Free Paper Session III: Spine

FP3.1

Full Endoscopic Unilateral Laminotomy for Bilateral Decompression for Lumbar Spinal Stenosis: An Early Review

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Introduction: Full endoscopic unilateral laminotomy for bilateral decompression (FE-ULBD) via a single portal is one of the most minimally invasive options for decompressing the spinal canal in patients suffering from lumbar spinal stenosis. In this study we reviewed the clinical outcomes of patients who underwent this treatment modality.

Methods: We reviewed patients who underwent FE-ULBD from October 2018 to July 2019. Patients' improvement in symptoms, operating time, postoperative drain output, length of stay, and incidence of complications were all analysed.

Results: In total, 17 patients received FE-ULBD within the study period and all patients reported improvement in their symptoms. The claudication time improved from 12.2 minutes (standard deviation [SD]=6.2 minutes) to 55.6 minutes (SD=39.1 minutes) [$p<0.01$]. A total of 18 levels were decompressed and the mean operating time per level was 131 minutes (SD=23.5 minutes). The mean postoperative drain output was 52.7 mL (SD=22.4 mL) and the mean length of stay was 4.2 days (SD=1.0 days). There was no incidence of durotomy, or nerve injury and no patient required additional decompression or fusion operation afterwards in the study period.

Conclusion: The FE-ULBD provides a safe and effective means of decompression in patients with lumbar spinal stenosis, with the benefits of less surgical trauma, shorter length of stay, and preservation of posterior tension band for better stability.

FP3.2

Cement-augmented Pedicle Screws for Short Segment Posterolateral Fusion with Kyphoplasty for Complicated Osteoporotic Vertebral Fractures: A Case Series

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Introduction: Patients with complicated osteoporotic vertebral fractures that require surgical treatment are most commonly treated by anterior approach, or by a combined anterior and posterior approach. These patients are often elderly with multiple medical comorbidities. We adopted a less invasive surgical method with good results: a posterior only approach with posterior decompression, kyphoplasty, short segment cement augmented instrumentation, and posterolateral fusion.

Methods: We reviewed 17 patients with complicated osteoporotic vertebral fractures with kyphoplasty and cement augmented short posterior instrumentation and posterolateral fusion done at a single centre from March 2013 to March 2019. Fourteen of them had neurological deficits, two had unstable fractures, and one had fracture non-union. The change in Cobb's angle, improvement in Japanese Orthopaedic Association (JOA) score and ASIA Impairment Scale, blood loss, and operating time was measured for each case.

Results: There was a mean improvement of Cobb's angle of 13 degrees. A total of 83% patients had improvement of JOA score with a mean improvement of 5. Nine out of 14 patients with neurological deficits improved at least 1 ASIA grade postoperatively. Mean operating time was 4 hours and mean blood loss was 456 mL. There was one case of postoperative wound infection which subsided with wound debridement and course of antibiotics. There were no cases of cement leakage or implant failure in our series.

Conclusion: For elderly patients with complicated osteoporotic vertebral fractures, a less invasive, posterior only approach with short segment cemented pedicle screw instrumentation shows reasonably good neurological and radiological results.

FP3.3

Anterior Column Realignment Application for Adult Spinal Deformity: A Prospective Cohort Study

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Introduction: Adult spinal deformity is a problem of growing prevalence owing to ageing population and longer life expectancies. Anterior column realignment (ACR) is a relatively new and emerging minimally invasive surgery for adult spinal deformity which has the potential to provide similar corrective ability to traditional posterior approaches. This study aimed to review the outcome of ACR in terms of deformity correction in restoring the sagittal imbalance.

Methods: We performed a prospective cohort study sampling patient with degenerative adult deformity with significant pelvic incidence–lumbar lordosis mismatch and positive sagittal balance. A total of 10 patients were recruited from May 2017 to May 2018 in authors' institution, a regional hospital in Hong Kong.

Results: There is overall improvement in segmental lordosis of a mean of 12.6 degrees with subsidence rate of 15%. Mean operating time (ACR part) was 120.5 minutes and the mean operating time including posterior element was 212.5 minutes. The mean total blood loss per level was 234 mL and the mean length of stay was 4.75 days. Nine out of 13 levels had follow-up computed tomography scan at 6 months and all of them showed successful fusion.

