

Abstract Book



17th International Phillip Zorab Symposium

One Great George Street, London
23rd - 24th June, 2022

Abstracts Podium Presentations Session 1

Title	The ciliary pathway implication in Adolescent Idiopathic Scoliosis
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Objectives	The aim of this study is to clarify the implication of ciliary pathway on the onset of the spinal curvature that occurs in Adolescent Idiopathic Scoliosis (AIS) patients through functional studies of two genes: POC5 and TLL11. Since the genetic implication for AIS is accepted, many association and candidate gene analysis revealed the implication of ciliary genes.
Methods	The characterisation of these two proteins was assessed by qPCR, WB and immunofluorescence in vitro using control cells and cells derived from AIS patients. The impact of genetic modification of these genes on the functionality of the proteins in vitro and in vivo was analysed in zebrafish model created by CRISPR/Cas9 using microCT and histologic analysis.
Results	Our study revealed that mutant cells, for both gene, were less ciliated and the primary cilia was significantly shorter compare to control cells. We also observed a default in cilia glutamylation by immunofluorescence and Western Blot. Moreover, we observed in both zebrafish model, a 3D spine curvature similar to the spinal deformation in AIS. Interestingly, our preliminary results of immunohistology showed a retinal defect, especially at the cone cell layer level.
Conclusions	This study strongly supports the implication of the ciliary pathway in the onset of AIS and this is the first time that a mechanism is described for AIS. Indeed, we show that shorter cilia could be less sensitive to environmental factors due to lower glutamylation and result in altered signaling pathway. Identifying the biological mechanism involved is crucial for elucidating AIS pathogenesis.

Abstracts Podium Presentations Session 1

Title	Increased dynamic stability in children with Adolescent Idiopathic Scoliosis
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Objectives	There is a need for non-radiographic, objective outcome measures for children with Adolescent Idiopathic Scoliosis (AIS). Standing balance and stability is altered in children with AIS. The Margin of Stability (MoS) has been used to compare gait stability clinical populations. Our objective is to compare the MoS in anterior-posterior (MoSAP) and mediolateral (MoSML) directions in girls with AIS to controls.
Methods	Girls with AIS and healthy girls walked at three speeds on an instrumented treadmill wearing retroreflective markers, surrounded by motion capture cameras. The MoSAP/ML was calculated at left and right heel strike. Data was processed using Visual 3D. A two-way ANOVA was used to compare MoSAP/ML between group, speed and the interaction between group and speed.
Results	A priori power analysis suggested 12 participants per group. Three cases and four controls were recruited so far. Girls with AIS all had right-sided main thoracic curves (Lenke type 1a, $61.3^\circ \pm 10.0^\circ$). MoSAP was significantly bigger for cases compared to controls on the left ($p=0.038$) and right foot ($p=0.041$). There was no significant difference between cases and controls for MoSML. There was no significant difference for speed or the interaction between group and speed for MoSAP or MoSML. Further subjects are being recruited.
Conclusions	Girls with AIS were more stable in the anterior-posterior direction during walking compared to controls, and speed did not affect this difference. There was no difference in mediolateral stability between cases and controls. Future work could test the effect of treatment and Cobb angle severity on the MoS.

Abstracts Podium Presentations Session 2

Title	Should traditional growth rods be revised to MAGEC?
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Objectives	There is limited information available surrounding effectiveness of revising TGR to MAGEC. We hypothesis that patients who undergo revision of TGR to MAGEC have limited remaining capacity for further spinal growth. To investigate this further we retrospectively reviewed all patients who underwent revision of TGR to MAGEC in our institute.
Methods	A retrospective observation review of all patients who had revision of TGR to MAGEC between 1st March 2010 and 1st March 2020.
Results	8 patients underwent revision of their TGR to MAGEC, 4 of which were female. 2 patients had congenital scoliosis, 2 had neuromuscular scoliosis and 4 had idiopathic scoliosis. Median age at insertion of TGR was 4.5 (4.3-5.6) years. TGR were revised to MAGEC after 4.6 (3.8-6.1) years. Median age at insertion of MAGEC was 9.2 (8.9-10.0) years. Children were followed up for 4.7 (4.4-5.2) years after insertion of their MAGEC rods. At the time of this review, two patients had undergone definitive fusion surgery. Overall a median of 28.9 mm (22.3-44.7) distraction was achieved with TGR, and 4.6 mm (1.1-12.0) with MAGEC. When taking in to account the number of years each method of distraction was used, an 8.23 (6.0-9.0) mm/year of spinal distraction was achieved during the use of TGR and 1.0 (0.2-2.6) mm/year with MAGEC (p<0.001).
Conclusions	Based on our experience there is limited potential remaining for spinal lengthening when revising TGR to MAGEC.

