TARGETED DISTRACTION: A TAIL-GATING TECHNIQUE

COLIN NNADI

Lead Clinician & Consultant Spine Surgeon

Spine Unit

Oxford University Hospitals UK

Disclosures

- Nuvasive

- MCGR has had favourable results since first publication in 2012
- Corrects spinal deformity and maintains growth
- Ability to match natural growth pattern of spine unknown
- Growth achieved through distraction
- 2 principal techniques – Maximum vs Targeted

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DEFORMITY

Targeted Distraction

Spinal Growth in Children With Early-Onset Scoliosis Treated With a Tail-gating Technique for Magnetically Controlled Growing Rods

Mihai Mardare, MD, MSc,* David Christopher Kieser, MBChB, PhD, FRACS, FNZOA,†
Adil Ahmad, MBBS, MRCS, BSc,* Thejasvi Subramanian, MBBS,*
Shahnawaz Haleem, MBBS, MSc, MRCSEd, MRCSI, FRCS (Tr&Orth),*
Chrishan Thakar, BSc, MBBS, MRCS, MSc, FRCS (Tr&Orth),*
James Wilson-MacDonald, MBBS, FRCS (Tr&Orth),* and Colin Nnadi, MBBS, FRCSI, FRCS(Orth)*

Distraction Techniques

Maximum distraction

- Linear actuator maximally distracted within tolerable level of discomfort
- Axial load generated > distraction mechanism capacity
- Audible or palpable clunk

Targeted distraction (Tail-gating)

- Utilises spinal growth charts (DiMeglio)
- Estimate distraction required to match ‘normal’ population
- Based on age and weight
- ‘common denominator’

Aim

- Assess whether standard use of MCGR with TGT accurately mirrors expected sitting to standing height ratio (S^2HR) of age and sex-matched normal European population
- S^2HR well recognized technique to account for normal variations in human height
- Controls bias introduced by outliers
- using S^2HR allows spinal growth (sitting height) to be directly compared to child's limb growth (standing height)
- Determines whether spine growth proportional to normal physiology

EUROPEAN DATA ON S^2HR

TABLE 3. Published Data on the Standing/Sitting Height Ratios of Females With European Descent[20–22,24–32]

Author	Age, yrs												
	3	4	5	6	7	8	9	10	11	12	13	14	15
Fredriks	0.569	0.552	0.547	0.541	0.537	0.531	0.528	0.522	0.519	0.518	0.517	0.519	0.522
Arriba Munoz	0.575	0.565	0.556	0.547	0.541	0.535	0.530	0.523	0.519	0.518	0.522	0.525	0.527
Marcondes	0.591	0.575	0.563	0.557	0.549	0.543	0.537	0.534	0.531	0.529			
Laska-Mierzejewska					0.532	0.531	0.524	0.519	0.515	0.515	0.519	0.521	0.523
Krogman					0.546	0.540	0.536	0.529	0.527	0.527	0.528	0.529	0.527
NZ Dept Health				0.545	0.544	0.535	0.530	0.526	0.521	0.514	0.517	0.528	0.528
Sabharwak					0.542	0.542	0.534	0.531	0.536	0.533	0.529	0.529	0.539
Lozano		0.568	0.557	0.548	0.540	0.532	0.529	0.528	0.523	0.524			
McCammon	0.580	0.567	0.559	0.550	0.543	0.535	0.530	0.524	0.520	0.516	0.516	0.519	0.521
Tuddenham							0.526	0.520	0.514	0.513	0.516	0.521	0.524
Simmons	0.580	0.571	0.563	0.554	0.546	0.537	0.530	0.525	0.518	0.517	0.523	0.528	0.530
Nelson			0.560	0.553	0.545	0.539	0.532	0.526	0.521	0.519	0.521	0.527	0.529
Mean	0.579	0.566	0.558	0.549	0.542	0.536	0.531	0.526	0.522	0.520	0.521	0.525	0.527
SD	0.008	0.008	0.005	0.005	0.005	0.004	0.004	0.004	0.006	0.006	0.005	0.004	0.005

