Masters Technique: MdGRs
[Magnet driven Growing Rods]

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Magnet driven Growing Rods (MdGR) for Early-onset Scoliosis (EOS)

Presenter: MHH Noordeen — K2M, Ellipse Tech & Stryker (a, b & c)

Co-author: NS Harshavardhana — No relationships

ICEOS annual meeting, Warsaw
20th -21st, Nov 2014

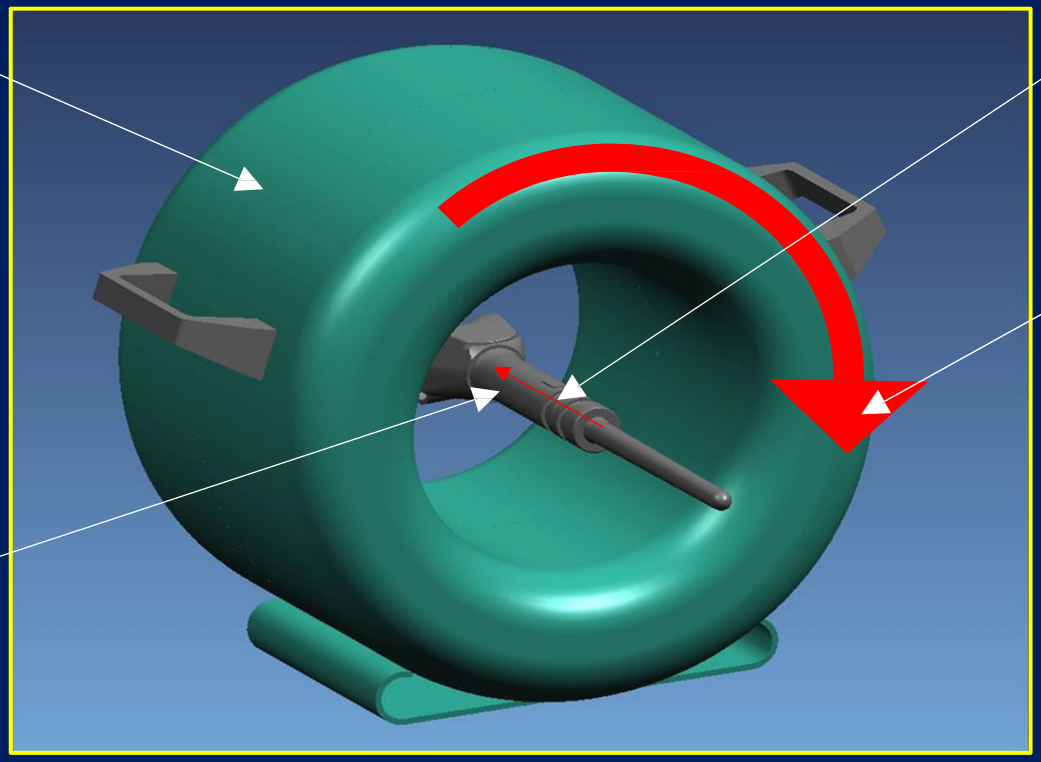
Authors Disclosure Information

a. Grants/Research Support
b. Consultant
c. Stock/Shareholder
d. Speakers' Bureau
e. Other Financial Support

Background: What is MdGR?

- Novel growing rod with incorporated magnet
- A new ***'Game changer'*** in surgical management of Early-onset scoliosis (EOS)
- Aim: One-off surgery eliminating the need for repetitive anaesthesia every 4-6 months
- I share my experience with at least **100** MdGR insertions over past **4½ years**