Abstracts Podium Presentations Session 3

Title	Development of a core outcome set for Adolescent Idiopathic Scoliosis (AIS): An exploration of views from a range of stakeholders
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Objectives	A Core Outcome Set (COS) for treatment of adolescent idiopathic scoliosis (AIS) is essential to ensure that the most meaningful outcomes are evaluated and used consistently. Measuring the same outcomes ensures evidence from clinical trials and routine clinical practice of different treatments can be more easily compared and combined, therefore increasing the quality of the evidence base. The SPINE-COS-AYA project aims to develop a gold standard COS which can be used internationally in research and routine clinical practice to evaluate the treatment (surgical and bracing) of AIS.
Methods	In this qualitative study, the views of adolescents and young adults with AIS (10-25 years of age), their family members and healthcare professionals in a UK region were sought, via interviews, on treatment outcomes. Participants were purposively recruited from a variety of sources including NHS outpatient clinics and social media. Semi-structured interviews were analysed using thematic analysis.
Results	Key findings will be presented, to include potential core outcome domains identified by the different subgroups.
Conclusions	The core outcome domains identified in this research programme will subsequently form part of an international consensus survey to agree a COS. In future, if the COS is used by healthcare staff and researchers, it will be easier for everyone, including patients and their families, to assess which treatment works best.

Abstracts Podium Presentations Session 3

Title	Optimisation and validation of thermal adherence sensors for monitoring spinal orthosis wear-time in a clinical trial
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Objectives	Thermal sensors have been used in bracing research as self-reported diaries are inaccurate. Little is known about new low-profile sensors, optimal location within a brace, locational thermal micro-climate and effect of brace lining. Our objective is to Determine an optimal temperature threshold for sensor-measured and true wear time agreement. Identify optimal sensor location. Assess all factors to determine the best sensor option for the Bracing Adolescent Idiopathic Scoliosis (BASIS) multicentre RCT.
Methods	Seven Orthotimer and five iButton (DS1925L) sensors were synchronised to record temperature at five-minute intervals. Three healthy participants donned a rigid spinal brace, embedded with both sensors across four anatomical locations (abdomen/axilla/lateral-gluteal/sacral). Universal-coordinated-time wear protocols were performed in/out-doors. Intraclass correlation coefficient (ICC) assessed sensor-measured and true wear time agreement at thresholds 15-36oC.
Results	Optimal thresholds, determined by largest ICC estimate: Orthotimer: Abdomen=26oC, axilla=27oC, lateral-gluteal=24.5oC, sacral=22.5oC. iButton: Abdomen=26oC, axilla=27oC, lateral-gluteal=23.5oC, sacral=23.5oC. Warm-up time and error at optimal thresholds increased for moulded sensors covered with 6mm lining.
Conclusions	Location: anterior abdominal wall. Excellent reliability and higher optimal thresholds, less likely to be exceeded by ambient temperature; not a pressure area. Sensor: iButton, longer battery life and larger memory than Orthotimer; allows recording at 10 min intervals for life of brace. Orthotimer only able to record every 30 mins, increasing error between true and measured wear time; Orthotimer needs 6-monthly data download. Threshold: 26oC is optimal threshold to balance warm-up and cool-down times for accurately measuring wear time. Sensor should not be covered by lining foam as this significantly prolongs warm-up time.

