Supplementary methodology

Radiography methods and analysis

Digital radiography of the whole spine ('scoliosis protocol') in the unsupported patient was performed using Philips Digital Diagnost version 2 (2.0.2.SPI). Coverage began at the external auditory meatus (EAM) and extended caudally to include the femoral heads. Patients were positioned by one researcher and one radiographer and were instructed with the following commands: 'We want to see what your spine looks like normally, so please stand as is normal for you the majority of the time'. Whole spine acquisition was acquired in two segments and stitched in a semi-automated fashion (the two films were automatically overlaid with final adjustments performed manually) to produce a whole spine radiograph. CT scans were performed on a Siemens SOMATOM Definition AS 128 slice multidetector CT (Siemens, Erlangen, Germany). Patients were positioned by one researcher and one radiographer supine on the table with just one head support (identical for each patient), no additional cushions or supports were used in order to achieve a neutral unsupported supine position. The 'arms down' position (arms by the patient's side) was used in order view normal supine spinal alignment. Spiral acquisition of images with coverage from the EAM down to and including the femoral heads was performed. Acquired images were reconstructed on 0.6mm bone and soft-tissue algorithms which included a reconstruction of the true AP and lateral radiographic projection (to give a two dimensional (2D) maximal intensity projection composite) and a three-dimensional (3D) surface rendered reconstruction.

Measurements of the spinal parameters were undertaken by 2 of the researchers on the radiographs and CT projections, measurements were taken based on the guidelines set out by the Spinal deformity study group consensus[1]. The major curve was identified and assessed using the Cobb method[2], this involved identification of the apical vertebra (i.e. the most laterally displaced, most internally rotated, but least tilted segment) followed by identification of the cranial and caudal end vertebrae from which the angle was measured (supplementary figure A). The cranial and caudal end vertebrae selected to measure the scoliosis angle in the standing radiograph were also used in the supine CT derived images (supplementary figure B). The Nash-Moe method of assessing degree of vertebral rotation was graded for the apical vertebra[3] (supplementary figure C). Scoliosis was defined as spinal curvature with at least 10^0 measured by the Cobb method plus the presence of at least grade one vertebral rotation as measured by the Nash-Moe scale. The relative collapse of scoliotic curves was calculated as the difference between the Cobb angle standing and supine divided by the Cobb angle standing as previously described[4]. The 3D surface rendered images were used to assess osteophytic changes extending from the surface of the vertebrae. The vertebral bodies rendered fixed by osteophytic bridging was quantified.

Analysis of the spinal parameters (radiographs and radiographic projections from the CT reconstructions) were performed on Agfa IMPAX picture archiving and communications systems (PACS) (IMPAX 6.4.0.4551, Agfa Healthcare N.V. Belgium, 2010) and viewed on 3 megapixel monochrome Barco monitors (Barco MXRT 5200). Analysis of the 3D surface rendered images was performed on Siemens Leonardo Syngo MMWP VE36A workstations (Siemens AG, Munich 2009). All radiographic devices utilised for acquisition, analysis and viewing were medical standard.

Statistical methods

Radiological parameters were assessed for inter-observer correlation using Kendall's coefficient of concordance. All parameters used in the final analysis were deemed concordant at the significant level of p=0.05 and the mean of the concordant values used for further calculations. Clinical, demographic and radiological features from the two subgroups (those with mobile scoliosis and those with 'structural scoliosis') were compared using student's t-test (95% confidence intervals) for continuous variables and Fisher's exact tests for nominal variables. Correlations were assessed by scatter plot and Pearson's test of correlation. SPSS 19.0 statistical package was employed for all analyses.

This study was approved by the National Research Ethics Service (NRES) in London - Bloomsbury (Central London REC 2).

Legend for supplementary figure

Supplementary figure: Quantification of scoliosis on spinal imaging.

A Whole spine Anterior-posterior radiograph (patient standing). The area where the 2 images were stitched can be seen by the broken white lines. The apical vertebra of the primary scoliotic curve is crossed by 2 blue lines (centroid method). The cranial and caudal vertebra of the curve were selected and the Cobb angle of the curve measured as 38.8^0 (green lines). **B** Two-dimensional radiographic projection reconstructed from the CT scan of the same patient in A, but in the supine position **C** Nash-Moe method for assessment of vertebral rotation: white arrow = grade 0 (neutral), red arrow = grade 1 (pedicles have rotated so that one is at edge of the vertebral body).

References

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