Principle behind MdGR



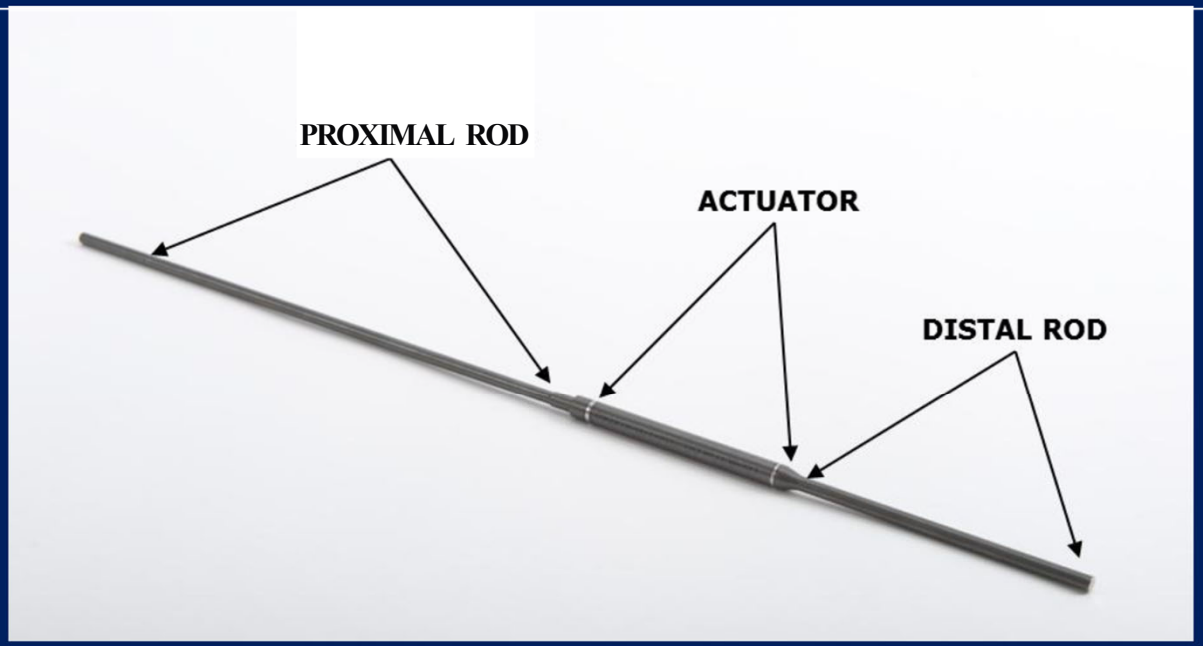
An external rotating magnetic field captures a powerful magnet mounted inside the growing rod causing it to rotate in synchronisation generating a small torque. This torque is then amplified through a gearbox driving a power screw that telescopes and lengthens the rod.

Magnet driven Growing Rod

----------26cm ---------- , -- 9c=m ---s , ---- 1 2 c m ---4

47cm

J

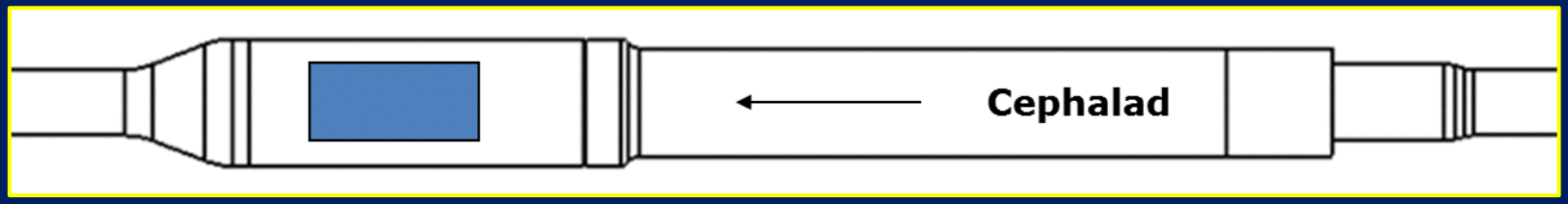


MdGR: Standard and Off-set rod

- Available in 4.5 mm and 5.5 mm diameter rods
- The proximal and distal rods can be bent / contoured to match the desired (natural) curvature of the spine.
- The MdGR rod is attached to the spine using standard anchors (hooks / screws) which could be either rib or spine based
- A permanent magnet in the actuator area can be non-invasively lengthened by the External Remote Controller (ERC)

