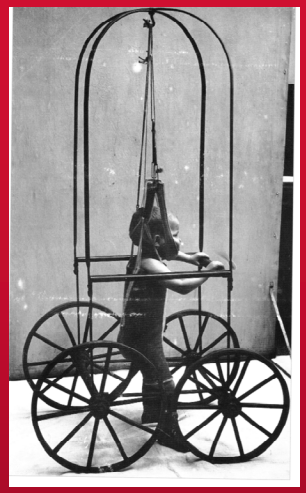
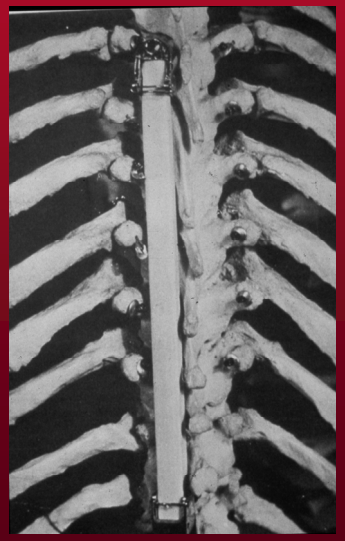
Early Onset Scoliosis – 50 years back and 50 years forward



David S Marks FRCS, FRCS(Orth)
Consultant Spinal Surgeon
Department of Spinal Surgery
Royal Orthopaedic Hospital
Birmingham Children's Hospital
Birmingham
England

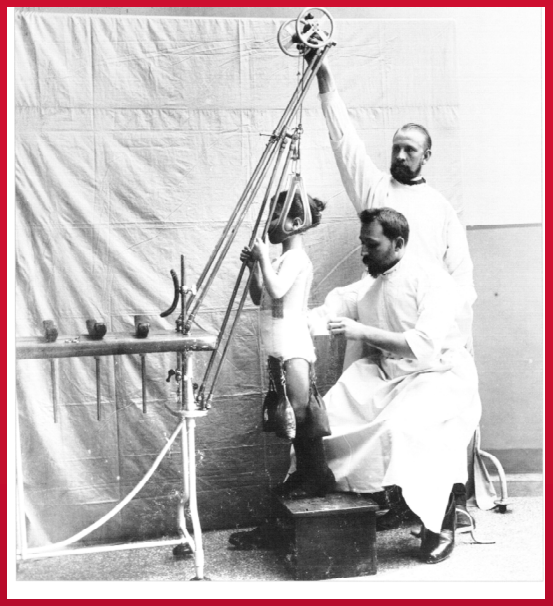


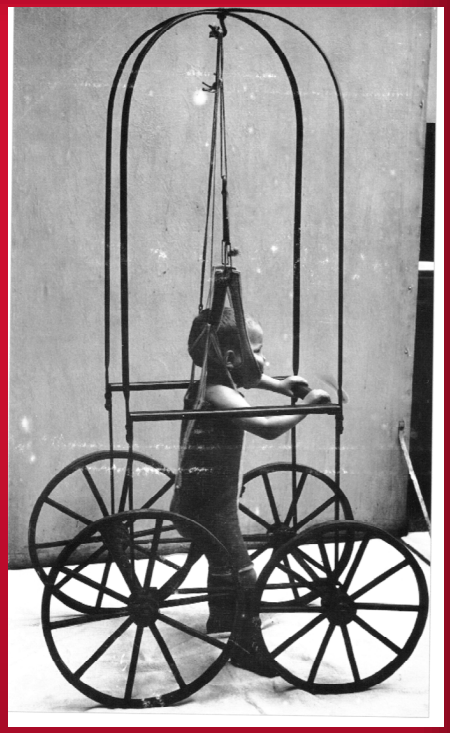
1817

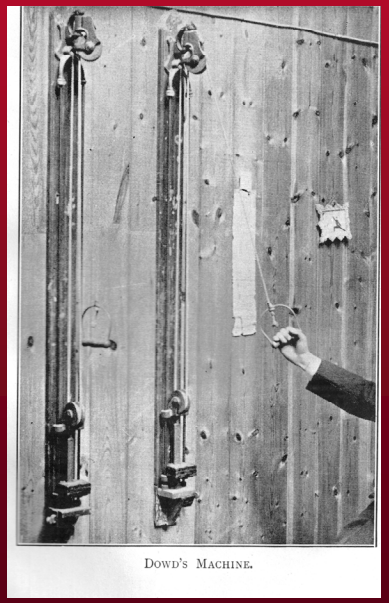
1856

Historical

- Sporadic case reports
- No MRI / CT
- Basic genetics
- No reliable implants
- Soft tissue releases
- Limited fusions
- Plaster / Casting
- Elaborate external correction apparatus
- Exercise / diet / fresh air !!







Dowd's Machine.

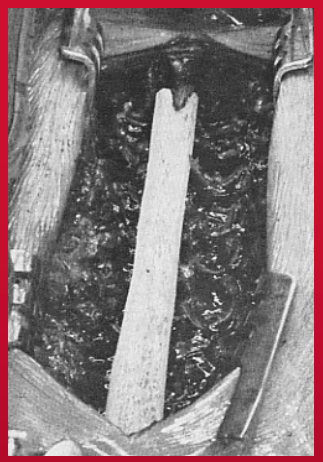
Exercise for left Erector Spinæ. (First Position.)

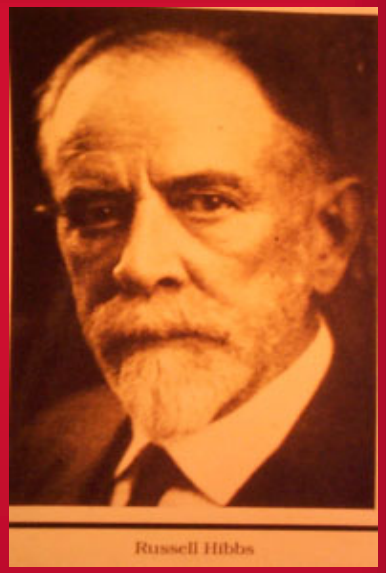
Exercise for left Erector Spinæ. (Second Position.)

Pre - 1957

- Hibbs 1911 fusion (later soft tissue releases)
- Kuhns 1934 ‘Congenital scoliosis without significant bone changes’
- Harrenstein 1936 ? Ricketts
- Blount 1948 Milwaukee brace
- J I P James 1951 Infantile Idiopathic Scoliosis

James JIP 1951 JBJS 33B 399





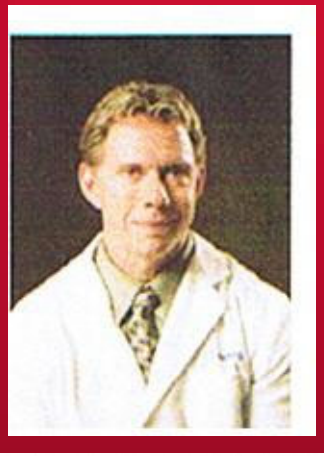
Polio (1920's)

