

Surgical Results of Magnet-driven Growing Rods (MdGR) for Early-onset Scoliosis (EOS) at Five Years

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ICEOS 2015 – Oral presentation

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Authors Disclosure Information

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

Background: MdGRs

Novel implant used in the surgical treatment of EOS

Considered to be a *game-changer* in EOS Rx

Recently approved by US-FDA & NICE-UK for EOS

Eliminates the need for repetitive anaesthesia and surgical lengthening in OR

No published studies reporting surgical results with a minimum follow-up of **FIVE years**

Aims and Objectives

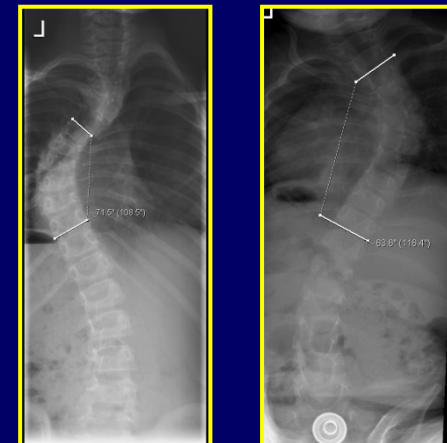
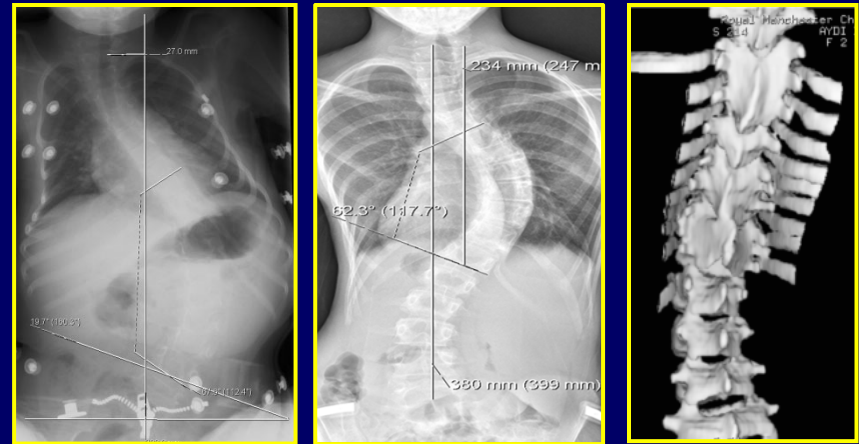
- ❖ To report surgical results of MdGRs at 5 years
- ❖ Share our experience with MdGR: >100 cases
- ❖ Narrate the journey to graduation from MdGR program (five patients)
- ❖ Share:
 - Evolution of MdGR over past five years
 - Unique situations encountered / solutions developed to address them

Materials and Methods

- ❖ Single surgeon case series of all MdGRs (LoE IV)
- ❖ EOS of all etiologies with minimum f/u: Five yrs
- ❖ Inclusion criteria:
 - Preop Cobb \angle $>50^\circ$
 - T₁-T₁₂ height of $<220\text{mm}$
 - Risser grade 0
- ❖ Two hospitals in one city (London, UK)

Etiology (n=9)

- Neuromuscular – 03
- Idiopathic - 02
- Congenital - 02
- Syndromic – 02
- Neurofibromatosis – 01