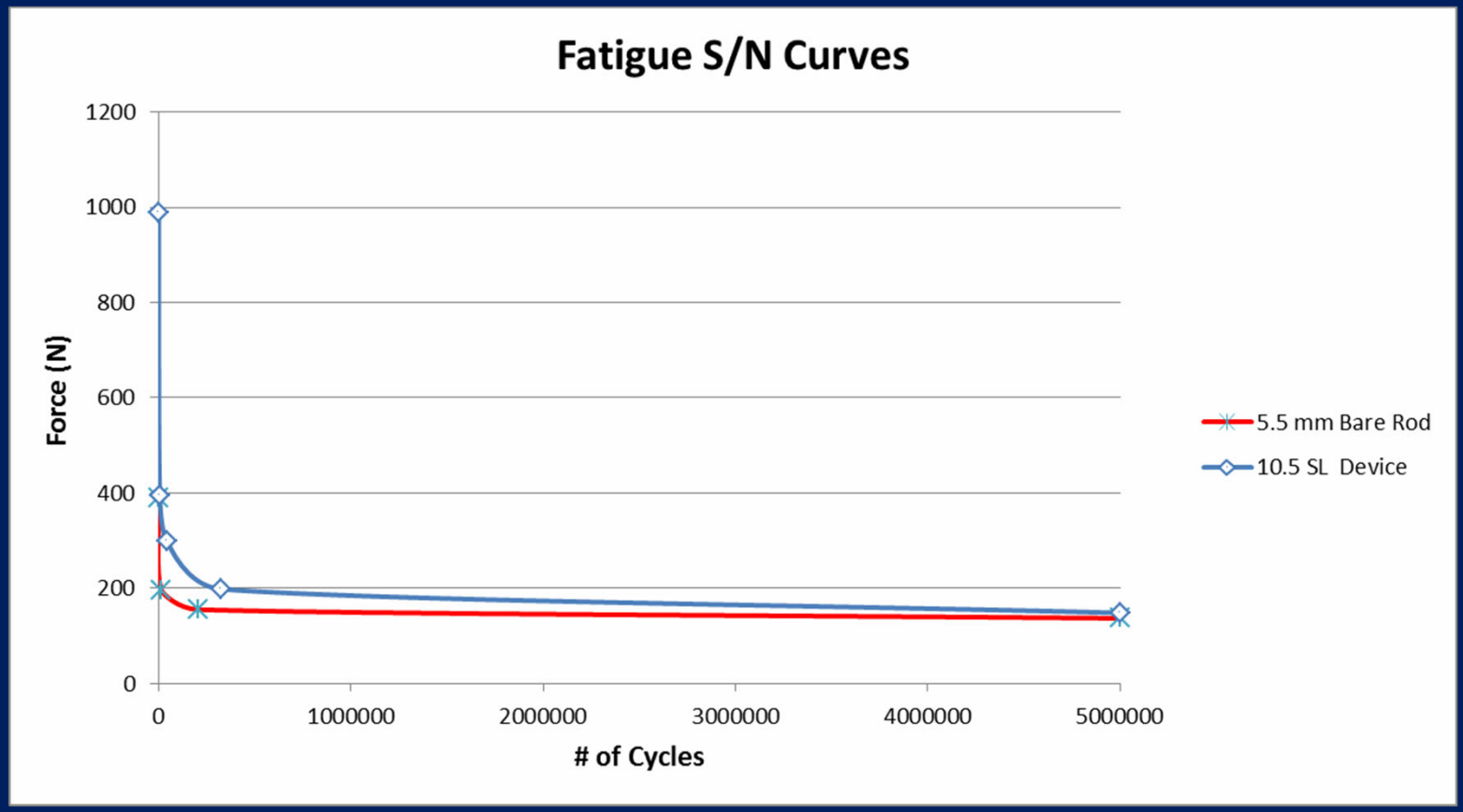
SL rod

SLR rod



The magnet is off-set in the SLR rod: Differential distraction

MdGR: Biomechanical Tests



Stronger than a standard 5.5mm Ti rod over 5m cyclical loading

Withstands up to 270N distraction force (Eq. to 3mm gap per lengthening)

My Practice for EOS (Past)

- Up to yrs. ago: Used conventional growing rods for EOS
  - Single & Dual sub-muscular
- Repetitive 4-6monthly distractions: ↓ GA
- Law of diminishing returns: Force needed doubled by 5th lengthening