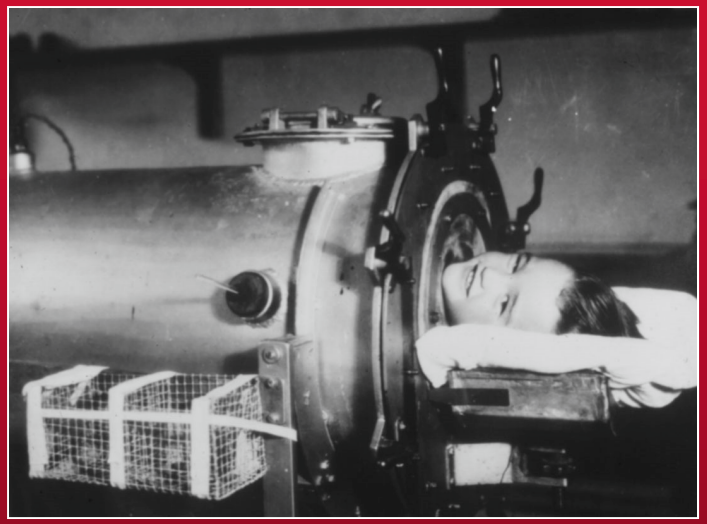
Pre - 1957

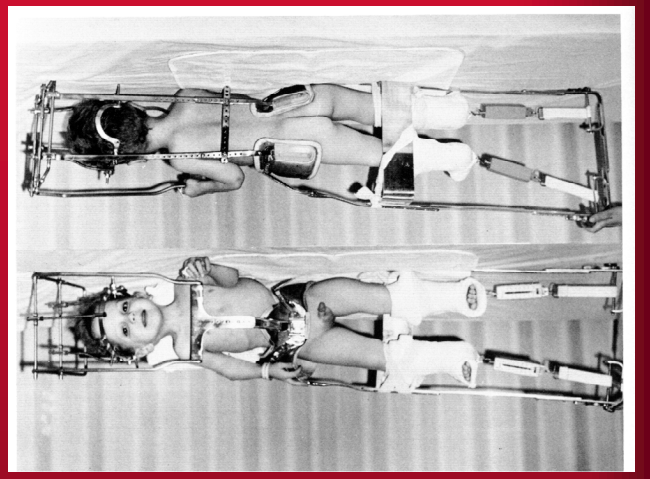
Risser

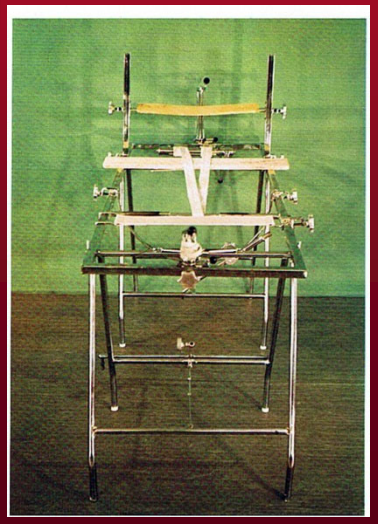
Risser JC 1948 Am Acad Orth Surg 5 248 -60

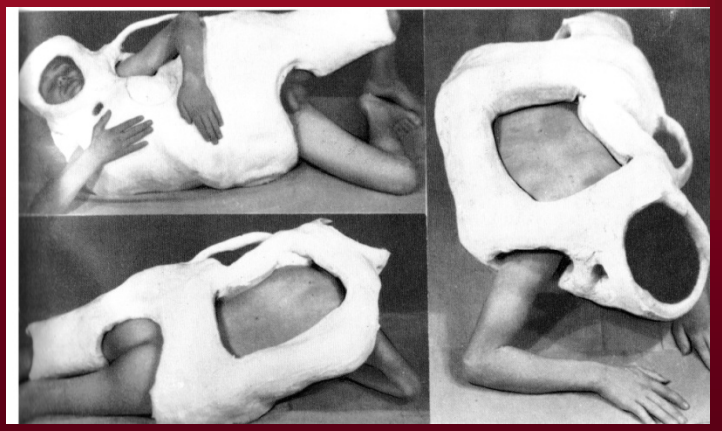
Traction

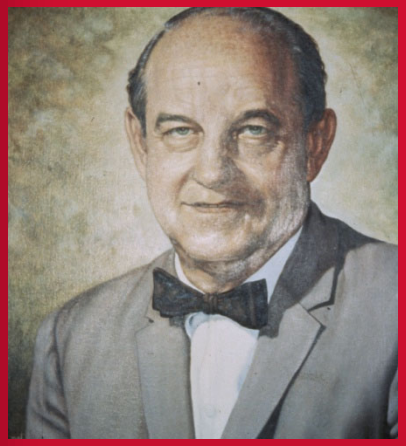




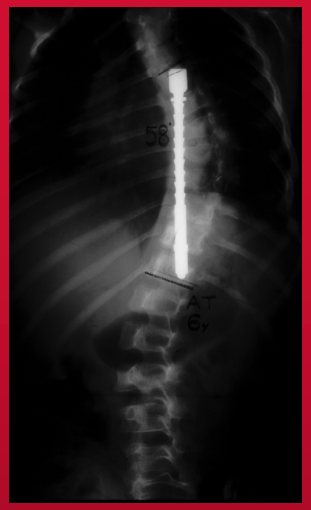


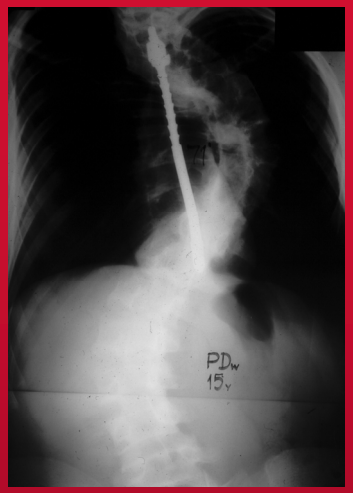


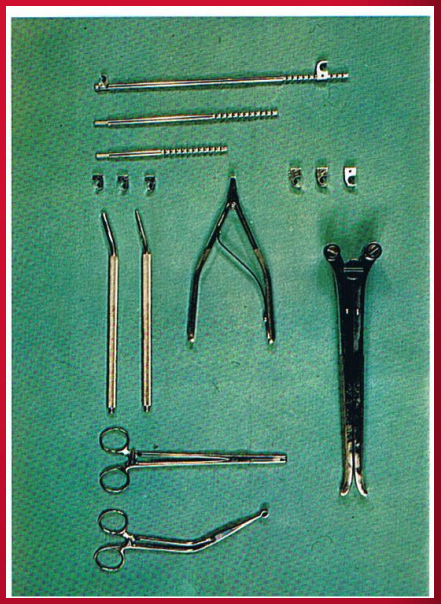




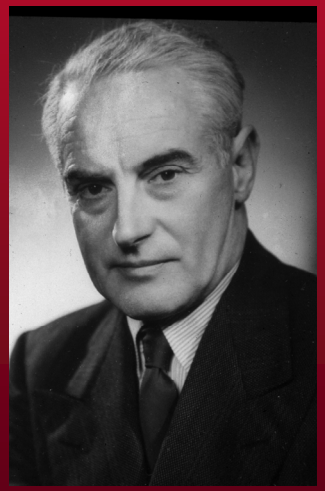
1957 - 1965

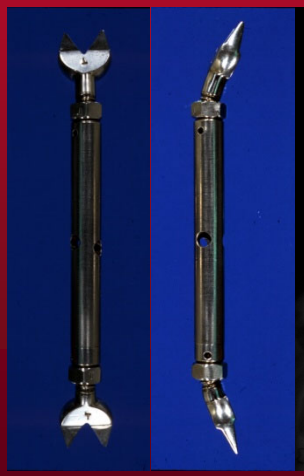






- Harrington 1963
- Allen 1963
- Roaf 1964 Growth Arrest for IIS
- Lloyd-Roberts Pilcher 1965 Progressive and resolving types IIS





Lloyd-Roberts, Pilcher 1965 JBJS 48B 520

1966 - 1975

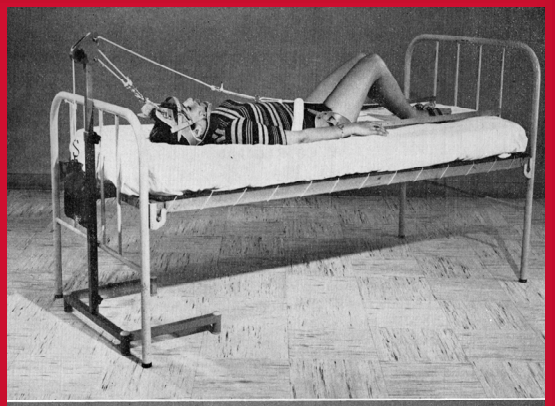
Cottrel 1968 (dynamic traction)