Study cohort

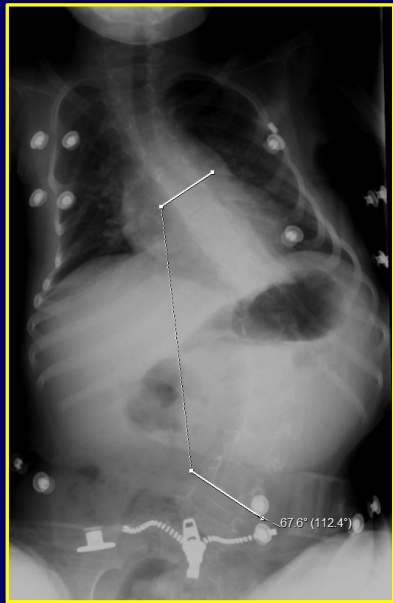
- 9 children operated for EOS & mean f/u of 5.2 yrs
- 5♂ & 4♀ (1st Mar 2010 – 30th June 2013)
- Mean age at surgery: 9.0yrs (range: 5.1 – 12.6y)
- 4 single rods(SR) vs. 5 dual rods(DR) insertions
- 5 MdGR graduates:
 - 1 DR explanted at 3.25 years
 - 2 pts: Definitive spinal fusion (1SR & 1 DR)
 - 2 pts: Maximum of 48mm lengthening (SMA-II)

Demographics & radiological parameters

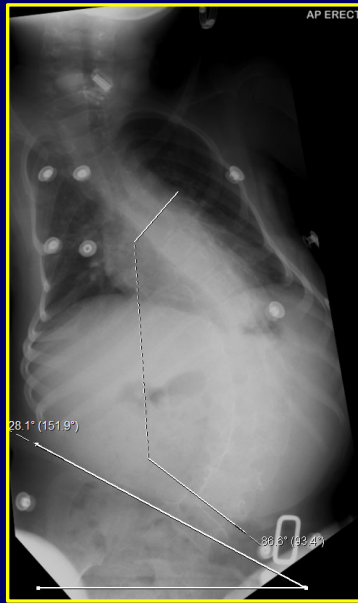
Parameters	Mean	Range
Age at 1 st visit	5.1 years	2.74 – 8.60 years
Age at MdGR insertion	9.07 years	5.11 – 12.49 years
Duration of follow-up	5.20 years	5.04 – 5.40 years
Cobb [^] le @ 1 st visit	55 ⁰	20 ⁰ - 87 ⁰
Preoperative Cobb [^] le	69 ⁰	44 ⁰ - 95 ⁰
Postoperative Cobb [^] le	45 ⁰	12 ⁰ - 70 ⁰
Cobb [^] le at Two year F/u	46 ⁰	8 ⁰ - 80 ⁰
Cobb [^] le at Five year F/u (n=21)	65 ⁰	6 ⁰ - 85 ⁰
T ₁ - S ₁ length @ 1 st visit	292mm	217 to 360 mm
Preoperative T ₁ - S ₁ length	316mm	242 to 377 mm
Postoperative T ₁ - S ₁ length	339mm	287 to 375 mm
T ₁ - S ₁ length @ Two year F/u	358mm	245 to 435 mm
T ₁ - S ₁ length @ Five year F/u	369mm	302 to 415 mm

Case 1 – SMA II Rxed by Dual MdGR @ 5yr

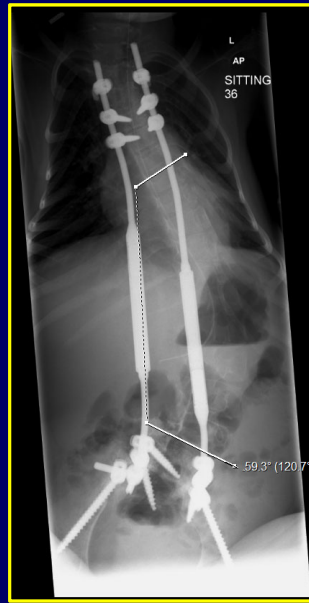
(Serial x-rays from 1st visit to 5yrs post-op Rxed by Dual MdGRs)