Minimizing Complications With Single Submuscular Growing Rods

A Review of Technique and Results on 88 Patients With Minimum Two-Year Follow-up

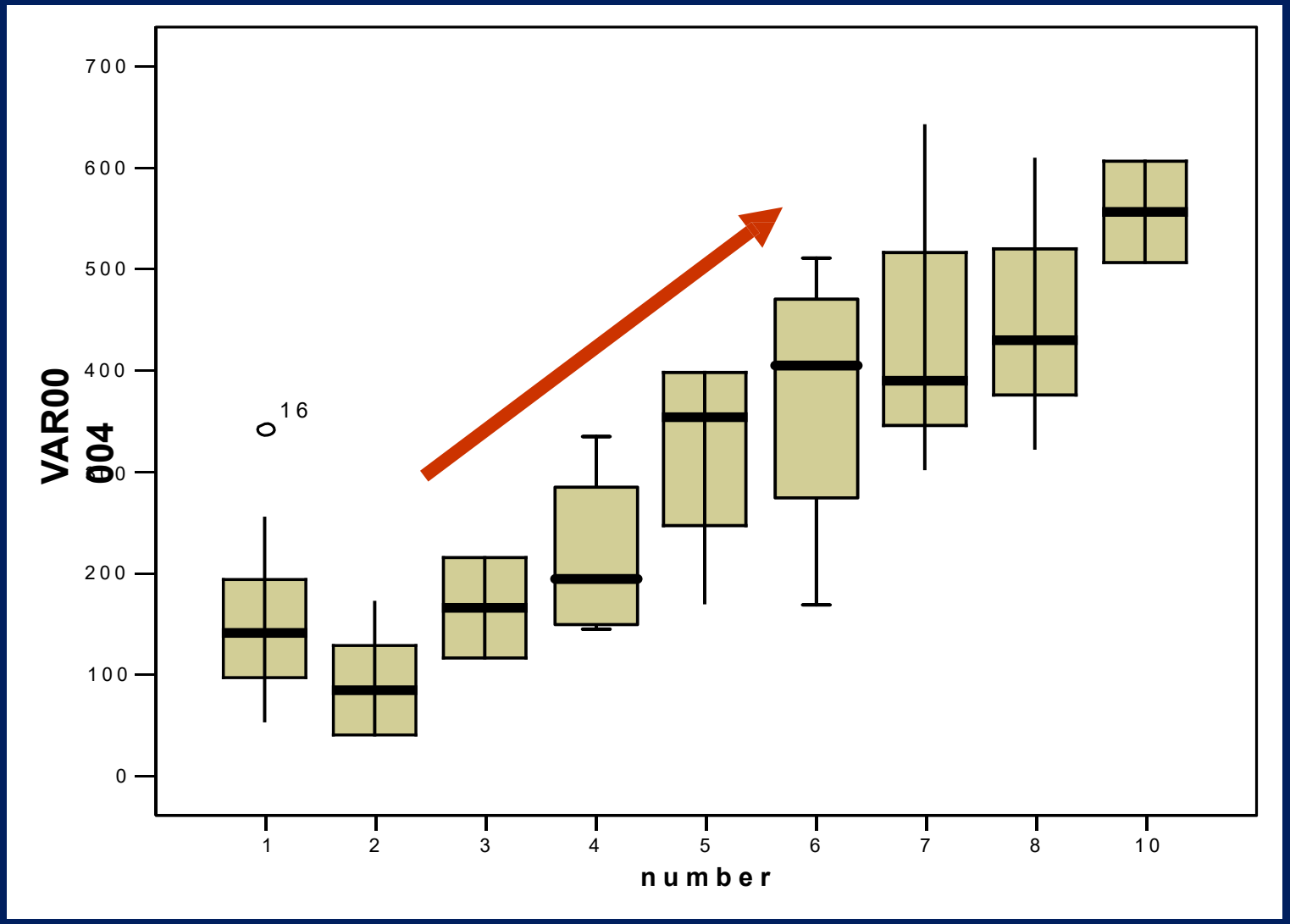
Najma Farooq, FRCS(Tr & Orth),*† Enrique Garrido, EBOT, MRCS,‡ Farhaan Altaf, MRCS,*† Joanne Dartnell, MRCS,*† Suken A. Shah, MD,§ Stewart K. Tucker, FRCS(Orth),*† and Hilali Noordeen, MA, FRCS*†

In Vivo Distraction Force and Length Measurements of Growing Rods

Which Factors Influence the Ability to Lengthen?

Hilali M. Noordeen, FRCS (Orth),* Suken A. Shah, MD,† Hazem B. Elsebaie, FRCS, MD,‡ Enrique Garrido, EBOT, MRCS,* Najma Farooq, FRCS (Tr & Orth),* and Mohannad Al Mukhtar, MRCS*

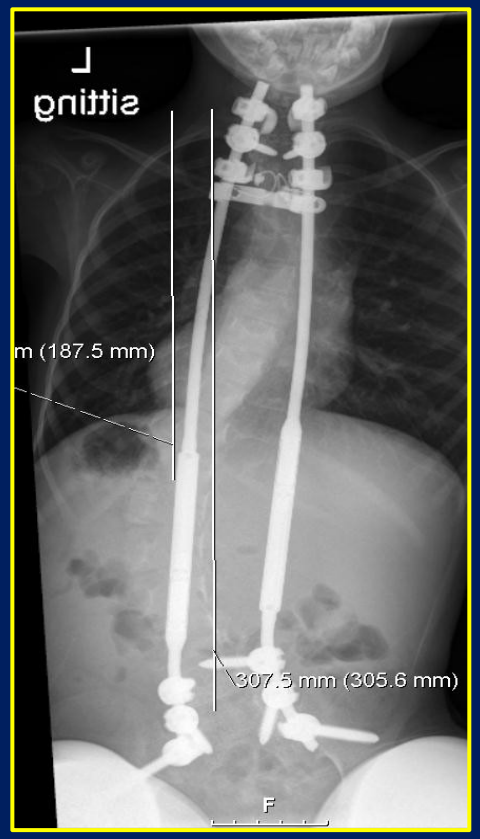
Growth Rods: In-vivo distractive forces



Noordeen MHH et al, Spine 2011

MdGR: How do I insert them?