Abstracts Podium Presentations Session 3

Title	Double-rod vs Single rod Instrumentation For the Correction of Neuromuscular Scoliosis (NMS)
Main author	Chadi Ali
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Objectives	Less invasive single-rod fusion technique may be indicated in the management of NMS to minimise operative time, blood loss and wound-related complications. This retrospective 12-year cohort study (2008-2020) aims to evaluate and compare the outcomes of this technique to the current standard dual rod technique to determine their safety and efficacy.
Methods	28 patients in the single rod group (Mean age = 16.4 [SD ±4.0]) and 30 in the double rod group (Mean age = 16.3 [SD±3.5]). Indications included a minimum 2 year follow period, detailed information on the type of implant and a complete pre- and post-operative imaging and medical records. Baseline demographics, comorbidities, and surgical characteristics were collected. Outcomes assessed included the immediate post-op and final follow up angles and general complications. All outcome analysis was performed using a regression approach.
Results	Angles at final follow-up: lumbar (Difference ratio (DR)= 2.60 [95% CI 0.37 – 18.4], p=0.25), thoracic (DR= 1.08 [95% CI 0.19 - 6.28], p=0.92), thoracolumbar (major curve angle) (DR 1.35 [95% CI 0.60 - 3.06], p=0.46) and kyphosis (DR = 0.97 [0.66, 1.42] p=0.86). There was no statistically significant difference, between the two groups, for any of the above angle outcomes as well as for length of surgery, blood loss and complication outcomes.
Conclusions	Both single and double rod instrumentation achieves satisfactory and safe deformity correction which is maintained at final follow up. A larger scale study is warranted to further assess these techniques while also conducting a cost-benefit analysis between them.

Abstracts Podium Presentations Session 4

Title	Treatment of adjacent spinal surgical site infections with a biphasic antibiotic eluting osteoconductive scaffold (cerament g)
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Objectives	Surgical site infections following spinal surgery profoundly influence continued treatment, significantly impacting psychological and economic dimensions and clinical outcomes. Its reported incidence varies up to 20%, with the highest incidence amongst neuromuscular scoliosis and metastatic cord compression patients. We describe the first reported biphasic osteoconductive scaffold (Cerament G) with a logarithmic elution profile as a cumulative strategic treatment modality for adjacent spinal surgery infections.
Methods	All patients who developed surgical site infections following instrumented fusion (May 2021-December 2021) had their demographics (age, sex), type and number of procedures, isolated organism, antibiotics given, comorbidities, and WHO performance status analysed. The infected wound was debrided to healthy planes, samples taken, and Cerament g applied.
Results	Thirteen patients were treated for deep SSI following spinal instrumentation and fusion procedures with intraoperative Cerament G application. There were four males and nine females with an average age of 40 ranging between 12 and 87. Nine patients underwent initial surgery for spinal deformity, and four were treated for fractures as index procedure. 77% of infections were attributable to MSSA and Cutibacterium acnes; others included Klebsiella, Pseudomonas and Streptococcus and targeted with multimodal cumulative therapy. A WHO performance score improved in 11 patients. In addition, there was no wound leak, and infection was eradicated successfully in 12/13 with a single procedure.
Conclusions	This series shows the successful eradication of the infection and improved functional outcomes with Cerament G. However, the low numbers of patients in our series are an essential consideration for the broader applicability of this device.