TABLE 2. Published Data on the Standing/Sitting Height Ratios of Males With European Descent[20–31]

Author	Age, yrs												
	3	4	5	6	7	8	9	10	11	12	13	14	15
Fredriks	0.572	0.555	0.548	0.540	0.538	0.531	0.526	0.520	0.517	0.512	0.509	0.508	0.510
Arriba Munoz	0.579	0.570	0.559	0.551	0.544	0.531	0.524	0.519	0.514	0.514	0.514	0.516	0.519
Marcondes	0.591	0.572	0.566	0.558	0.550	0.545	0.539	0.534	0.529	0.526			
Laska-Mierzejewska					0.538	0.528	0.522	0.517	0.512	0.508	0.507	0.507	0.511
Krogman					0.547	0.534	0.538	0.530	0.524	0.519	0.514	0.520	0.522
NZ Dept Health				0.546	0.544	0.539	0.532	0.528	0.523	0.518	0.513	0.511	0.522
Mendez					0.527	0.539	0.538	0.530	0.528	0.523	0.518	0.521	0.522
Lozano		0.569	0.557	0.546	0.540	0.535	0.533	0.527	0.526	0.517			
McCammon	0.582	0.567	0.557	0.549	0.540	0.534	0.528	0.523	0.518	0.512	0.509	0.507	0.509
Tuddenham							0.529	0.523	0.517	0.512	0.509	0.509	0.511
Simmons	0.587	0.576	0.566	0.556	0.547	0.542	0.535	0.527	0.523	0.518	0.513	0.514	0.518
Nelson			0.563	0.555	0.545	0.539	0.533	0.527	0.523	0.516	0.514	0.510	0.515
Mean	0.582	0.568	0.559	0.550	0.542	0.536	0.531	0.525	0.521	0.516	0.512	0.512	0.515
SD	0.007	0.007	0.006	0.006	0.006	0.005	0.006	0.005	0.005	0.005	0.003	0.005	0.005

Materials and Methods

- Retrospective review
- Children of European descent
- MCGR insertion between 2011 – 2015
- 35 pts
- 17 M 18 F
- Av Age 7.7 (2.3 – 14.3)
- Idiopathic (9), Cong (4), NMS (3), Syndromic (19)

- Primary (21)
- Conversion (14)
- 31 dual/4 single
- FU 41mnths (21 – 69)