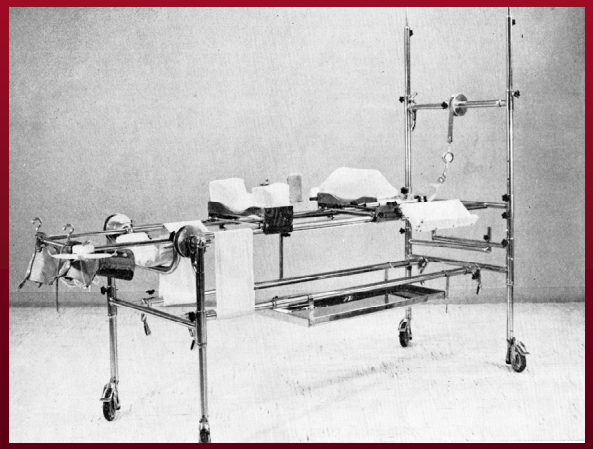
1973 EDF cast and fusion

Wynne-Davies 1967 (plagiocephaly)

1975 (CDH / CHD / Breech

low birth weight)





1966 - 1975

Tanner 1970

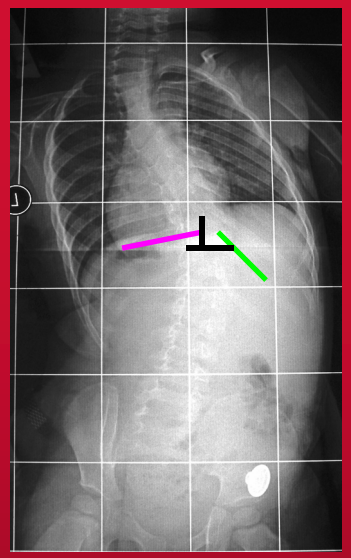
Duval-Beaupere 1971

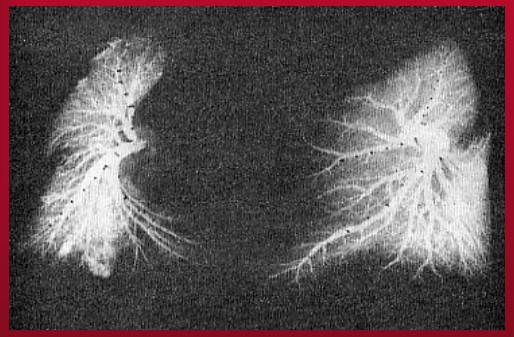
L Reid 1971 Growth of the cardio-respiratory system

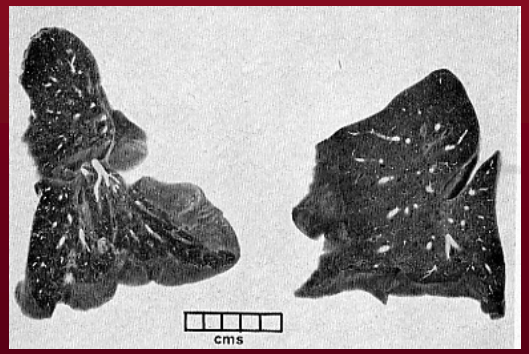
Arch disease childhood 46 - 623

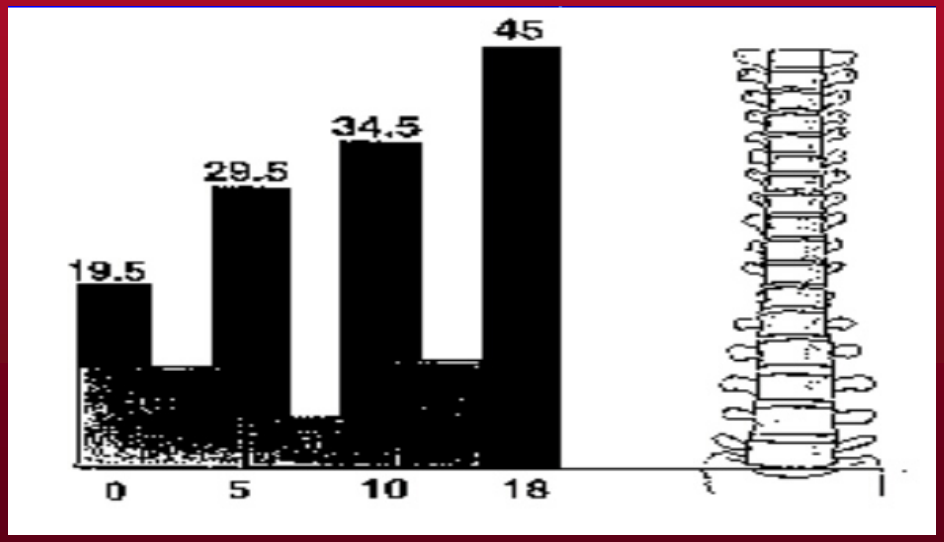
Metha 1972 RVAD 20º

JBJS 54B 230 - 243









From work by Dimeglio et al 1995

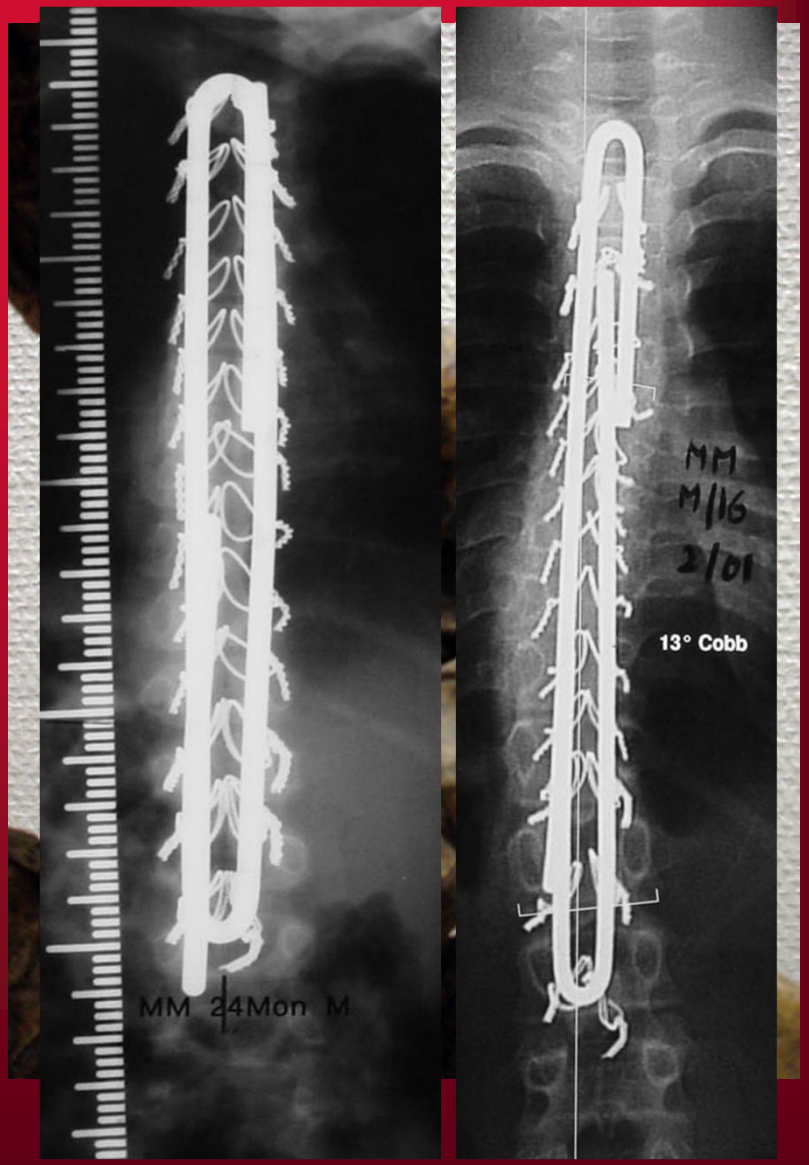
1976 - 1985

- Stagnara 1976 (muscular cellular changes in IIS)
- Moe SRS 1978 (non-fusion)
- Leatherman 1979
- Watenabe / Stokes 1980's
- Luque

