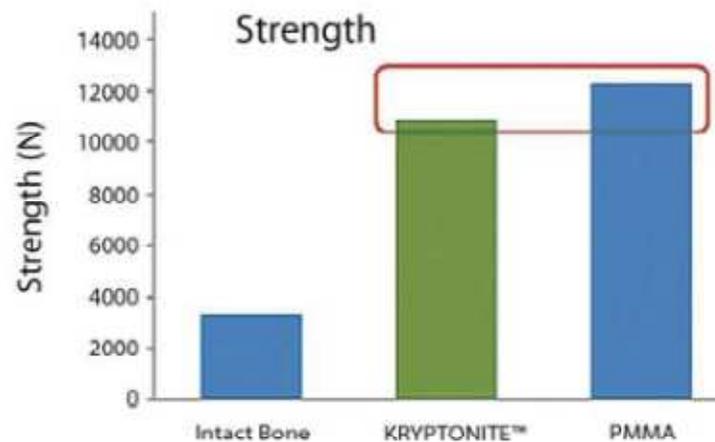




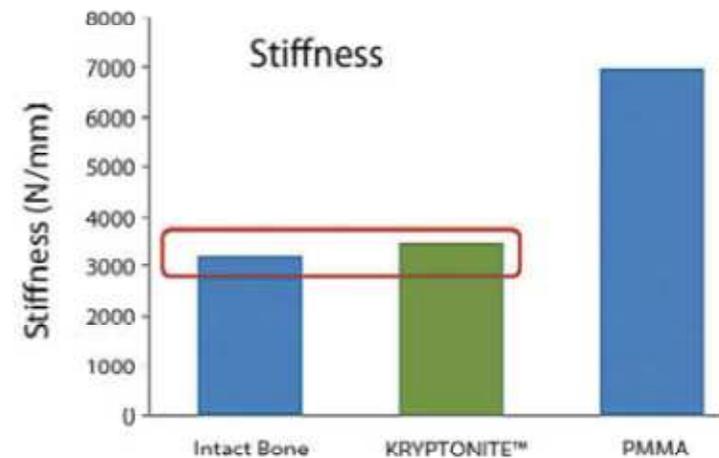
# Kryptonite. Osteoconductive.



Cadaveric bone specimens were augmented with KRYPTONITE™ OA and PMMA to assess their mechanical properties under compression. [2]



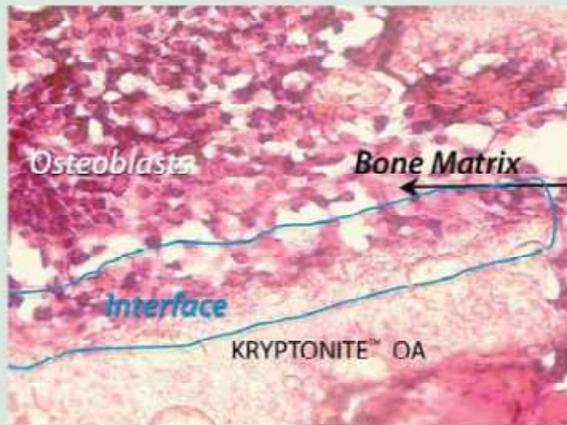
**Yield strength** of KRYPTONITE™ OA augmented specimens equivalent to PMMA



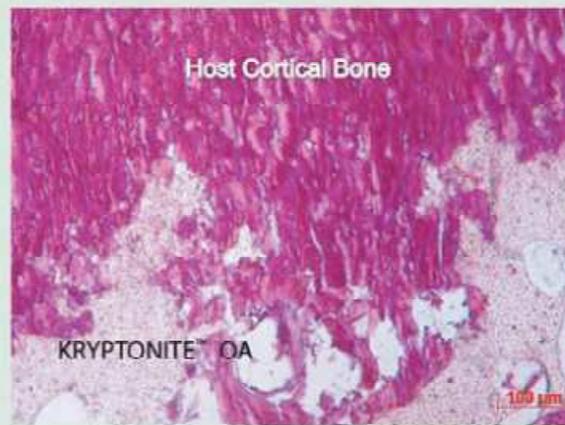
**Stiffness** of KRYPTONITE™ OA augmented specimens approximates that of intact bone

### Bony Ingrowth

Femoral defect in mouse model filled with PMMA and KRYPTONITE™ OA.  
Micro CT and histology studies conducted at intervals through one year. [5]



Osteoblasts grow and produce a bone matrix on KRYPTONITE™ OA

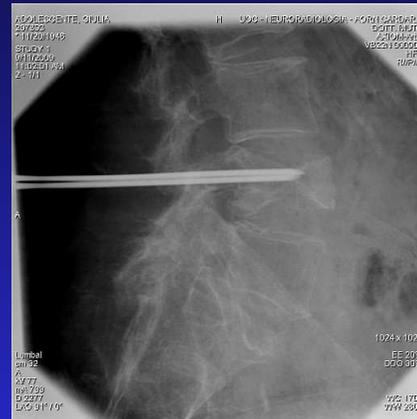


Complete integration of KRYPTONITE™ OA



Cortical-like bone in holes inside KRYPTONITE™ OA

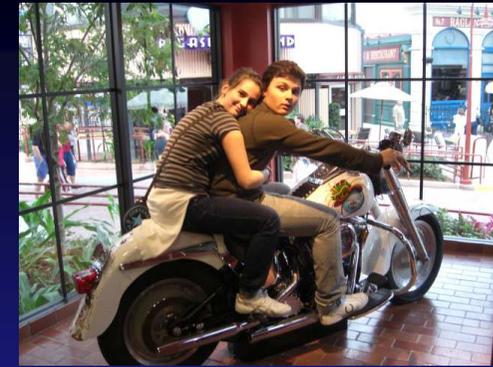
# Kryptonite



# Complications

- Infections (rare)
- Bleeding (rare)
- Pulmonary Emboli  
( frequent- rarely symptomatic)
- Local Trauma (spinal cord, pulmonar - rare)
- Increasing pain (1-2%)
- Vascular leakage of cement, frequent often asymptomatic
  - osteoporosis 2-5%
  - ◆ tumors 5 - 10%
- Paraplegia
- Death

# Conclusions



- In our experience major indications for KP is represented mostly by Magerl type A1 and selected A2 and A3 fractures with a better morphological cement distribution compared to VP
- New device for KP are coming out with reduced cost and smaller cannula.
- New material associated to KP can help to recover giving good stiffness and resistance similar to normal bone.