- Two 2″ - 3″ incisions to expose
  - T2-T5 (all EOS)
  - L4 – S1 (EOS-NMD)
- Prepare the sub-muscular bed
- Insertion of anchors
  - Upper (Hybrid: Spine based Hooks & screws)
  - Lower (All screws construct)
- Testing the MdGR & appropriate sagittal contouring



Tips & Tricks I: Proximal anchors

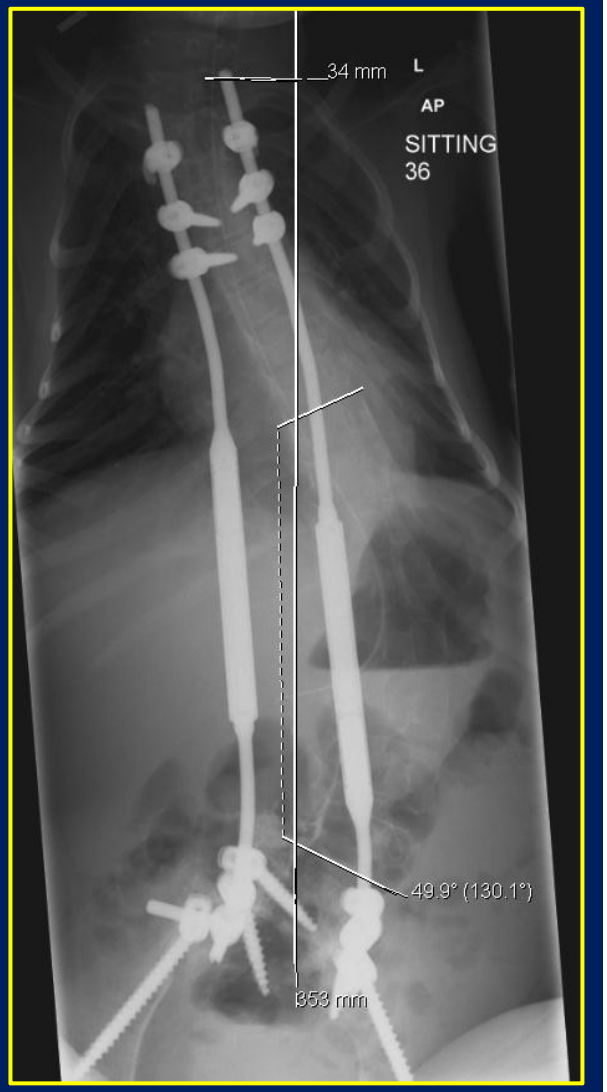
Minarets have 7-12^0 outward tilt: Intentional

In event of earthquake: The central dome is protected
(minarets falling outwards)

Optical illusion: From distance - appear erect

TP Hooks: Apply laterally directed forces
In event of screw loosening, they do not migrate medially and compress spinal cord

Proximal anchors: Two pair of pedicle screws and one pair of TP Hooks



The Taj Mahal construct

MdGR: Stanmore Experience (2013)

■ SPINE

Early results of a remotely-operated magnetic growth rod in early-onset scoliosis

Z. Dannawi,
F. Altaf,
N. S. Harshavardhana,
H. El Sebaie,
H. Noordeen

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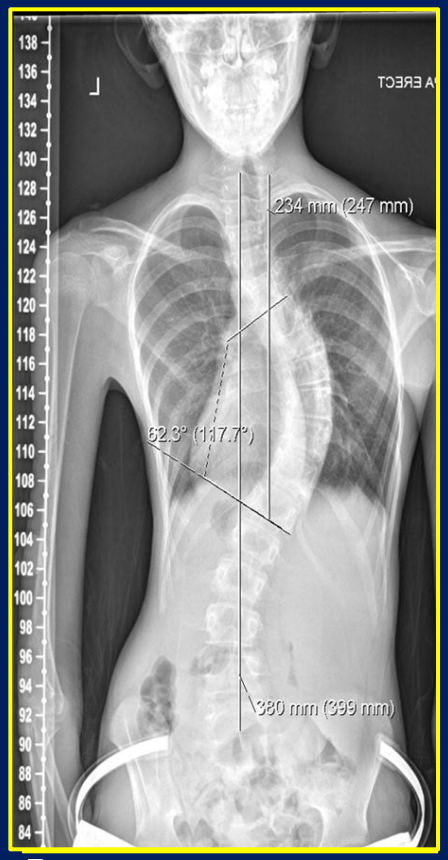
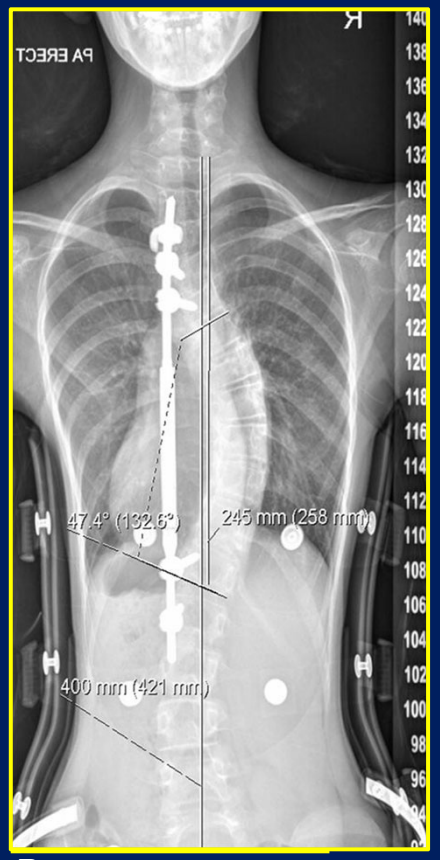
- World's largest published series to this day (English)
- My 1st MdGR insertion at GOSH in Mar 2010
- My preferred option for Rx EOS: All cases