- Dickson 1984

Early Onset Scoliosis

Dickson RA JBJS 66B 8 - 15

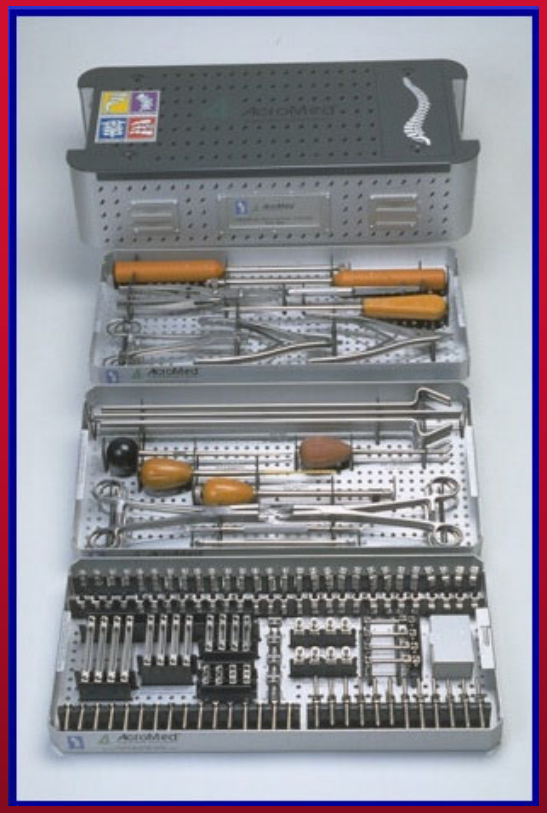


1986 - 1995

Pehrsson 1992 Long term follow-up of patients with untreated scoliosis : A study of mortality, cause of death and symptoms

Spine 17 1091 - 96

MRI



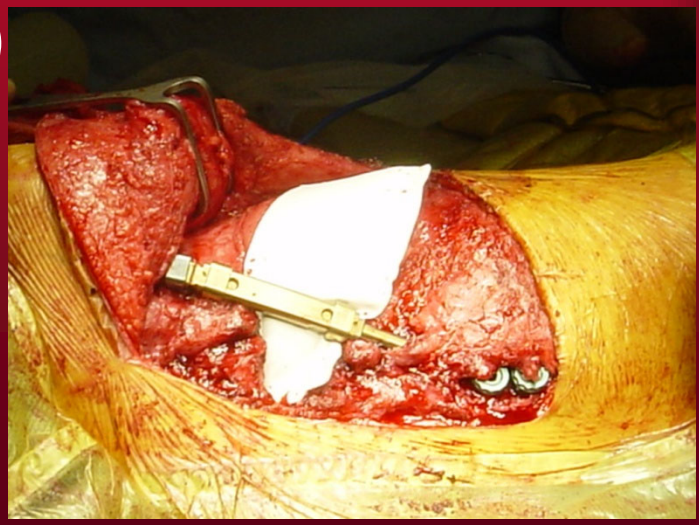
Advent of dedicated paediatric Systems (ISOLA / Synergy / CD Instrumentation without fusion

1996 - 2005

- Klemme 1997 long term follow-up of Moe's cases of HR instrumentation without fusion

  Klemme et al JPO 1997 17: 734-742

- Campbell 1996 Thoracic Insufficiency
- Freeman et al 2003 (L. trolley)
- Akbarnia et al 2005 (growing rods)



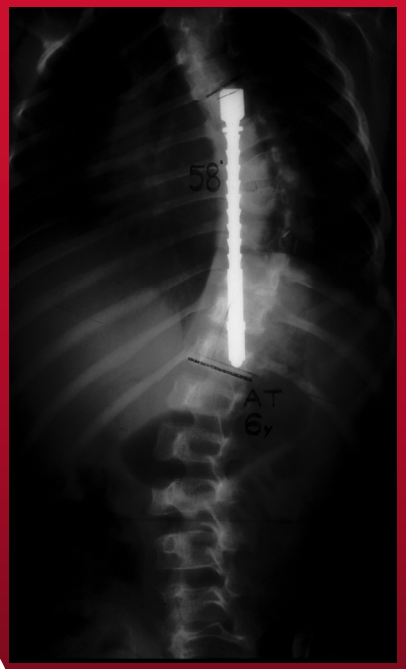
Limited - fusion

Harrington's original concept 1962

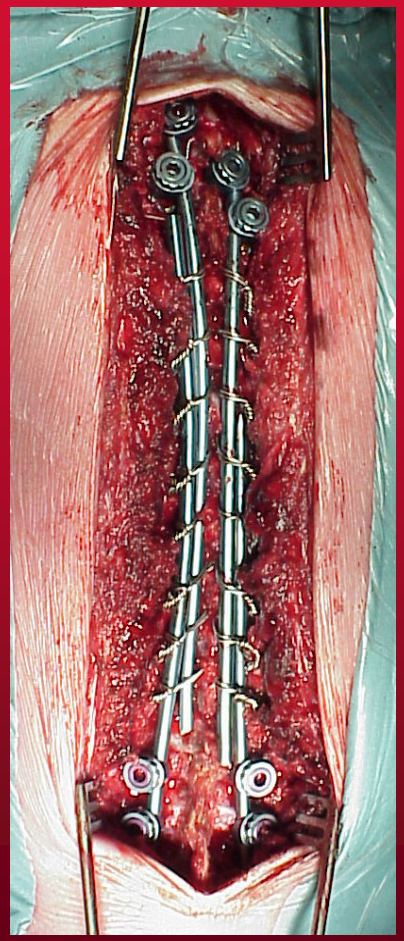
Luque trolley segmental instrumentation without formal fusion 1979

Subcutaneous or submuscular rod (Isola/Synergy/USS)

Shilla technique 'pedicle screw trolley'