Abstracts Podium Presentations Session 4

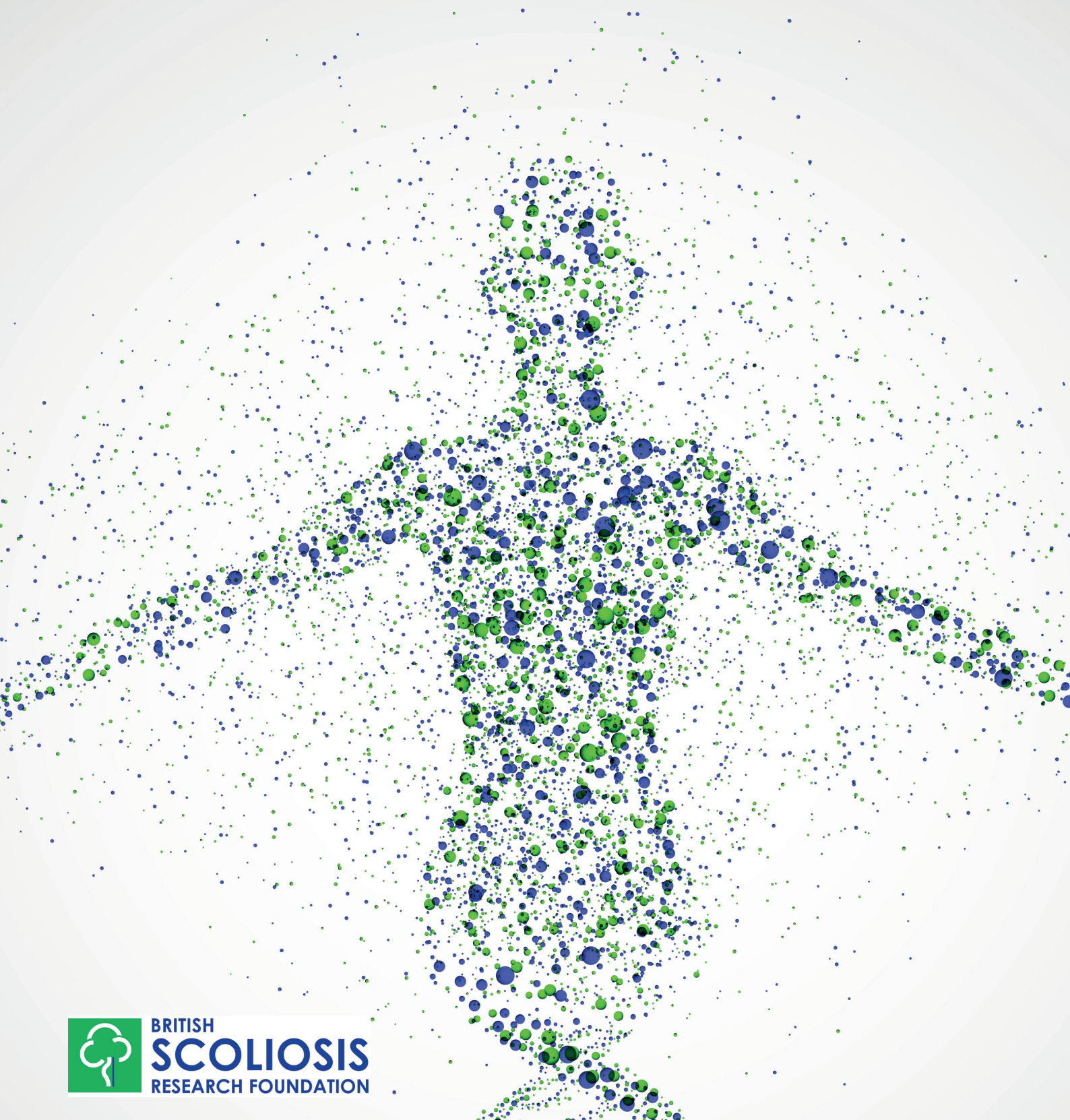
Title	Does Maldistributed Lumbar Lordosis Lead to Mechanical Failure in Long Fusions? Lordosis Distribution Index (LDI) in Long Segment Lumbar Spine
Main author	Puneet Tailor
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Objectives	The lordosis distribution index (LDI) describes distribution of lumbar lordosis, measured as the % of lower lumbar lordosis (L4-S1) compared to global lordosis (L1-S1) with normal value 50-50%. Maldistributed LDI is associated with higher revision in short lumbar fusions, 4 vertebrae. We hypothesise maldistributed LDI is also associated with mechanical failure in longer fusions.
Methods	Retrospective review of 29 consecutive ASD patients, aged 55+, undergoing long lumbar fusion, 4 levels, with >3-years follow-up. LDI, pelvic incidence (PI) and sagittal vertical axis (SVA) were measured on pre- and post-op whole spine standing X-rays (Fig A and B). Patients were categorized according to their pelvic incidence (PI) and postoperative LDI: Normal (LDI 50-80), Hypolordotic (LDI < 50), or Hyperlordotic (LDI > 80) and assessed for failure rate compared to normal LDI and PI < 60.
Results	Mean follow-up 4.5 years. 19 patients had mechanical failures including junctional failure and metalware fracture. PI > 60 was associated with higher mechanical failure rates (Chi ² p < 0.05). Hypolordotic LDI was associated with 82% mechanical failure (Chi ² p < 0.001), Hyperlordotic 88% mechanical failure (Chi ² p < 0.001) and Normal 8% mechanical failure (Table 1).
Conclusions	Maldistributed LDI, whether Hyperlordotic or Hypolordotic, correlated with 10x greater mechanical failure rate compared to Normal LDI in long fusions. LDI is a useful measurement that should be considered, especially in high PI patients.