Case 1: Juvenile IS (single rod)



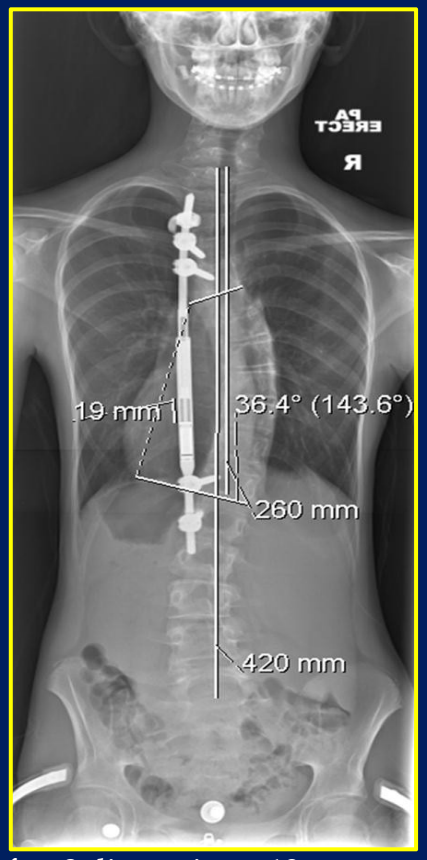
Pre-op

T1-S1: 360mm
Cobb ^le – 62^0



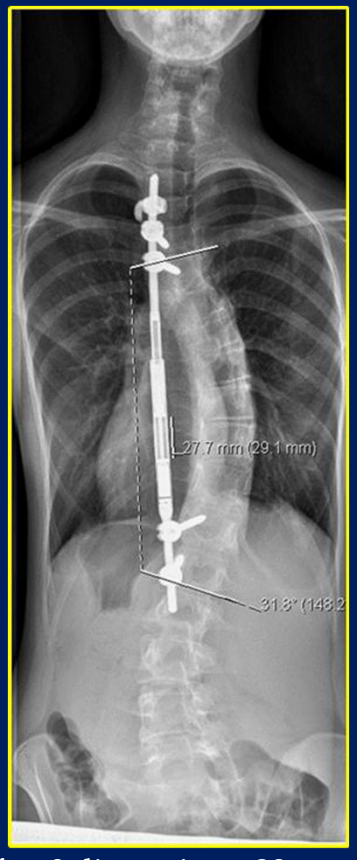
Post-op

T1-S1: 375mm
Cobb ^le – 47^0



After 3 distractions: 19mm

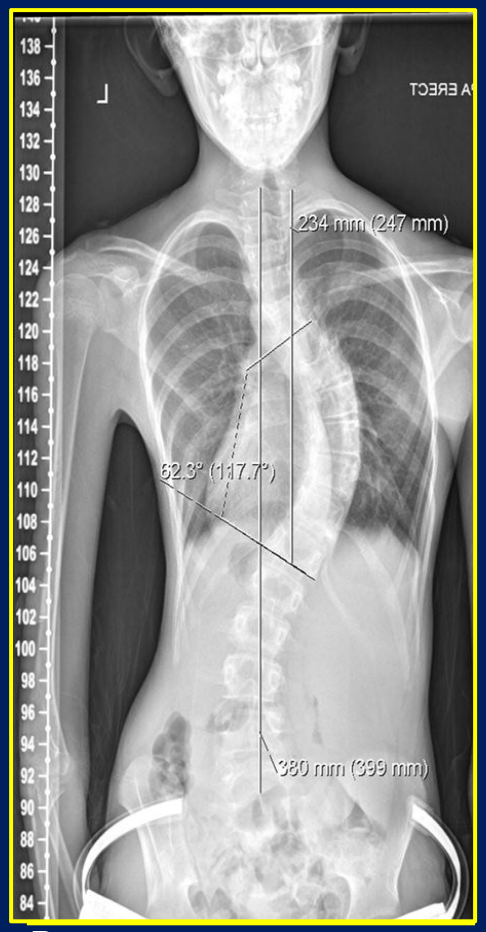
T1-S1: 400mm
Cobb ^le – 36^0



After 9 distractions: 28mm

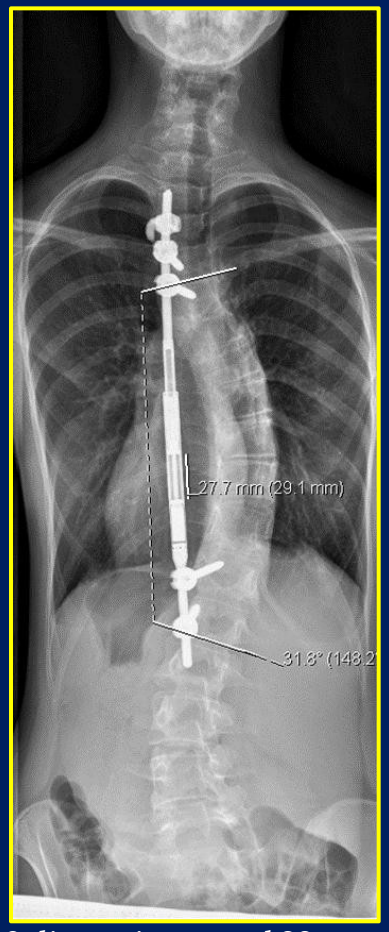
T1-S1: 435mm
Cobb ^le - 32^0

Case 1: JIS (My 1st MdGR graduate)



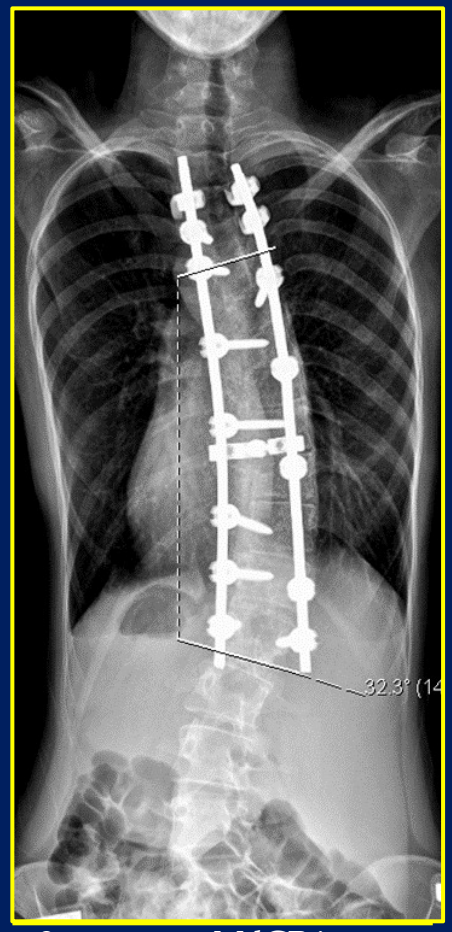
Pre-op

T1-S1: 360mm
Cobb ^le - 62^0



9 distractions: total 28mm

T1-S1: 435mm
Cobb ^le – 32^0



3 years post MdGR insern

T1-S1: 446mm
Cobb ^le maintained at 32^0

MdGR & Pulmonary Function

Spine Publish Ahead of Print
DOI: 10.1097/BRS.0000000000000383

Improvement of pulmonary function in children with early onset scoliosis using magnetic growth rods

Noordeen H et al 2014

- Level of Evidence (LoE): Prognostic II
- Dramatically reduced the rate of decline in pulmonary function (statistically significant)
- Facilitated normal developmental milestones with improvement in quality of life
- Fewer complications and high care giver satisfaction