Conclusion: The ACR has the advantage of inserting anterior or lateral cages with comparable results in improving the sagittal profile compared with traditional approaches. It also has the advantage of being a minimally invasive procedure which minimises blood loss and shortens length of hospital stay. It remains a safe and effective method with careful anatomical consideration, adequate experience, and proper training.

FP3.4

Predictors of Flatback Deformity during Brace Treatment for Adolescent Idiopathic Scoliosis: Influence of Spinopelvic Parameters

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Introduction: The effect of bracing on the sagittal spinopelvic alignment in adolescent idiopathic scoliosis is unknown. The objective of this study was to determine the influence of pelvic parameters on tendency of patients with adolescent idiopathic scoliosis to develop sagittal alignment changes after brace treatment and its effect on quality of life (QoL) outcomes.

Methods: In total, 265 subjects under Boston bracing were recruited between December 2008 and 2013. Posteroanterior and lateral radiographs were obtained before and after completion of bracing with 2-year post-brace follow-up. Multiple regression analyses utilising various parameters of coronal and sagittal parameters to determine sagittal parameter changes was performed and the refined Scoliosis Research Society 22-item questionnaire (SRS-22r) studied QoL changes. Odds ratios (ORs) were generated.

Results: Reduced T5-12 kyphosis (mean -4.3° [standard deviation (SD)=8.2]; $p<0.001$), maximum thoracic kyphosis (mean -4.3° [SD=9.3]; $p<0.001$), and lumbar lordosis (mean -5.6° [SD=12.0]; $p<0.001$) were observed after bracing treatment. Increasing pre-brace maximum kyphosis (OR=1.133) and lumbar lordosis (OR=0.92) was associated with post-bracing hypokyphotic change. Pre-brace sagittal vertical axis (OR=0.975), pre-brace sacral slope (OR=1.127), pre-brace pelvic tilt (OR=0.940), and change in maximum thoracic kyphosis (OR=0.878) were predictors for lumbar hyperlordotic changes. These sagittal parameter changes did not lead to worsened SRS-22r scores.

Conclusion: Brace treatment leads to flatback deformity with thoracic hypokyphosis and lumbar hypolordosis. Changes in the thoracic spine are associated with similar changes in the lumbar spine. Increased sacral slope, reduced pelvic tilt and pelvic incidence are associated with reduced lordosis in the lumbar spine after bracing, without worsening of QoL.

FP3.5

Morphological Changes on Intervertebral Disc and Vertebral Wedging in Patients with Adolescent Idiopathic Scoliosis: A Magnetic Resonance Imaging-based Study

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Introduction: Previously, our studies showed that there was significant reduction of spinal cord tethering to vertebral column ratios in adolescent idiopathic scoliosis (AIS). In accordance, other studies postulated that the intervertebral disc (IVD) may potentially be deteriorated and have further degeneration due to the rotatory deformity with progression. The aim of this study was to evaluate the difference of IVD and vertebral wedging between girls with or without AIS.

Methods: The magnetic resonance multiplanar reconstruction was performed in 30 adolescent girls (10 with moderate and 10 with severe AIS with right-sided thoracic curve, and 10 age- and sex-matched controls). Measurements of IVD and vertebral height difference ratio, length, wedge angle and area, position of nucleus pulposus in coronal and sagittal profiles were performed. Spearman correlation test was made with selected parameters and Cobb's angle.

Results: There were significant differences on IVD and vertebral wedging and height difference ratio between AIS and controls. Also, the position of nucleus pulposus in AIS subjects was significantly shifted to the convexity as well as wedging. No difference in disc area was found. The vertebral wedging and height difference ratio and the position of nucleus pulposus were positively correlated with Cobb's angle ($R=0.782$, $R=0.781$ and $R=0.850$, $p<0.01$). However, these differences were not found in sagittal profile.

Conclusion: Although disc degeneration has not been found yet, the mechanical effect of scoliosis leads to both IVD and vertebral wedging only happened in coronal profile. Nevertheless, the above features may suggest the potential cause of scoliosis for further curve progression.

FP3.6

Patterns of Coronal and Sagittal Deformities in Adolescent Idiopathic Scoliosis

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Introduction: To determine the association between the coronal deformity and sagittal malalignment in patients with adolescent idiopathic scoliosis (AIS), and their possible influence on patient-perceived quality of life.

