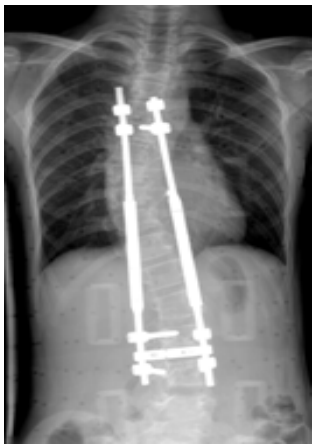
THE FLUOROSCOPIC TECHNIQUE FOR MONITORING DISTRACTION OF A NON-INVASIVE LENGTHENING DEVICE(MAGEC™) IN EARLY ONSET SCOLIOSIS



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Introduction

- Conventional growing rods require repeated X-rays to monitor distraction
- Cumulative ionising radiation exposure potentially high with increased carcinogenic risk in children
- Fluoroscopy minimises radiation exposure
- Useful alternative to X-rays

International definitions of radiation exposure

Level of risk for planned exposures	Category	Risk factor	Effective dose	Societal benefit to justify exposures
Trivial	I	I in 1000,000	<0.1 mSv	Minor
Minor	IIa	1 in 100,000	0.1 -1 mSv	Intermediate
Intermediate	IIb	1 in 10,000	1-10 mSv	Moderate
Moderate	III	1 in 1000	> 10 mSv	Substantial

International Commission for Radiological Protection (ICRP) categorization of level of risk for radiation exposure

Aim

- To evaluate the amount of radiation exposure using fluoroscopy compared to X-rays in the monitoring of distraction of a non-invasive growth rod system

Methods - Pilot

FLOUROSCOPY PHANTOM TEST

Radiographer	Pulse rate	Dose	Time
1	3	0	0.01
2	3	0	0.01
3	3	0.1	0.02
4	3	0	0.01
5	3	0	0.01
6	3	0	0.01
7	3	0	0
8	3	0	0
9	3	0.1	0.03
10	3	0.2	0.05

SPINE PHANTOM RADIATION DOSES FOR FLOUROSCOPY
(Average 0.04 $mGym^2$)

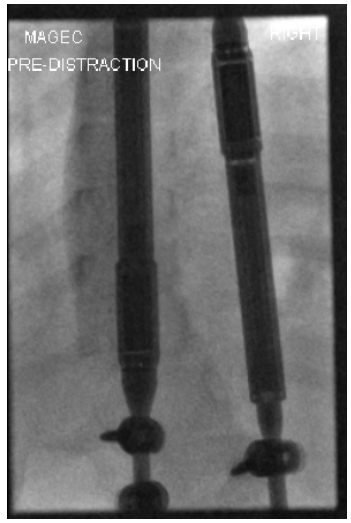
SPINE PHANTOM RADIATION DOSE FOR PLAIN X-RAY 0.5$mGym^2$

Methods

- 12 pts (9 M/3 F) Average age 5.2 yrs
- All had surgery for EOS
- 5 primary 7 conversions
- Radiation exposure dose comparison in conversion pts:
  whole spine x-rays pre-Magec vs fluoroscopy post-Magec
  Each pt acts as own control
- Imaging wthin previous 1 yr and up to 9 mnths post Magec
- Cancer induction risk calculated

Technique

- Patient in prone position:
- arms should be up away from the X-ray beam to avoid radiation scatter.
- Beam**:** C arm in frontal position (Image Intensifier over the table)
- Reference points: Mark drawn on back by surgeon after locating the actuators with a small magnet.
- Central beam directed to the mark drawn on patient's back. .
- Tube to II distance – standard 80cms.
- Collimate to include the actuator as directed by the surgeon**.**



- Exposure – flouro set to spine setting
- Average exposure of 60Kvp with duration 0.01 sec

Results

- Mean radiation exposure with X-ray whole spine: 0.11 mSv
- Mean radiation exposure with fluoroscopy: 0.0028 mSv
- Mean cancer induction risk with X-rays 1 in 247000
- Mean cancer induction risk with fluoroscopy 1 in 14.3 million

Radiation Exposure and Cancer Risk

Patient	Plain XR (mSv)	Cancer Induction Risk*	Fluoro (mSv)	Cancer Induction Risk*	Plain/Fluoro
1	0.11	1 in 170000	0.003	1 in 6700000	40
2	0.33	1 in 60000	0.005	1 in 3600000	65
3	0.04	1 in 450000	0.0004	1 in 50000000	111
4	0.04	1 in 470000	0.001	1 in 17000000	35
5	0.13	1 in 150000	0.002	1 in 12000000	87
6	0.07	1 in 280000	0.003	1 in 7000000	26
7	0.12	1 in 150000	0.005	1 in 4000000	26

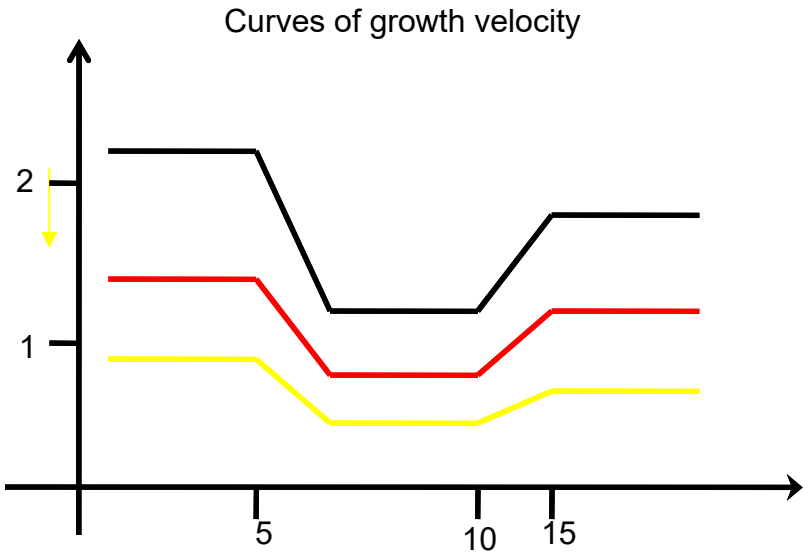
Conclusion

- Fluoroscopic evaluation is a useful technique
- Provides good visualization of distraction
- Allows assessment of proximal and distal fixation points
- Significantly reduced radiation exposure (up to 50 fold)