- Disproportionate dwarfism excluded

STATISTICAL ANALYSIS

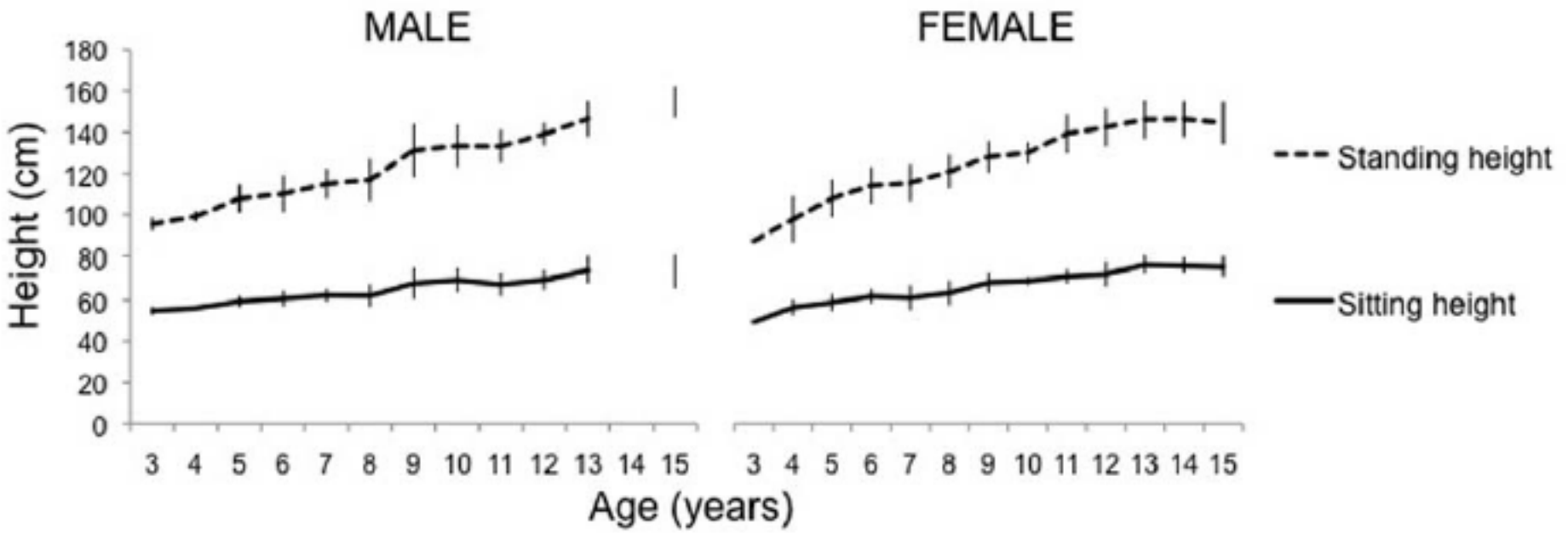
- Patient demographic and condition specific data analyzed as an average
- Radiographic outcome data and post-operative S^2H presented as a mean and standard deviation (SD).
- Comparison between the mean pre-operative and post-operative radiographic parameters and S^2H of each study performed with two-tailed homoscedastic t test.
- The international reference values for S^2HR in European children pooled according to age to determine a mean (SD).
- Post-operative results grouped according to patient age at each follow-up and average S^2HR plotted for each age bracket according to gender.
- Comparison of patients to the international reference range performed with Pearson correlation coefficient to determine similarity in the trend of S^2HR with age and sex.
- Further analyzed results with paired t test between our data and the international means
- Able to determine overall difference between our patients and the expected normative values.
- Statistical significance defined as a P value < 0.05.

Results

TABLE 1. Overall Mean (± 1SD) Radiographic Outcomes

	Pre-operative	Immediate Post-operative	6 Months Post-operative	12 months Post-operative	24 Months Post-operative	Latest Follow-up
Major curve cobb angle, °	52.3 (17.0)	37.2 (16.8)	34.5 (14.2)	35.7 (14.4)	37.3 (14.3)	38.7 (16.1)
Thoracic kyphosis, °, (T1–T12)	43.7 (20.9)	35.9 (16.8)	42.4 (17.5)	39.6 (20.2)	42.0 (20.5)	47.7 (43.8)
T1–T12 height, mm	168.6 (32.8)	177.4 (30.1)	185.6 (34.9)	190.3 (33.7)	182.6 (33.7)	190.5 (36.6)
T1–S1 height, mm	292.4 (50.0)	299.6 (43.8)	309.3 (50.7)	317.5 (49.2)	313.1 (47.7)	327.1 (51.6)

Post-operative cumulative mean sitting and standing heights



Sitting/standing height ratios vs international normal reference values

Pearson correlation coefficient of 0.95 for males and 0.90 for females

0.0124 (P<0.001) for males and 0.0068 (P<0.010) for females

(mean difference between expected and observed S^2HR)