Methods: A retrospective cross-sectional study of 1054 patients (10-18 years old) with AIS was performed. The coronal Cobb's angle curvature were measured on posteroanterior radiographs. Sagittal parameters including thoracic kyphosis (TK) and lumbar lordosis (LL), pelvic incidence (PI), PI-LL mismatch (PI-LL), pelvic tilt, and sacral slope (SS) were measured on lateral radiographs. Patients were separated into groups according to the location of coronal major curve and the number of coronal structural curves, respectively. The refined 22-item Scoliosis Research Society questionnaire (SRS-22r) was collected to examine patient-perceived quality of life. Sagittal values were compared between groups, and its association with SRS-22r scores.

Results: Thoracic major curves have significantly less PI-LL mismatch ($p=0.0019$), smaller LL ($p=0.0032$), and increased loss of TK ($p<0.001$) compared with thoracolumbar or lumbar major curves. Multiple structural curves group had significantly larger PI ($p=0.022$), larger SS ($p=0.041$), less PI-LL mismatch ($p=0.049$), and more loss in TK ($p=0.012$) than the single curve group. There was no correlation between SRS-22r scores with sagittal parameters, while the magnitude of coronal curve was negatively correlated with function, appearance, and pain domains.

Conclusion: Thoracic curves are associated with less pelvic malalignment but greater thoracic hypokyphosis than thoracolumbar/lumbar curves. Multiple structural curves exhibit less spinopelvic malalignment than single curves. Coronal deformities have greater influence on quality of life outcomes compared with the sagittal parameter.

FP3.7

Decompression Surgery without Fixation with Microendoscopy for Primary Lumbar Canal Stenosis

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Introduction: Lumbar canal stenosis is one of the most common diseases for the elderly people. The basic treatment for lumbar canal stenosis is decompression surgery; however, the need for fixation surgery has also been widely reported. In our hospital, decompression surgery only is performed with microendoscopy, in principle without fixation surgery. In this study, we introduce our technique and report 1-year follow-up results.

Methods: We used the METRx system (Medtronic) and performed microendoscopic laminotomy (MEL) or microendoscopic lateral fenestration (MELF). Usually the MEL method uses a unilateral approach with bilateral decompression owing to the less bony resection. Patient neurological status was assessed before and after surgery using the Japanese Orthopedic Association (JOA) score and the Oswestry Disability Index (ODI) score.

Results: We performed decompression surgery on 93 patients from December 2017 to June 2018, of which 84 (91%) patients (53 men; 31 women) were followed up for ≥1 year and included in the study. The mean age of the patients was 67 years (range, 43-87 years). Patients' diagnoses included lumbar canal stenosis (n=60) and lumbar spondylolisthesis (n=24). The MEL method was used for 80 patients and the MELF method for 15 patients. Mean vertebral level was 1.6, mean operating time was 114.5 minutes, and mean blood loss was 31.4 g. The mean JOA score was 15.7 (4-23) before surgery and 26.5 (14-29) that after surgery, with a mean improvement rate of 81.5% (-43%-100%). The mean ODI score was 44 (0-84) before surgery and 15.2 (0-62) after surgery. One case needed additional operation at another vertebral level. No cases required additional fixation. Three cases had poor prognosis (JOA score improvement rate <40%), none of which had spinal instability or indication for fixation surgery.

Conclusion: We consider that fixation surgery is unnecessary when performing decompression surgery.

FP3.8

Surgical Outcomes after Posterior Decompression Surgery in Patients with Cervical Ossification of the Posterior Longitudinal Ligament: A Prospective Multicentre Asian Study

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FP3.9

Long-term Health-related Quality of Life of Operated and Non-operated Patients in Lenke 1 and 2 Curves: A 12-Year Follow-up Analysis

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Introduction: This study compared the long-term health-related quality of life (HRQoL) between patients treated with posterior selective thoracic spinal fusion (STF) and non-operative treatment (NOT), with a minimum 12-year follow-up.

Methods: In all, 38 patients with adolescent idiopathic scoliosis (AIS) with Lenke type 1 and 2 curves were recruited. Thoracic spinal motion was assessed clinically by rotation range of movement (ROM) using compass application, and spinal flexibility in the NOT group was assessed by active side bending radiographs. The following HRQoL instruments were administered to the patients: SRS-22, SF-12, EQ-5D-5L, RSE, BDI-II, STAI, QLPSD, TAPES-R, and a misconception survey.

