Masters Technique: MdGRs
[Magnet driven Growing Rods]

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

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Authors Disclosure Information

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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
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

--- 26 cm ---

--- 9 cm ---

--- 12 cm ---

47 cm
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).

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
Najina Farooq, FRCS(Tr & Orth),†* Enrique Garrido, EBOT, MRCS;† Farhaan Altaf, MRCS;†* Joanne Darrell, MRCS;† Sukon A. Shah, MD;† Stewart K. Tucker, FRCS(Orth);† and Hili Noordeen, MA, FRCS*†

*In Vivo Distraction Force and Length Measurements of Growing Rods*
Which Factors Influence the Ability to Lengthen?
Hili Noordeen, FRCS (Orth),* Sukon A. Shah, MD;† Hazem B. Elsebaie, FRCS, MD;‡ Enrique Garrido, EBOT, MRCS;* Najina Farooq, FRCS (Tr & Orth);* and Muhammad 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
Minarets have 7-12° 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
MdGR: Stanmore Experience (2013)

- 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°

Post-op
T1-S1: 375mm
Cobb ^le – 47°

After 3 distractions: 19mm
T1-S1: 400mm
Cobb ^le – 36°

After 9 distractions: 28mm
T1-S1: 435mm
Cobb ^le – 32°
Case 1: JIS (My 1st MdGR graduate)

Pre-op

T1-S1: 360mm
Cobb ^\le\ - 62°

9 distractions: total 28mm

T1-S1: 435mm
Cobb ^\le\ – 32°

3 years post MdGR inser^n

T1-S1: 446mm
Cobb ^\le\ maintained at 32°
MdGR & Pulmonary Function

- 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

Noordeen H et al 2014
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!)
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