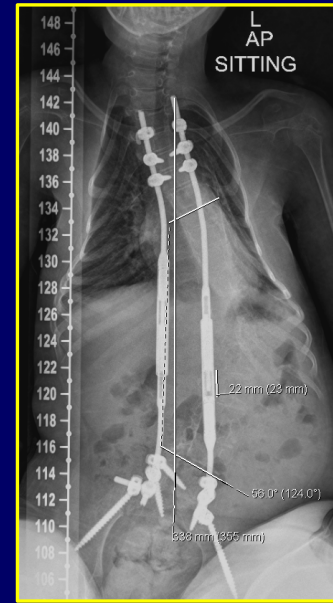
First visit
2008



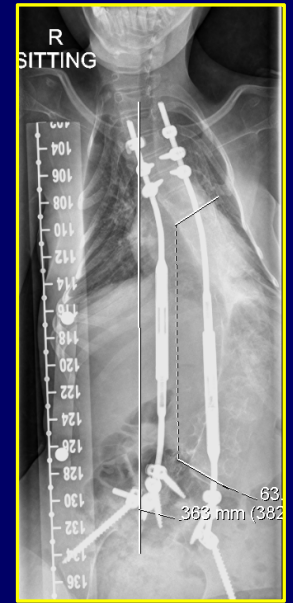
Pre-op



Post-op
2010



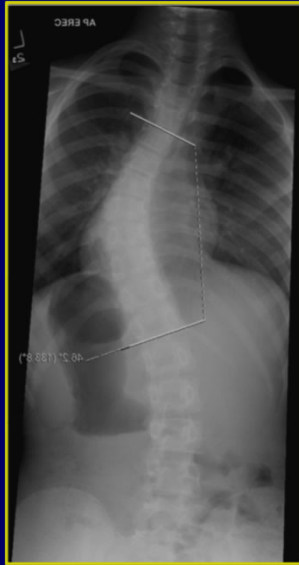
2yrs post-op



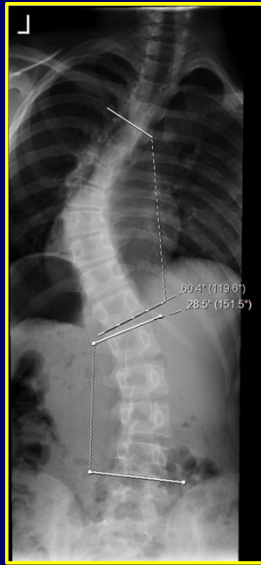
5yrs post-op
2015

Worsening **Parasol** deformity despite curve containment & ↑↑ in PFT
We are treating her as **MdGR graduate**: Has 48mm distraction
No anchor problems or PJK / PJF