Distraction Techniques

- Outpatient clinic setting
- Targeted vs Maximum
- Vast debate surrounding frequency and technique of distraction
  - Kenneth Cheung, Hong Kong – 1/12
  - Hilali Noordeen RNOH Stanmore – 6/12
  - Colin Nnadi Oxford - Tail-gating – Dimeglio's growth curve

ANNUAL GROWTH VELOCITY T1 - L5
(Dimeglio)



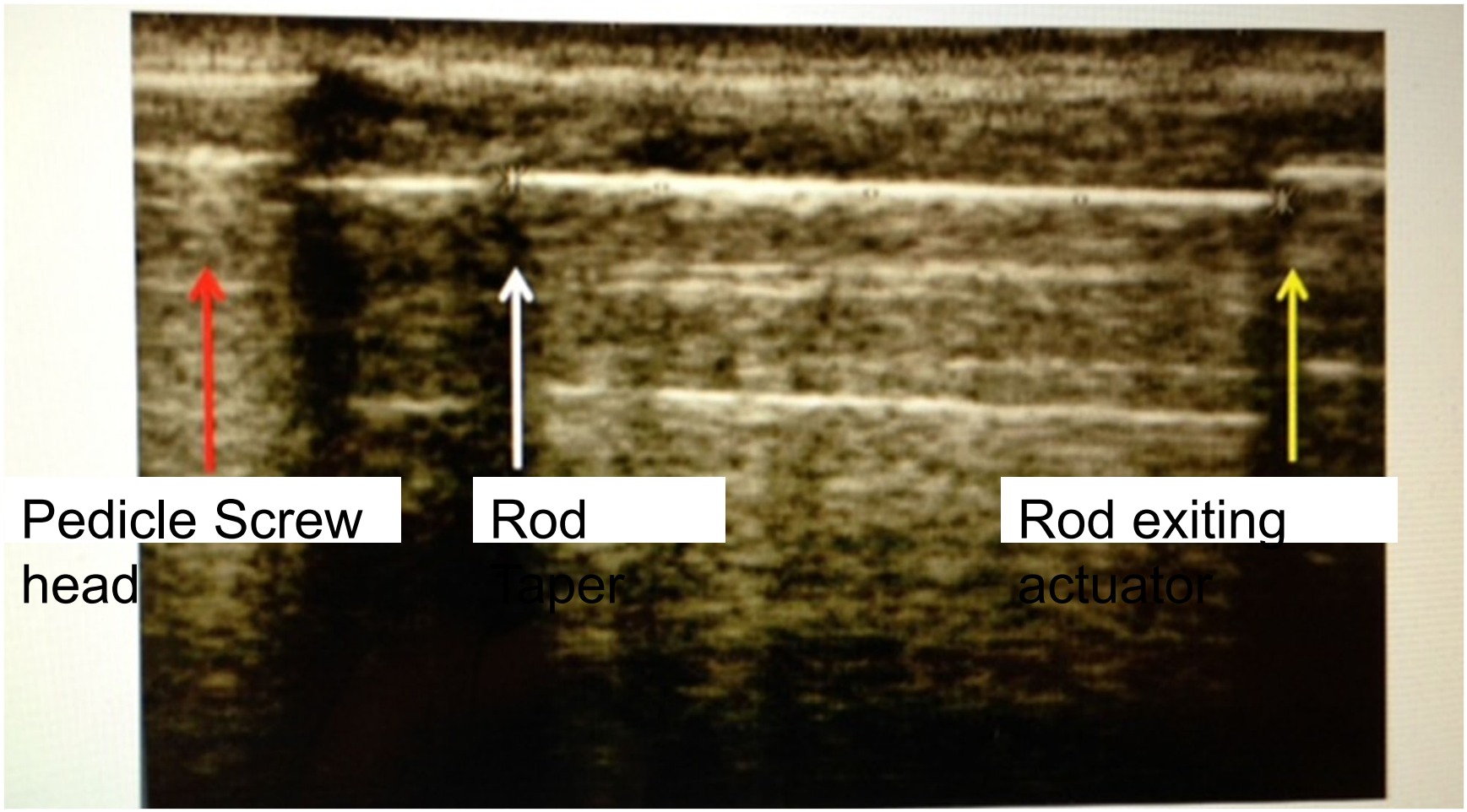
Birth – 5 yrs 2.2cm 20kg

5 – 10 yrs 1.1cm 30kg

10 yrs – Puberty 1.8cm >30kg

- ‘Maximum’ distraction with conventional GR
- ‘Law of diminishing returns’
  Skaggs et al Spine 2011
- ‘Tail-gating’ concept to shadow growth
- Spine in EOS does have growth potential
- Magec rods allow for controlled distraction
- Apply knowledge of expected growth
- Less force on construct = less risk of failure
- ‘Scientific approach’

Ultra Sound Distraction Measurement Landmarks



Thank you