Results: A total of 21 patients were in the STF group, and 19 were in the NOT group, with a mean follow-up period of 14 years. There were no significant differences between the groups with respect to gender and age at final follow-up, except for Cobb's angle prior to surgery in the STF group and that at skeletal maturity in the NOT group. Patients in the STF group demonstrated similar degree of thoracic rotation ROM compared with patients in NOT group. There was no significant difference in the spinal flexibility between standing and supine bending radiographs within the NOT group. No significant differences were found between the groups on any of the HRQoL instruments which measured depression, anxiety, self-esteem, self-image, activity restriction, and misconception of scoliosis.

Conclusion: This study showed that AIS Lenke 1 and 2 patients who underwent STF had similar spinal motion and HRQoL outcomes compared with those with NOT at a minimum of 12-year follow-up.

FP3.10

Misconceptions and Distress of Patients in an Adolescent Idiopathic Scoliosis Screening Population

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Introduction: The current study sought to investigate the misconception of adolescent idiopathic scoliosis (AIS) and distress in patients from an AIS school screening population.

Methods: A true/false, 17-item survey was distributed to 41 patients with AIS referred to a tertiary scoliosis clinic from school screening before and after their first clinic consultation. The survey consisted of questions designed to assess patient understanding of the aetiology, symptoms, effects and treatment of AIS. Level of distress following the first clinic consultation of patients was also measured with Kessler Psychological Distress Scale (K10).

Results: A total of 36 patients completed the survey and were included in the analysis. Patients answered a mean 8.85 (standard deviation [SD]=2.14) items incorrectly before the clinic, and 8.05 (SD=2.32) items incorrectly after the clinic consultation. Low levels of distress (mean K10 score 6.97 [SD=7.19]) were reported by the patients. These results suggest a high level of misconception among adolescents regarding the diagnosis, symptomatology, effects, and treatment of AIS, and that these misconceptions persist even after consultation with the doctor.

Conclusion: Although we are unable to draw any conclusion regarding the long-term effects of these misconceptions, they may have an adverse effect on the psychological aspects of AIS care. A more comprehensive clinical care model incorporating AIS-related health education may be necessary to help patients with AIS change their perception so as to improve patients' compliance to follow-up and early treatment, enhance coping skills and psychological well-being, and ultimately reduce the total healthcare costs incurred.

FP3.11

Diagnosis of C4 Radiculopathy

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Introduction: Cervical nerve root compression causes neck and scapular pain, and its location indicates the affected root. Furthermore, C5 to C8 radiculopathy is usually accompanied by specific neurologies. However, features of C4 radiculopathy are not well-known.

Methods: We retrospectively studied patients who underwent posterior foraminotomy of the unilateral C3-4 intervertebral level between 2012 and 2018 and showed improvements within 1 month after surgery. We collected data on symptom duration, site of neck pain, Spurling test, imaging findings, selective root block (SRB) effect, and surgical results using a cervical radiculopathy scoring system (normal=20 points).

Results: In total, eight patients were included, with mean age of 73 (range, 52-83) years, and mean follow-up of 2 years. Symptom durations were 3 months to 5 years and exceeded 1 year in five patients. All patients reported unilateral nape pain of the suboccipital and upper trapezius region. Spurling test elicited reproduction or increase of nape pain in every patient. Plain radiographs showed facet joint hypertrophy and foraminal stenosis at C3-4 level on the symptomatic side in every case. Those findings were also clear on magnetic resonance imaging and computed tomography scans. In five patients who underwent SRB, pain reproduction and its temporary relief were obtained. Cervical radiculopathy scores ranged from 9 to 15 points before surgery, and from 16 to 20 after surgery. Mean improvement rate was 90%.

Conclusion: Elderly patients suffering for long time from unilateral nape pain with positive Spurling test may have C4 radiculopathy.

FP3.12

Normative Data for Parameters of Whole-body Sagittal Alignment in Healthy Chinese Adults: An Analysis of Gender-specific Differences and Changes with Ageing in 584 Asymptomatic Individuals

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FP3.13

Anterior Cervical Discectomy and Fusion for Cervical Myelopathy Using Standalone Tricortical Iliac Crest Autograft: Predictive Factors for Neurological and Fusion Outcomes

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Purpose: To investigate the outcomes after anterior cervical discectomy and fusion (ACDF) surgery with standalone tricortical iliac crest autograft and to determine predictive factors for poor neurological recovery, non-union, graft collapse, and loss of C2-7 sagittal alignment.