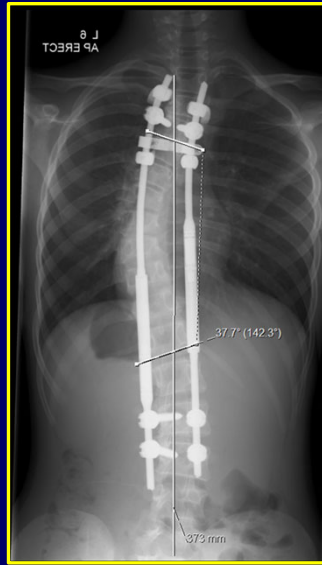
Case 2: JIS Rxed by Dual 1st Gen MdGR



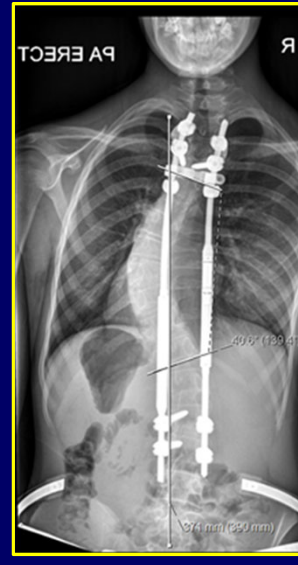
First visit
2007



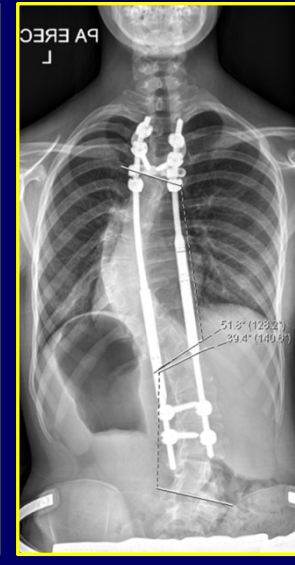
Pre-op



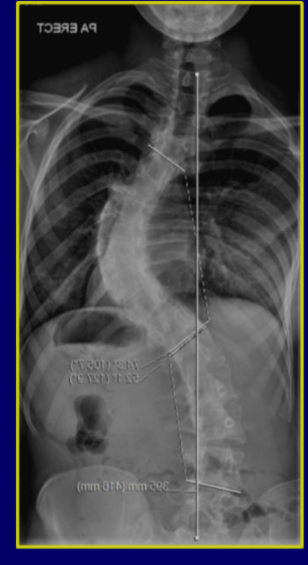
Post-op
2010



1yr Post-op



2yr Post-op



1.5yr Post
explant
2015

No evidence of distraction in post-op x-rays: Progression of compensatory lumbar curve - **40°** & is structural now
[Has cervical syrinx – Post-explant MRI no worsening]

MdGR Graduate

Results: Summary

Diagnosis	Age at Sx	Follow-up duration	No of Rods	Cobb angle 1st visit	Cobb angle Imm pre-op	Cobb angle Imm post-op	Cobb angle 2 years	Cobb angle 5 years	T1-S1 Lgt First visit	T1-S1 Lgt Imm pre-op	T1-S1 Lgt Imm post-op	T1-S1 Lgt 2 years	T1-S1 Lgt 5 years	PJK - Y/N
Congenital scoliosis	12.49	5.00	1	50	58	40	28	50	351	359	368	392	405	Yes
NF-1	6.49	4.92	1	67	76	46	41	65	303	313	354	378	361	No
JIS	11.25	4.92	1	27	65	30	30	DSF	360	368	375	435	DSF	No
EDS	5.11	4.92	1	63	95	70	82	96	217	242	287	245	302	Yes
William syndrome	10.67	4.75	2	60	71	48	45	DSF	267	304	328	342	DSF	Yes
SMA - II	5.43	4.67	2	55	60	40	32	54	300	310	335	360	371	No
Congenital insensitivity to pain	10.91	4.67	2	64	50	41	50	54	256	317	330	343	366	Yes
JIS	12.28	4.67	2	46	60	37	51	71	346	377	373	400	415	No
SMA - II	6.99	4.67	2	67	87	50	58	63	230	252	297	325	363	u/a

Table showing
breakdown of

Etiology

Follow-up duration

No of rods used

Cobb angle & T₁-S₁ lengths @ 2 and 5 yrs

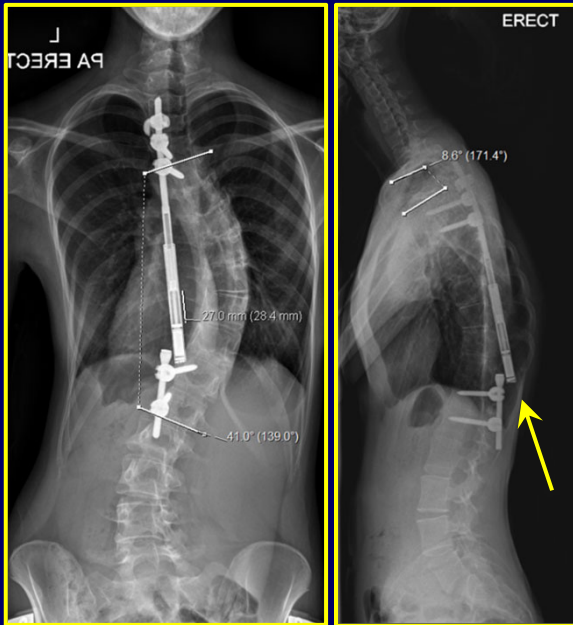
Two patients graduated from the program at 3.25 & 3.75 yrs post MdGR insertion

