

Free Paper Session IV — Spine I

4.1

An Evaluation of Outcomes for Anterior Cervical Fusion with Polyetheretherketone Cages with Demineralised Bone Matrix

CK Lau, NM Wong, MS Luk, SW Lau

Department of Orthopaedics and Traumatology, United Christian Hospital, Hong Kong

Objective: To evaluate the outcome of polyetheretherketone (PEEK) cages with demineralised bone matrix (DBM) for anterior cervical discectomy and fusion (ACDF).

Materials and Methods: A retrospective study of 22 patients who underwent ACDF with PEEK cages and DBM from 2011 to 2014 was conducted. The clinical outcomes were evaluated with Japanese Orthopaedic Association (JOA) score, Odom's criteria, and numeric pain rating scale (NPRS). The radiographic outcomes were measured with X-ray taken preoperatively, immediately after operation, and 1 year postoperatively.

Results: The mean age of the patients were 51 years. A total of 22 patients underwent ACDFs with 33 levels performed, including 1-level ACDF in 13 patients, 2-level ACDF in 7 patients, and 3-level ACDF in 2 patients. Clinically, statistically significant improvement in pain score and JOA score were noted. Odom's criteria were excellent or good in 90% of patients. Radiographic data showed all levels were fused at 1 year postoperatively with the majority of grade 3 fusion (67%). The anterior disc height and interbody height (IBH) were increased 1 year postoperatively compared with preoperation, however, a certain degree of subsidence was noted 1 year postoperatively (mean, 2.9 mm) compared with that immediately after operation, and 23 levels showed >2 mm reduction in the 1-year postoperative IBH. However, the subsidence did not affect clinical outcomes and no major complications were noted in all patients.

Conclusion: Anterior cervical discectomy and fusion with PEEK cage and DBM showed promising result in terms of clinical improvements and the fusion rate.

4.2

Quantitative Anatomy of C7 in Southern Chinese for Insertion of Lateral Mass Screws and Pedicle Screws

MSH Tse, CH Chan, KK Wong, WC Wong

Department of Orthopaedics and Traumatology, Kwong Wah Hospital, Hong Kong

Introduction: C7 lateral mass is known to have a smaller size when compared with other subaxial cervical levels and thereby causing a limitation in lateral mass screw length. Some studies then suggested pedicle screws for better fixation while on the other hand it is limited by the narrow pedicle width. In this study we analysed the quantitative anatomy of C7 for insertion of lateral mass screws and pedicle screws in southern Chinese.

Materials and Methods: We obtained computed tomographic (CT) scan of cervical spine in 0.625 mm slices from Radiology Department of our hospital. These patients were adults with CT done for neck pain in the period from May 2015 to July 2015. By cooperating with our radiologist we measured the lateral mass screw length using Magerl technique, inner pedicle width, and pedicle screw trajectory under 3-dimensional reformatted images using the GE Healthcare Advantage Workstation for Diagnostic Imaging.

Results: The CT scans of cervical spine of 70 patients were obtained and 140 lateral masses and pedicles of C7 were measured. The mean (\pm standard deviation) lateral mass screw length was 13.2 ± 1.7 mm, mean inner pedicle width being 3.6 ± 0.9 mm, and mean pedicle screw trajectory being 30.1 ± 3.8 degrees.

Discussion and Conclusion: The mean lateral mass screw length measured in our study was longer compared with other similar studies, while our mean inner pedicle width was narrower.

4.3

5-Year Longitudinal Magnetic Resonance Imaging Follow-up of a Population-based Cohort of Subjects with Ossified Yellow Ligament: A Natural History Study

CYK Tang, JPY Cheung, D Samartzis, KMC Cheung

Department of Orthopaedics and Traumatology, Queen Mary Hospital, Hong Kong

Introduction: Ossified yellow ligament (OYL) causes the majority of thoracic myelopathy. This study presents longitudinal follow-up of these individuals to assess changes related to disease progression and risk factors for such progression.

Methods: In a population-based study of 1864 southern Chinese volunteers using magnetic resonance imaging (MRI), 114 individuals were identified to have OYL. The MRI parameters assessed included the size of OYL, levels of involvement, OYL morphology, whether the OYL crossed midsagittal region, and the presence of degenerated discs. Both baseline and 5-year follow-up MRIs were read by 2 observers blinded to clinical information and any differences were settled by consensus.