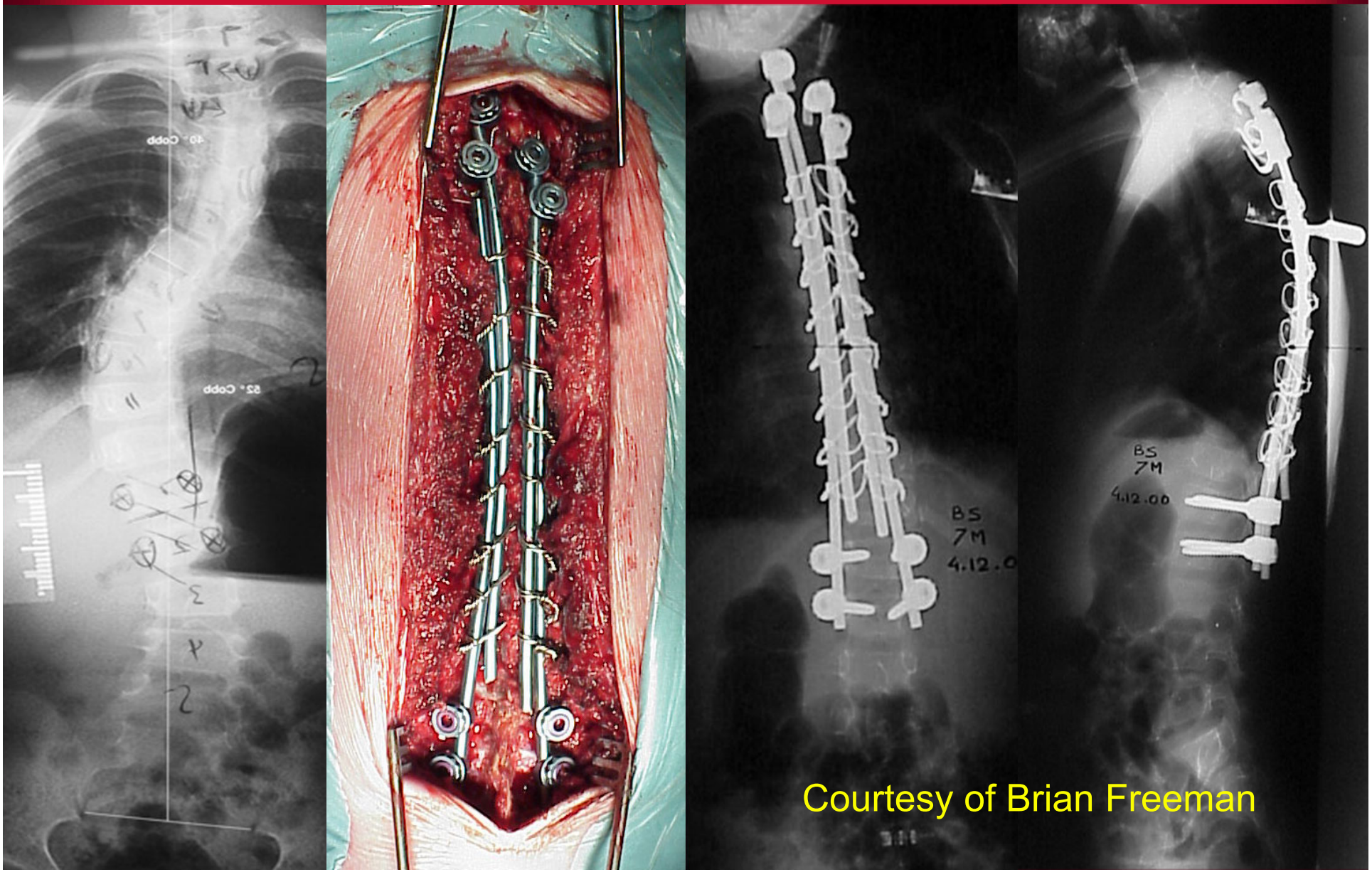


Harrington


Luque trolley

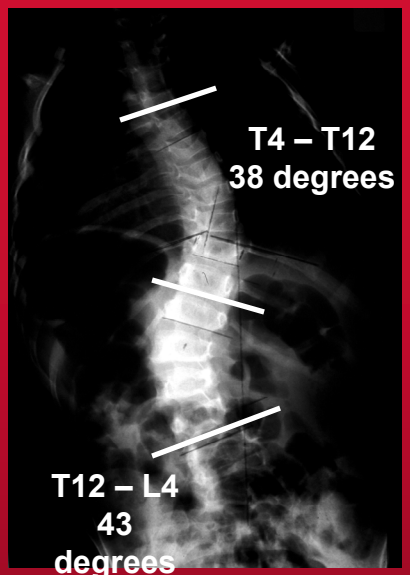

Paed ISOLA

Luque trolley

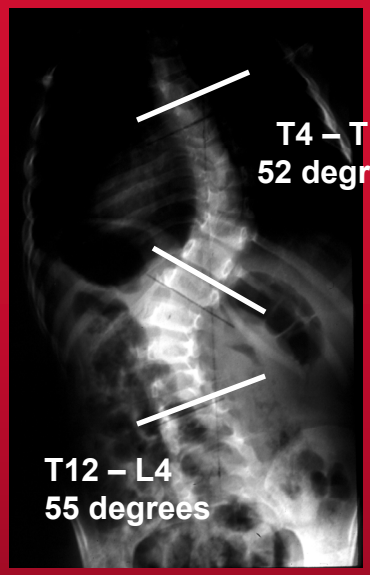


Courtesy of Brian Freeman

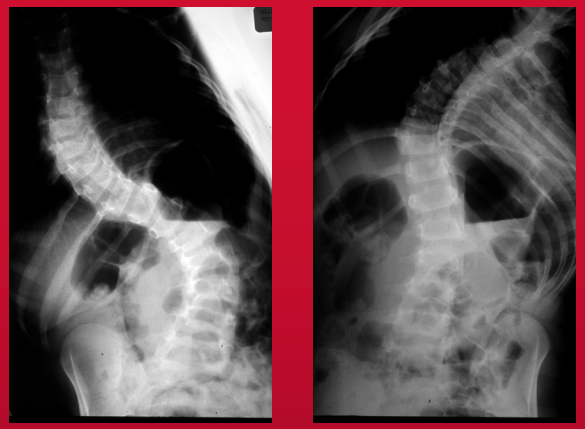
Subcutaneous Rods



Presentation 3 + 6



5 years (18 months post bracing)



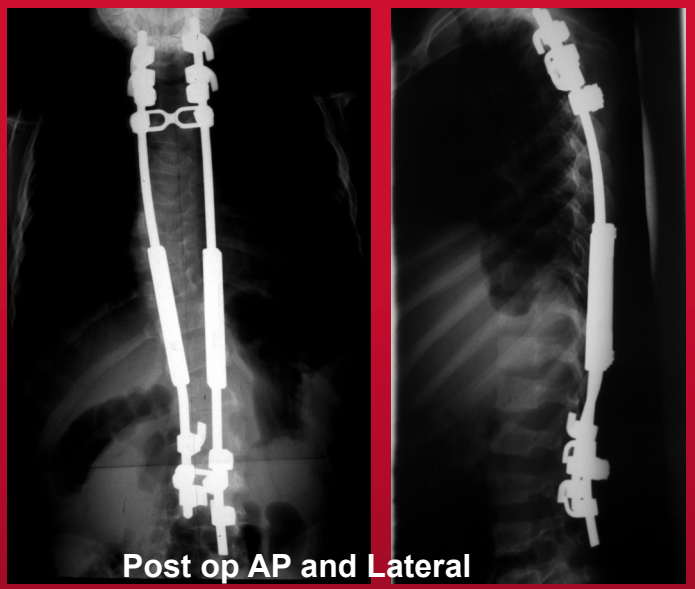
Left & Right bend films

MC presented 3 years six months old with R thoracic L lumbar curves secondary to Beales syndrome

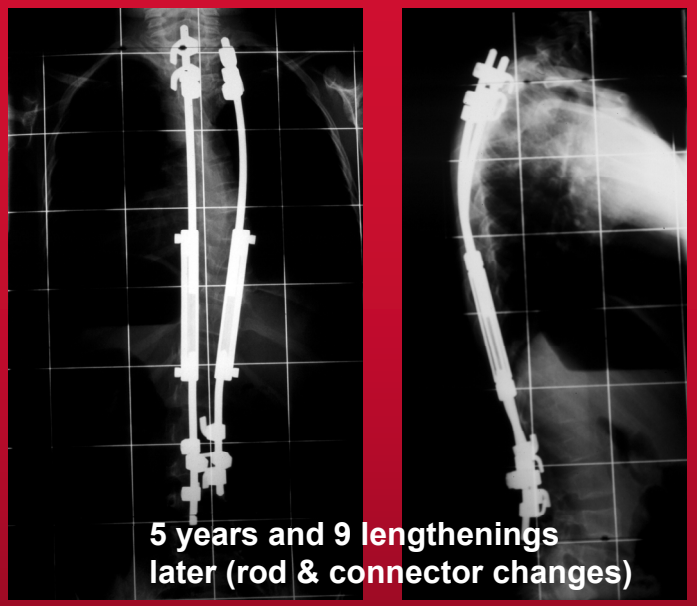
Progression despite bracing

Bending films show stiffness in both curves

Subcutaneous rods



Post op AP and Lateral



5 years and 9 lengthenings later (rod & connector changes)