Complications: Summary

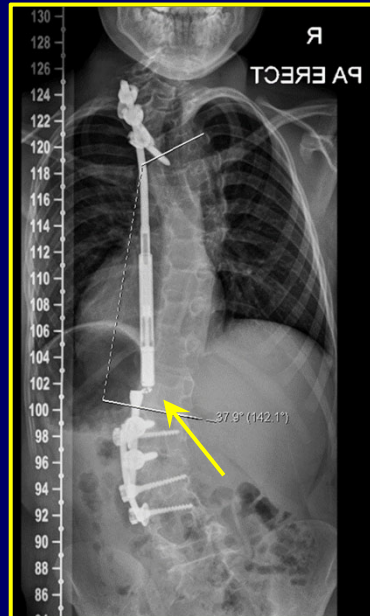
- Wound infections: 1 superficial (none deep)
- Rod fractures: 4 (3 SR & 1 DR)
- Loss of distraction: External magnet wear
- Progression of deformity: 1 (instrⁿ to pelvis)
- Worsening upper thoracic kyphosis: 1 (PSF)

Complication: Rod breakage pattern

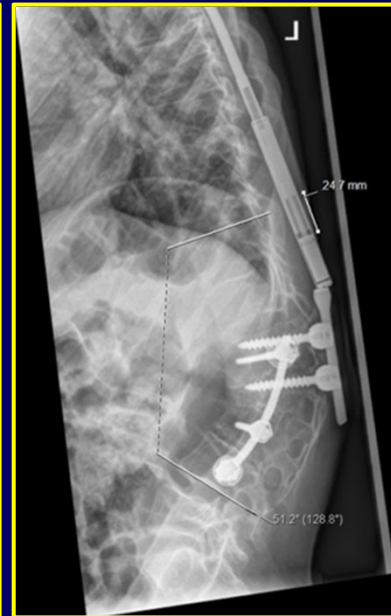
[Seen in 3 pts amongst our first 10 insertions]



JIS: 36mo post-op



Cong scoliosis: 18mo post-op

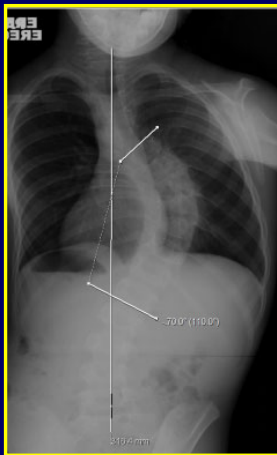


Syndromic: 9mo post-op

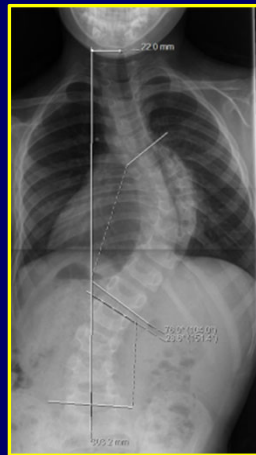
- Poor weld characteristics @ magnet – actuator junction
 - Solution: Welding technique re-visited
 - Welding: i. Continuous laser
ii. Pulse laser
iii. Selective laser sintering (**SLS**): **Mono-block**
- Prone for stress-rising

Loss of MdGR distraction: External magnet

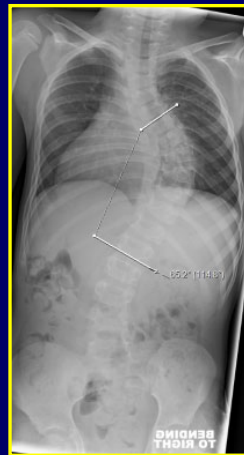
[Still in MdGR Treatment]



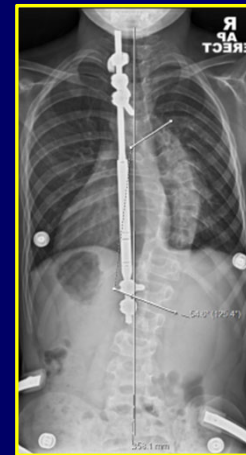
First visit
2008 (5.3y)