Abstracts Podium Presentations Session 4

Title	Spinal HDU-plus – a new, cost-effective and safe place for the postoperative management of high risk children undergoing scoliosis surgery
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Objectives	Children undergoing posterior spinal fusion (PSF) for neuromuscular and syndromic scoliosis were admitted to the paediatric intensive care (PIC) until about 6 years ago, at which time we created a new unit, a hospital floor-based spinal high-dependency unit-plus (SHDU-plus), in response to frequent bed-shortage cancellations. This study compares postoperative management on PIC with HDU-plus for these non-hospital floor suitable children with syndromic and neuromuscular scoliosis undergoing PSF.
Methods	Retrospective review of 100 consecutive children with syndromic and neuromuscular scoliosis undergoing PSF between June 2016 and January 2022. Inclusion criteria were: 1) diagnosis of syndromic or neuromuscular scoliosis, 2) underwent PSF, 3) not suitable for immediate postoperative hospital floor-based care. Exclusion criteria were children with significant cardio-respiratory co-morbidity requiring PIC postoperatively.
Results	55 patients were managed postoperatively on PIC and 45 on SHDU-plus. No significant difference between groups was found with respect to age, weight, ASA grade, preoperative Cobb angles, operative duration, number of levels fused and estimated blood loss. 4 patients in the PIC group and 1 in the SHDU-plus group were readmitted back to PIC or HDU following step-down to the hospital floor. Average length of stay was 2 days on PIC and 1 day on SHDU-plus. Average total length of hospital stay was 16.5 days in the PIC group and 10.5 days in the HDU-plus group. 19 (35%) patients developed complications in the PIC group, compared to 18 (40%) in SHDU-plus. Mean specialist unit charge per day was less on SHDU-plus compared with PIC. There were no bed-shortage cancellations in the SHDU-plus group, compared to 11 in the PIC group.
Conclusions	For children with neuromuscular or syndromic scoliosis undergoing PSF, and deemed not suitable for post-operative care on the hospital floor, creation of a SHDU-plus was associated with fewer readmissions back to PIC or HDU, shorter hospital stay, an equivalent complication rate, significant cost-saving and fewer cancellations. Level of Evidence: Therapeutic Level III

Abstracts Podium Presentations Session 4

Title	AIS spinal osteoblasts subjected to mechanical strain do not revert to the transcriptomic phenotype of osteoblasts at the curve apex
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Objectives	We previously reported that osteoblasts at the curve apex in adolescent idiopathic scoliosis (AIS) exhibit a differential phenotype, compared to non-curve osteoblasts ⁽¹⁾ . However, the Hueter-Volkman principle on vertebral body growth in spinal deformities ⁽²⁾ suggests this could be secondary to altered biomechanics. This study examined whether non-curve osteoblasts subjected to mechanical strain resemble the transcriptomic phenotype of curve apex osteoblasts.
Methods	Facet spinal tissue was collected perioperatively from three sites, (i) the concave and (ii) convex side at the curve apex and (iii) from outside the curve (non-curve) from six AIS female patients (age 13-18 years; NRES 19/WM/0083). Non-curve osteoblasts were subjected to strain using a 4-point bending device. Osteoblast phenotype was determined by RNA sequencing and bioinformatic pathway analysis.
Results	RNAseq revealed that curve apex osteoblasts exhibited a differential transcriptome, with 1014 and 1301 differentially expressed genes (DEGs; p<0.05, fold-change >1.5) between convex/non-curve and concave/non-curve sites respectively. Non-curve osteoblasts subjected to strain showed increased protein expression of the mechanoresponsive biomarkers COX2 and C-Fos. Comparing unstimulated vs strain-induced non-curve osteoblasts, 423 DEGs were identified (p<0.05, fold-change >1.5). Of these DEGs, only 5% and 6% were common to the DEGs found at either side of the curve apex, compared to non-curve cells. Bioinformatic analysis of these strain-induced DEGs revealed a different array of canonical signalling pathways and cellular processes, to those significantly affected in cells at the curve apex.
Conclusions	Mechanical strain of AIS osteoblasts in vitro did not induce the differential transcriptomic phenotype of AIS osteoblasts at the curve apex.



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