Methods: This was a retrospective study involving patients with cervical myelopathy who underwent ACDF surgery with standalone tricortical iliac autograft between 2006 and 2016, minimum 2-year postoperative follow-up. Outcomes included the change in Japanese Orthopaedic Association (JOA) scores clinically and timing of fusion, graft height and C2-7 angle measured on lateral radiographs. Any complications such as neurological deterioration, non-union, graft collapse or loss of angle were recorded. Delayed union was considered as radiological union identified only beyond postoperative 6-months. Risk factors including age, smoking, drinking, comorbidities and operative levels were analysed through a multivariate regression for their respective influences on the various outcomes.

Results: Of the 69 patients studied, none of the patients had non-union while 33 (47.1%) achieved fusion in 6 months. The most common complications were anterior protrusion of graft (5.8%) and hoarseness (2.9%). The 1-year mean change in JOA score was 3.9 (standard deviation=2.7). The C2-7 angle gradually became more kyphotic despite an initial lordosis correction intra-operatively. The graft height also gradually collapsed during subsequent follow-up examinations. Multivariate regression model suggested that diabetics (cumulative odds ratio: 7.4) and drinkers (cumulative odds ratio: 8.6) were associated with delayed union.

Conclusion: The ACDF using tricortical iliac crest autograft has satisfactory outcomes with low occurrence of complications. Diabetes and regular alcohol consumption were predictors of delayed fusion.

FP3.14

Temporary Reductions in Distraction Lengthening Occurs in Magnetically Controlled Growing Rods: A Phenomenon That Defies the Law of Diminishing Gains

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Background: Divergence between targeted and achieved distractions has been observed with increased distractions of magnetically controlled growing rods (MCGR). This may be related to reduced distraction forces as the rod lengthens. Relationship of this reduced rate of achieved lengthening with remaining rod length has yet to be explored.

Methods: Early-onset scoliosis patients who underwent MCGR with minimum 2-year follow-up were consecutively enrolled in this prospective study. All patients underwent monthly distraction protocol of 2 mm at each visit, where targeted and achieved lengths were compared. Correlation (R^2) between percentage of lengthening achieved from targeted length was identified, as well as its relationship with timing of rod exchange.

Results: Twenty patients fulfilled the inclusion criteria. Mean age at index surgery was 9.5 years and mean postoperative follow-up was 68 (standard deviation=28) months. Eight patients had at least one rod exchange which occurred at 23 (standard deviation=4) months. The mean achieved lengthening dropped from 86% of targeted length at the first distraction to only 58.8% at the 21st distraction episode for the first set of rods. After rod exchange, this figure went back up to 81.3% but subsequently gradually decreased to 35% at the 19th distraction episode.

Conclusions: We propose a 'Law of Temporary Diminishing Distraction Gains' with MCGR, independent of patient factors, where diminishing distraction length gain was observed as the rod was lengthened. Rate of achieved lengthening returned to baseline after rod exchange. This should be distinguished from the 'law of diminishing returns' unique to traditional growing rods.

FP3.15

Clinical Outcomes of Vertebral Body Tethering with 2-Year Follow-up: The First United Kingdom Experience

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Introduction: Vertebral body tethering (VBT) is a relatively novel technique in the treatment of adolescent idiopathic scoliosis (AIS) and represents a non-fusion method for anterior correction of scoliosis. This is the first examination outside the United States for patient-related outcome measures with a minimum 2-year follow-up.

Methods: We retrospectively analysed prospectively collected patient-related outcome measures and radiographic data for patients with AIS treated with VBT with a minimum 2-year follow-up and analysed complications. Lenke classification was used for AIS. Spinal curvature was assessed using Cobb's angle. Patient outcomes were assessed using the Scoliosis Research Society Outcomes Questionnaire (SRS 30) scores.

Results: In total, 17 patients (94.1% female) with mean age 13 years were included. All patients were skeletally immature with a mean Risser stage of 1.76. Fourteen patients underwent single-stage VBT. Cases included 10 main thoracic curves (Lenke 1, n=10), two lumbar curves (Lenke 5, n=2), and five double major curves (Lenke 1C, n=2; Lenke 3C, n=1; Lenke 6, n=2). Patients had mean Cobb's angle 51.7° before surgery, bending Cobb's angle 26° (49.7%), and Cobb's angle 14.6° after surgery, with correction rate 73.1%. Mean level of tethering was 7.13 for main thoracic curves, 6 for lumbar curves, and 13 for double major curves. No planned or unplanned return to theatre was recorded at 2-year follow-up. The mean SRS 30 scores were 3.5 before surgery and 4.34 ($p<0.05$) at mean follow-up time 2.9 (range, 2.5-4.1) years after surgery.