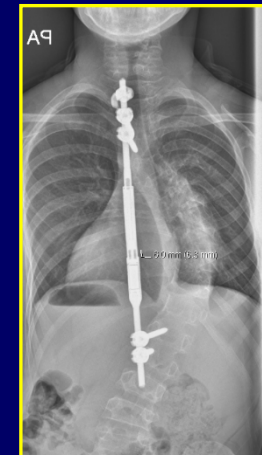
Pre-op



Convex bending



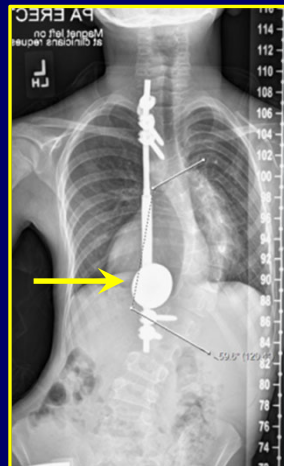
Post-op



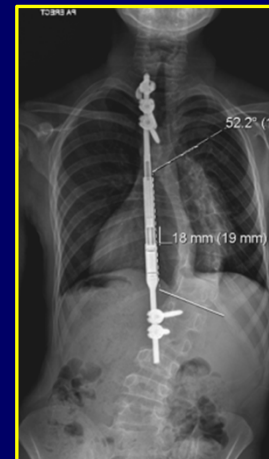
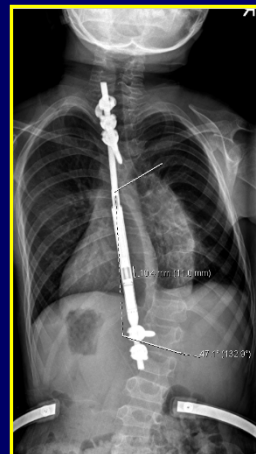
6 mo post-op