MdGR & Pulmonary Function

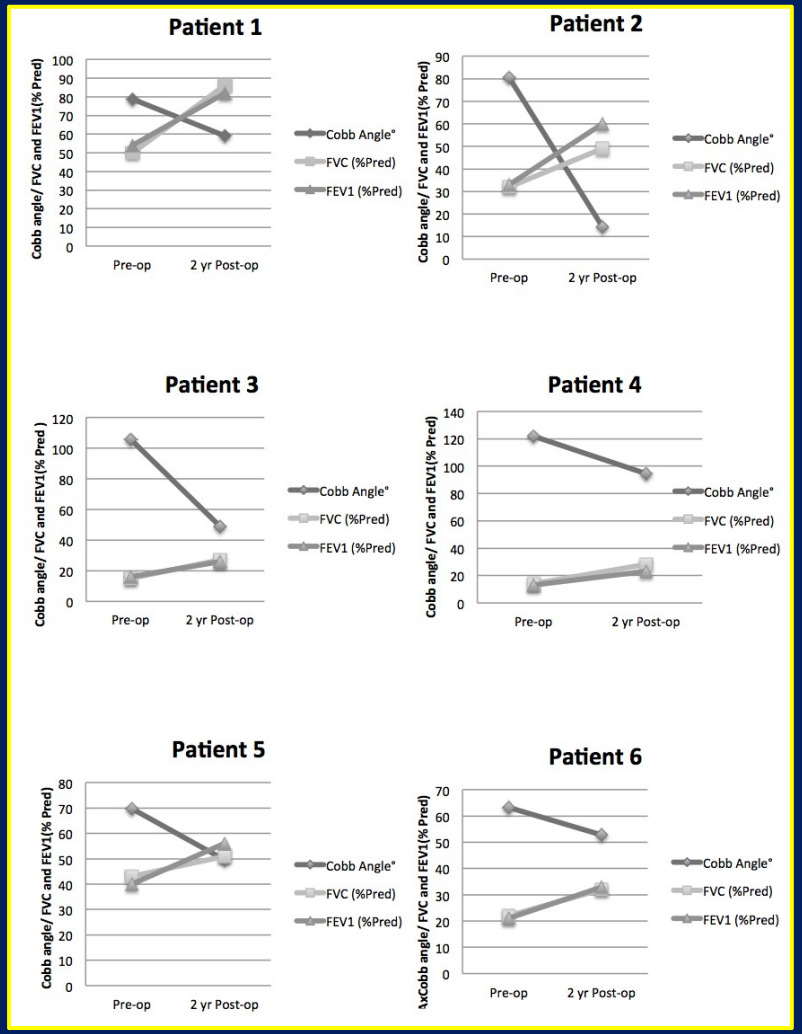
6 patients with EOS-NMD

SMA Type II – 2

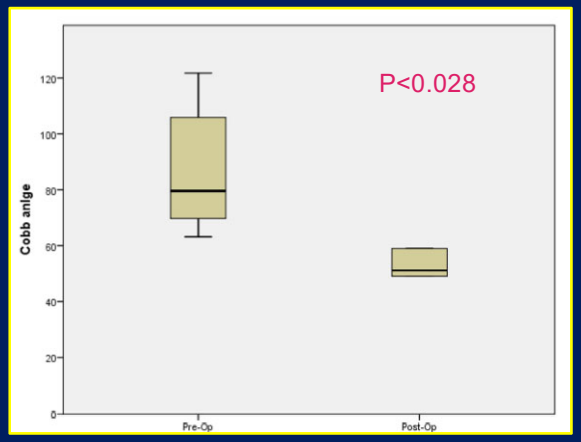
Neurofibromatosis - 2

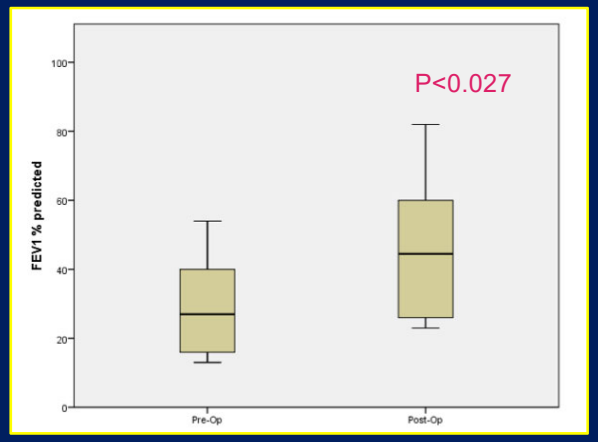
William's syndrome - 1

Cong muscular dystrophy – 1



MdGR & Pulmonary Function





- Box plots (SPSS v17) showing statistically significant:
  Decrease in Cobb angle
  Increase in both FEV_1 and FVC

- Spectacular improvement in PFT in patients with SMA-II

- MdGR probably arrest rapid deterioration / decline of PFT and do NOT alter its natural history **(γ error!)**

SUMMARY - I

- EOS: Growth guided surgery is standard of care (what growth guidance needs re-defining: MdGR vs. CGR vs. VEPTR vs. Shilla vs. Staples)
- I do **NOT** perform definitive spinal fusion for EOS
- Understand natural history, pulmonary maturation and life expectancy of different EOS etiologies
- MdGR: Promising early results with favourable cost-utility on long-term forecast analysis (10y)

SUMMARY - II

- A new *'game-changer'* amongst distraction based devices in surgical treatment of EOS
- Eliminates the need for repetitive anaesthesia
- Has been around now for at least *four* years
- Approved by NICE-UK (National institute of clinical excellence): FDA equivalent of USA
- Associated with improvement in PFT for EOS-NMD

Thank You

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