Conclusion: Anterior vertebral body tethering is a promising technique for correction of AIS with radiographically good correction. No unplanned or planned revisions had occurred at 2-year follow-up examination. Patient-related outcome measures improved over time. Further longer-term study is required.

FP3.16

Spinal Epidural Abscess Case Series: An Uncommon but Serious Emergency of Back Pain

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Introduction: Spinal epidural abscess (SEA) is an uncommon but serious differential diagnosis of spinal pain. The ambiguity of its clinical symptomatology causes a diagnostic difficulty in the accident and emergency department (AED). This study aimed to provide data in order to clarify criteria for early diagnosis of SEA in the AED setting.

Methods: A retrospective study of SEA from 2013 to 2018 at a local hospital was conducted.

Results: Twenty-one patients were identified with median age 70 years. On presentation, 90% of patients had back pain, 62% had fever, and 48% had neurological deficits; only 19% had all three. The most commonly involved level was thoracolumbar (62%), and the most commonly involved organisms were Staphylococcus (34%) and Streptococcus (19%). The mean time to magnetic resonance imaging diagnosis was 6.05 days. Only 33% of patients had a relevant diagnosis given in AED, causing a 79% reduction in diagnosis time to 1.29 days. The other 67% of patients were admitted to an orthopaedics ward, causing a 36% reduction in diagnosis time to 3.86 days. Mortality rate was high (29%), and more than half (57%) of patients were ambulatory on discharge from hospital.

Conclusion: The high morbidity and mortality of SEA, particularly in elderly patients, signifies the importance of its early recognition. A relevant diagnosis and orthopaedics admission decided in the AED can drastically reduce the time to radiological diagnosis. Clinical suspicion of SEA should be raised if patients present with spinal pain, C-reactive protein ≥100 mg/L, and erythrocyte sedimentation rate ≥80 mm/hour.

FP3.17

Adolescent Idiopathic Scoliosis Has High Prevalence of Negative Sagittal Balance: Anteversion of Pelvis Used to Decrease Lumbar Lordosis to Compensate for Loss of Thoracic Kyphosis

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Introduction: Positive sagittal balance is linked to increased pain and reduced ability to maintain horizontal gaze. The impact of negative sagittal balance is less well understood. Adolescent idiopathic scoliosis is known to be hypokyphotic (ie, thoracic lordosis) which may drive a negative plumb line. We compared sagittal vertical axis (SVA) to various spinal and pelvic parameters to investigate the possible proportional relationship between increased thoracic lordosis and negative SVA.

Methods: We retrospectively reviewed 116 patients who first presented with AIS from 2015 to 2016. For patients with negative SVA, this was compared with pelvic tilt (PT), thoracic kyphosis (TK), lumbar lordosis (LL), and pelvic incidence-lumbar lordosis (PI-LL).

Results: In total, 116 patients with AIS were reviewed. Of them, 85 had lateral radiographs and were included, and 72 (84.7%) of those had a negative SVA. Mean negative SVA was -41.43 mm; mean positive SVA was 22.99 mm. New classifications for negative SVA were developed: A=0 to >-35 mm; B= -35 to >-65 mm; C= ≤-65 mm. Mean SVAs for group A, B, and C were -19.82 mm, -46.59 mm, and -75.40 mm, respectively. Group A: mean LL=53.38°; mean PI-LL= -4.3°; mean PT=11.43°; mean TK=24.68°. Group B: mean LL=58.83°; mean PI-LL= -7.2°; mean PT=10.29°; mean TK=20.71°. Group C: mean LL=58.41°; mean PI-LL= -16.8°; mean PT=5.40°; mean TK=27.86°. Negative SVA correlations with PI-LL (R^2=0.92), PT (R^2=0.90), LL (R^2=0.67), and TK (R^2=0.21) were noted.

Conclusion: There is a high incidence of negative SVA in patients with AIS driving a negative plumb line because of thoracic hypokyphosis. Increasing negative SVA shows decreased PI-LL mismatch. Increased thoracic lordosis is associated with decreasing pelvic tilt to compensate and lower lumbar lordosis.