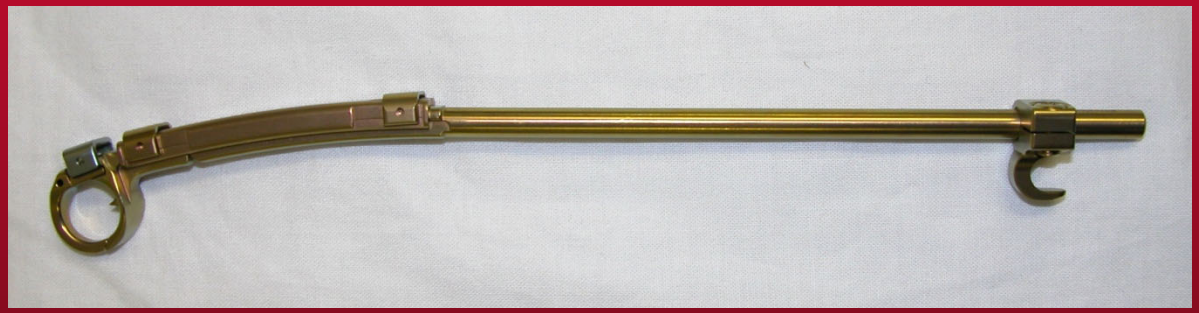
Now 13 years of age correction maintained in the Coronal plane and improved in the saggital plane

Overall spinal 'growth' has been 12 cm

Hardware problems required upper TRC removal

No brace / normal school activities including limited PE

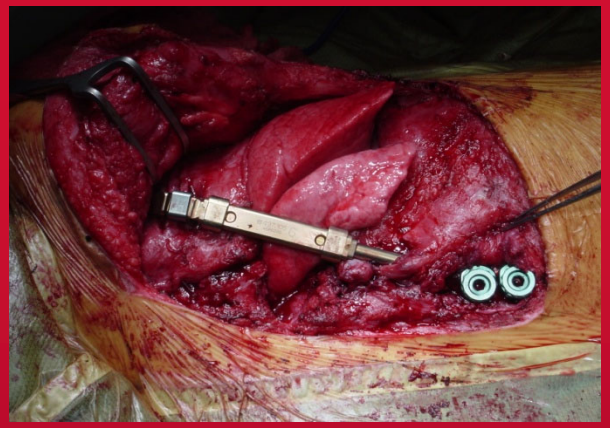
Thoracic Cage Instrumentation

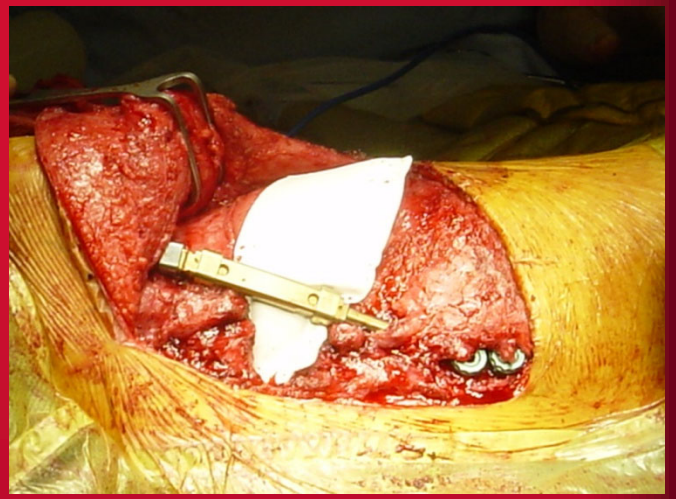


Sequential rib distraction and chest wall expansion improves respiratory function and indirectly provides spinal correction

Campbell R M. Congenital scoliosis due to multiple vertebral anomalies associated with thoracic insufficiency syndrome in State of the Art Reviews, Spine 14:1 2000

VEPTR

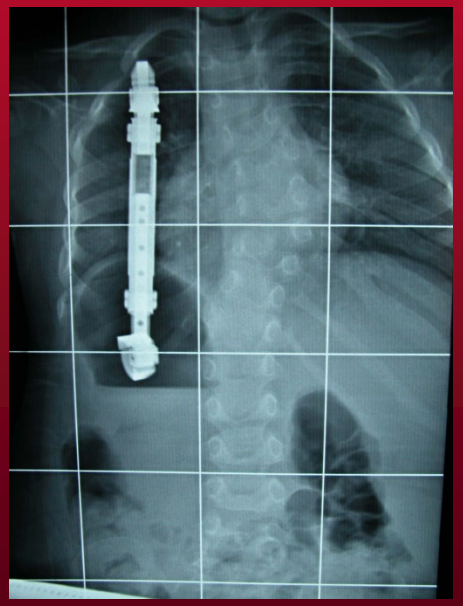




Following expansion thoracoplasty both the convex and concave sides of the thoracic spine and unilateral unsegmented bars appear to 'grow'

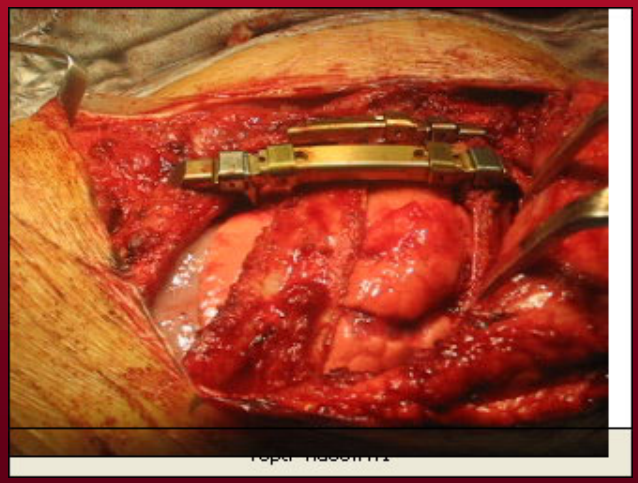
Campbell R M, Hell-Vocke A K
JBJS Am. 2003 Mar;85-A(3): 409-20

UK experience now >40 cases majority for congenital scoliosis with rib synostosis

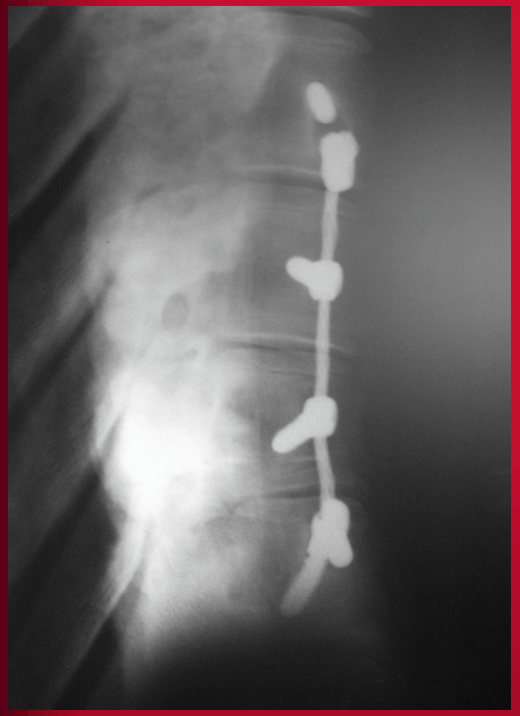


VEPTR

Salvage for significant trunk decompensation following lumbar hemi-vertebral resection



Next 10 years?
Anterior Tethering



Mechanical modulation of vertebral body growth: Implications for Scoliosis progression