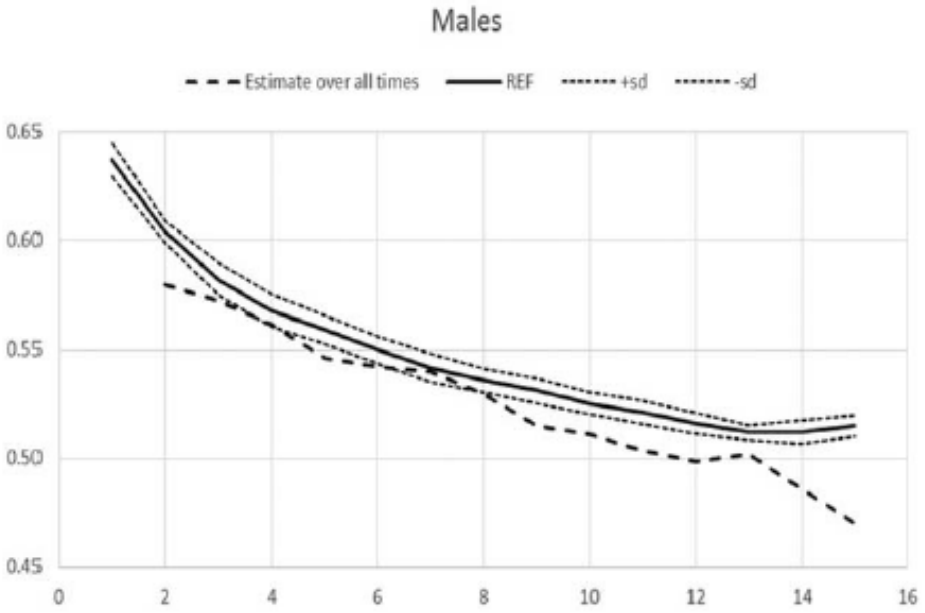


Figure 2. Sitting/standing height ratio for our male patients (blue line) compared with the reference international normative values (black line) ±1 SD for European populations (dashed line).

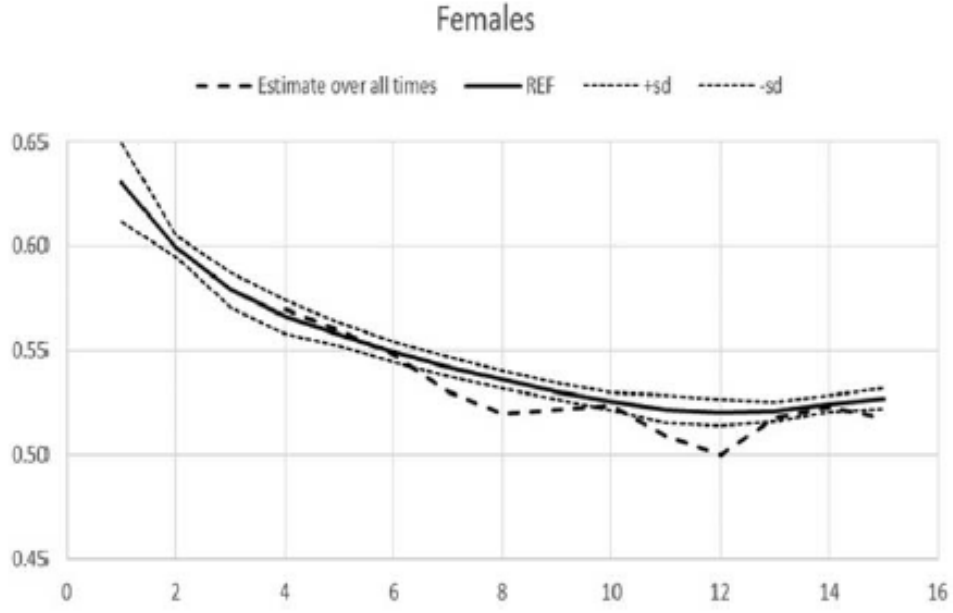


Figure 3. Sitting/standing height ratio for our female patients (blue line) compared with the reference international normative values (black line) ±1 SD for European populations (dashed line).

? Clinical Significance

Discussion

- Only included European populations in cohort and in literature review to control for ethnic influences on childhood growth
- (Pearson correlation coefficient of 0.95 for males and 0.90 for females) show that TGT accurately mirrors expected normal spinal growth in children with EOS treated with MCGR.
- However, TGT patients generally have shorter than expected sitting height in comparison to standing height
- Suggests TGT patients' spinal length < expected (mean difference between the expected sitting/standing height ratio and TGT results was 0.0124($P<0.001$) for males and 0.0068 ($P<0.010$) for females)
- Curve control and complication rates compare favourably to published reports