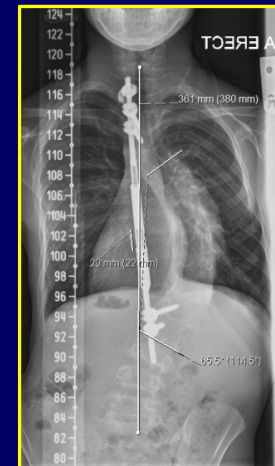
9 mo post-op



External magnet 15 mo post-op



Xchange rod

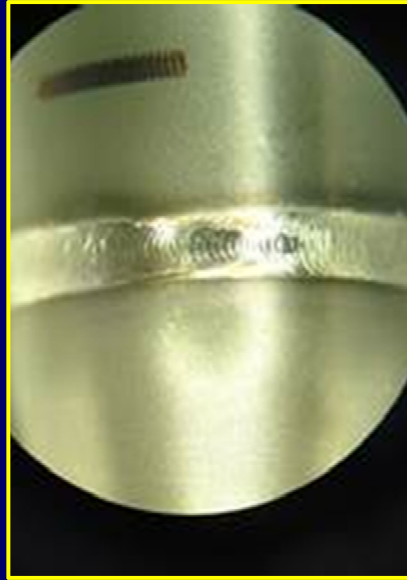


15mo post-XR
2015

Second Generation MdGRs



Keeper plate



1st Gen: Continuous wave laser

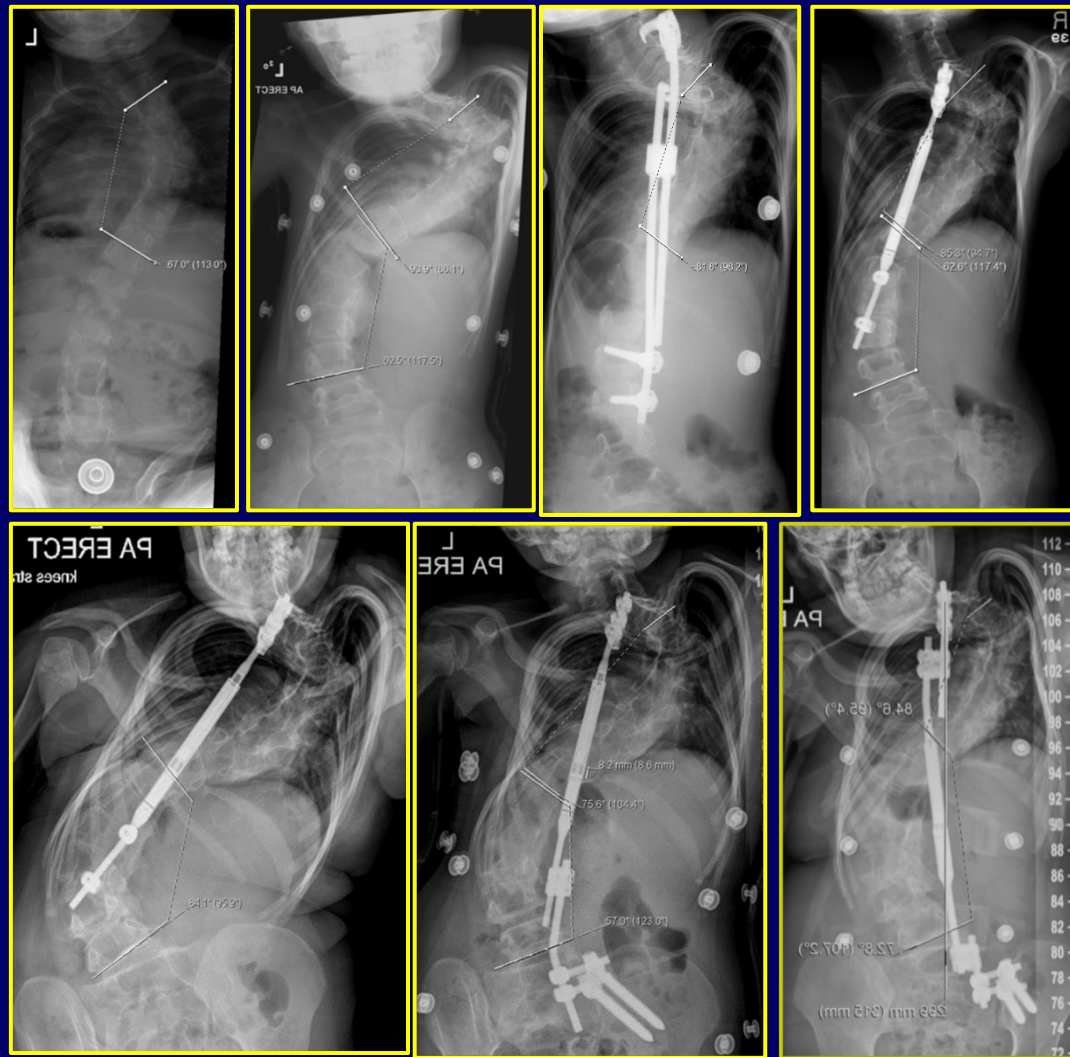


2nd Gen: Pulse wave laser
Not SLS rod

- Keeper plate (2012) – Prevents loss of distraction achieved
- Strengthening of the magnet-actuator jⁿ (2012): Change in weld characteristics (recommended **SLS technique**)
- Manufactured by CLW technique (?patchwork)

Complication: Extension to pelvis (5yr f/u)

(Conversion of CGR to MdGR in Ehler-Danlos syndrome)



Discussion & Conclusion

- Single rod: Invaluable for multi-planar deformities
- Dual rods minimise rod breakage (1/5 vs. 2/4)
- Greatest benefit in NMS & Syndromic EOS (**SMA II**)
- Surgical team input: 2nd Gen MdGRs (reliable)
- This is the first study to the best of our knowledge to report **five year follow-up** results with MdGRs

ICEOS 2015

9th Annual International Congress
on Early Onset Scoliosis (ICEOS)

November 19 & 20, 2015
Seaport Hotel • Boston, MA, USA



Thank You



Royal National Orthopaedic Hospital **NHS**
NHS Trust