Stokes I A et al: Presented to 30th Annual meeting SRS Asheville NC 1995

Asymetrical flexible tethering of spine growth in an immature bovine model

Newton P O et al: Spine 2002 Apr 1;27(7): 689-93

Next 10 years?
Memory metal staples

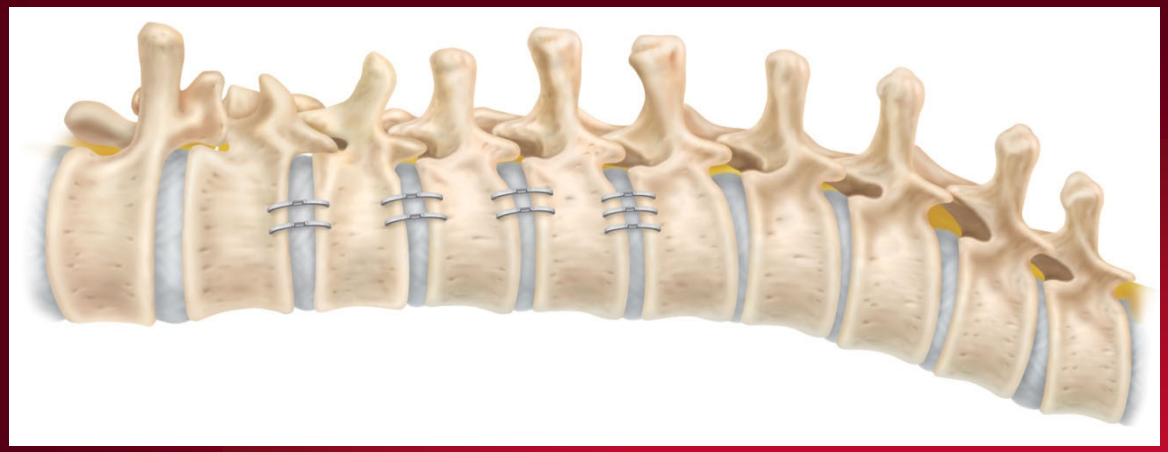
NITINOL

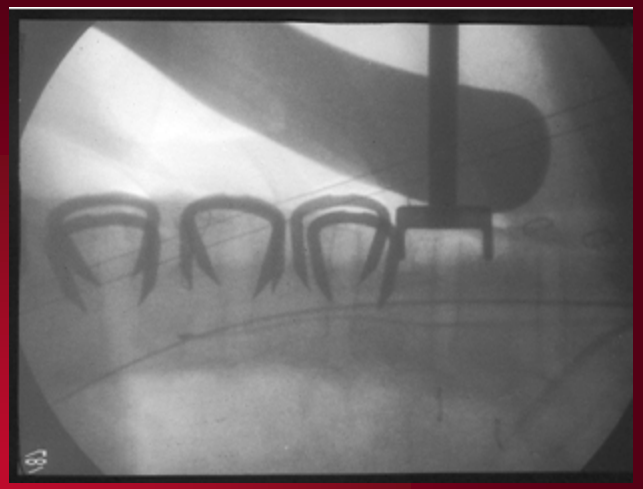
NIckel-**TI**tanium-**N**aval-**O**rdnance-**L**aboratory

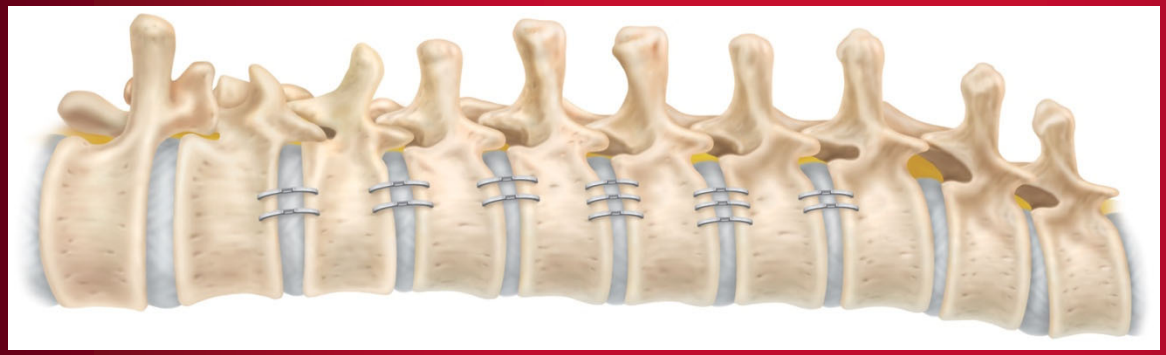
50% Nickel
50% Titanium

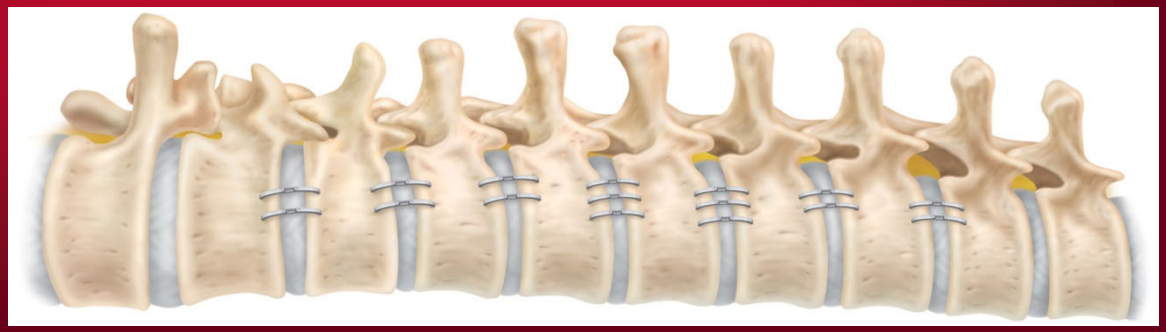
Improved pullout

Constant force after implantation

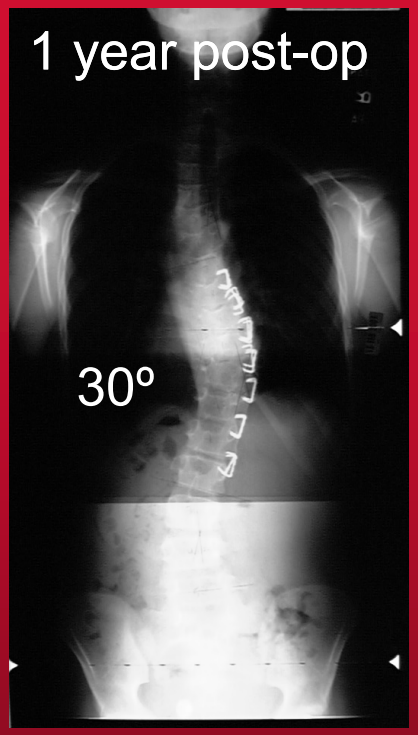


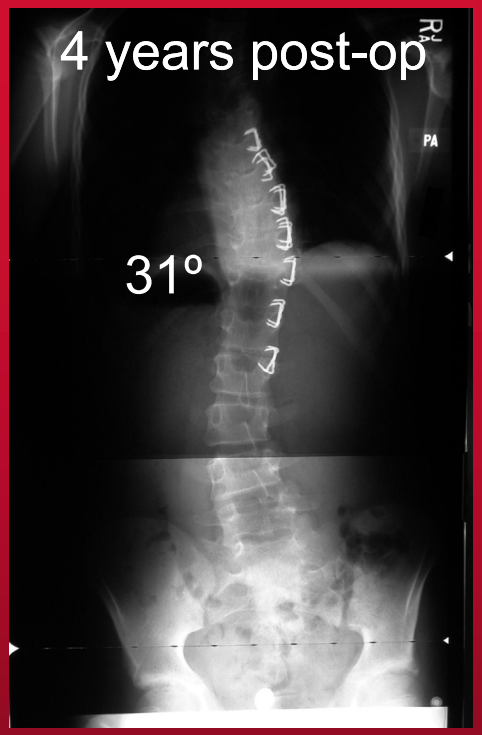






Next 10 years - Memory metal

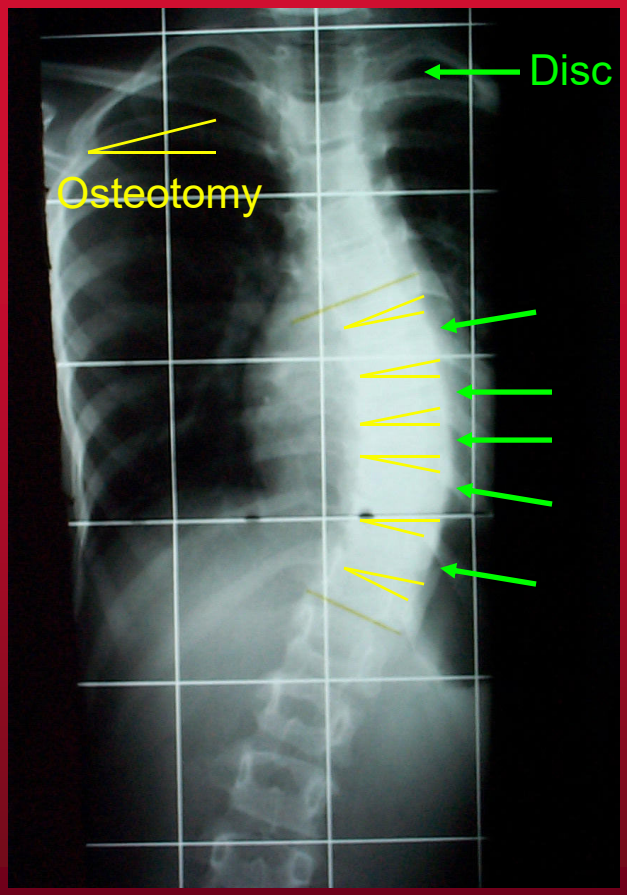


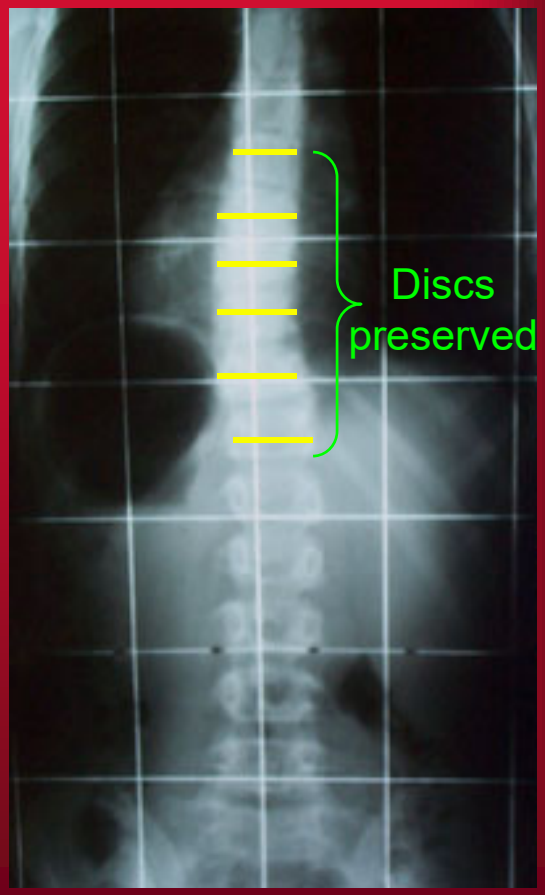


Convex Stapling of immature (<Risser 2) AIS curves appears to have the ability to control progressive curves in the short term

Betz RR, Kim J, D'Andrea L P, Mulcahey M J, Balsara R K, Clements D H
An Innovative technique of vertebral body stapling for the treatment of patients with adolescent idiopathic scoliosis; a feasibility, safety and utility study. Spine 2003 Oct 15; 28(20): S255-65

Next 10 years - Vertebral Body Osteotomy

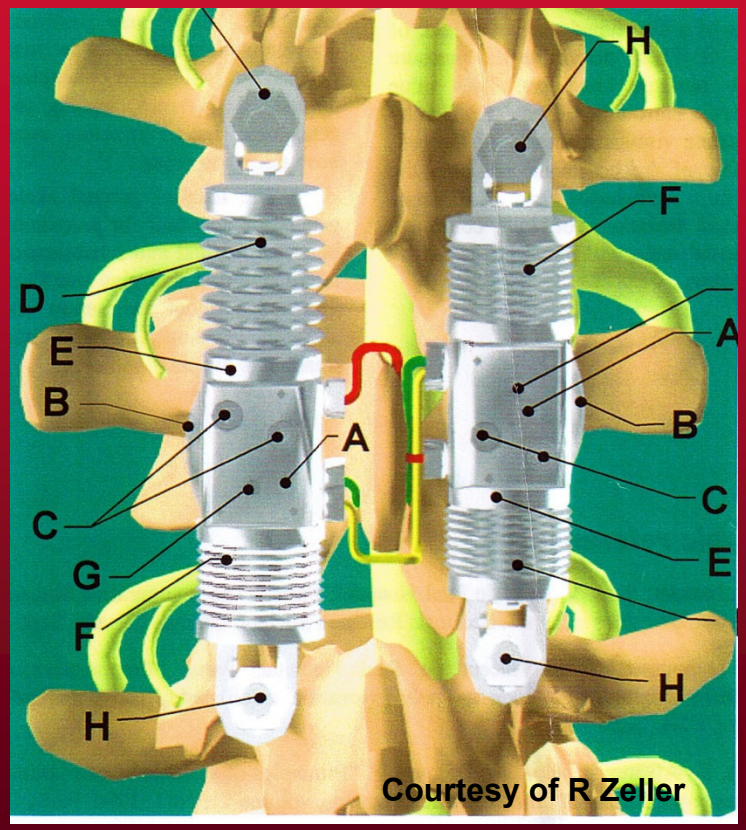




Multiple level vertebral body osteotomies with staple fixation

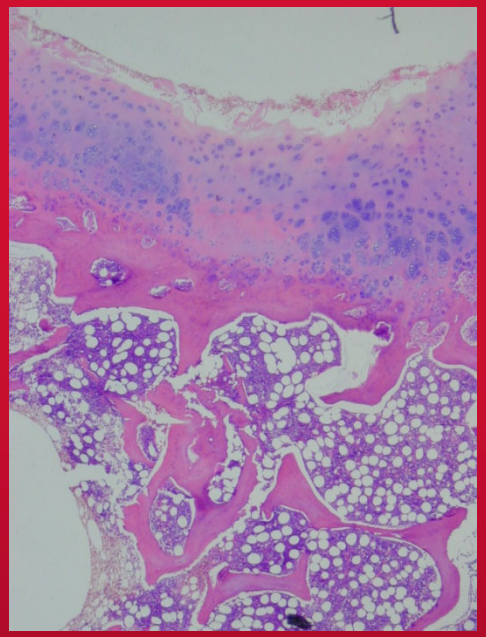
By 2015

- Refinement in chromosomal mapping of genetic influences in HOX / BOX segmentation genes
- Memory metal rods
- ‘Automated Growing’ rods – spine & chest
- Lengthened by ‘magnetic field’ induction



By 2030 ?

- Growth plate transplants
- Bio-resorbable ‘time effect limited’ implants
- Second generation active ‘A I’ correction implants
- Foetal spinal surgery – congenital vertebral anomalies



By 2057 ?

- Hormonal Modulation of growth by injection of growth factors into growth plates
- Gene manipulation
- Stem cell concave growth plate transplants
- *"take one tablet 3 x a day"*

Early Onset Scoliosis quo vadis?