Results: Size progression was defined as bigger OYL size in the follow-up MRI than that in baseline MRI. In all, 70% T9/10 and 62% T10/11 OYLs had size progression ($p < 0.05$). Majority of de-novo OYL (new OYL formed only in the follow-up scan) developed in T8/9 to T11/12. They were observed in 70% of segments who had body mass index of 30 to 40 kg/m² ($p = 0.02$), otherwise no other risk factors could be found.

Discussion: This is the first and only population-based series addressing the natural history of OYL. Myelopathy commonly occurs in the lower thoracic region and this study showed that most of the lower thoracic OYLs progressed in size. Knowing the natural history of OYL at 5-year follow-up, preventive measures such as weight reduction, close monitoring for myelopathy development, and perhaps early operation for lower thoracic OYL may be necessary.

4.4

Comparisons of Quality of Life of Adolescents with Idiopathic Scoliosis Undergoing Anterior Spinal Fusion with Transpleural and Extrapleural Treatments Using Online Scoliosis Research Society-22 Questionnaire

BKW Ng,¹ WW Chau,¹ ACN Hui,² CY Wong,² FKY Shit,² F Zhu¹

¹Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong, Hong Kong

²Department of Surgery, Prince of Wales Hospital, Hong Kong

Introduction: Patients with adolescent idiopathic scoliosis (AIS) undergoing anterior spinal fusion (ASF) in the treatment of thoracolumbar scoliosis are well known for its effect in curve correction, short fusion, and preservation of mobile distal segments. It has always been a clinical impression that these patients recover quickly and have a more flexible spine, leading to shorter recovery period and quality of life virtually the same as normal adolescents. These have yet to be documented.

Materials and Methods: Eligible subjects were invited to fill out the security-enhanced online version of Scoliosis Research Society-22 (SRS-22) questionnaire. The SRS-22 questionnaire completed before surgery in patients treated extrapleurally were extracted. Domain and mean total scores were calculated. Student's *t* tests comparing domain and mean scores between transpleural and extrapleural patients were carried out. Same comparisons before and after surgery in extrapleural patients were also carried out.

Results: A total of 28 patients (18 transpleural and 10 extrapleural) successfully filled out the online SRS-22 questionnaire. Their median duration of follow-up was 7.5 years. There was no significant difference in function, pain, self-image, mental health, satisfaction with management, and mean total scores between patients treated transpleurally and extrapleurally. All mentioned domains and mean total scores were significantly improved after AIS extrapleural surgery (all $p < 0.01$).

Discussion and Conclusion: Quality of life is significantly improved after ASF. A more detailed study is planned and underway to specifically look at the pulmonary function change in these patients.

4.5

Ambulatory Surgery for Lumbar Spinal Stenosis: A Prospective Study of Minimally Invasive Decompression for Lumbar Spinal Stenosis in an Ambulatory Setting

P Cheung, KK Wong, TK Kwok, WC Wong

Department of Orthopaedics and Traumatology, Kwong Wah Hospital, Hong Kong

Introduction: With advance in technology, spinal surgery could potentially be conducted in an ambulatory setting using minimally invasive surgery (MIS) techniques. The MIS decompression using tube retractor for lumbar spinal stenosis has been developed to minimise soft tissue damage, reduce amount of posterior element resection, reduce wound pain, and fasten rehabilitation. Limited studies have evaluated this procedure in ambulatory setting among our local population.

Materials and Methods: Patients with lumbar spinal stenosis who underwent MIS decompression using tubular retractor in Kwong Wah Hospital were consecutively enrolled. All patients were educated for ambulatory care before the operation. Standardised walking test with motorised treadmill together with functional assessment scoring were performed preoperatively, at 2 weeks, 3 months, and 1 year postoperation as outcome measures.

Results: A total of 8 patients with lumbar spinal stenosis were recruited into the study from February 2015 to July 2015. Among them, 3 patients were discharged at day 0 while 5 were discharged at day 1. Up till now 7 of them were followed up at 2 weeks postoperatively. The mean total distance walked improved from 103 metres to 413 metres. The mean total time walked improved from 6 minutes to 16 minutes. The mean distance of symptom onset improved from 56 metres to 366 metres. There was improvement in all the functional scores and no operative complication was noted in all the cases.

Discussion and Conclusion: The MIS decompression for lumbar spinal stenosis in an ambulatory setting is feasible, safe, and effective in our local population.

4.6

Assessing Volumetric Bone Mineral Density in Adolescent Idiopathic Scoliosis: Quantitative Computed Tomography Versus High-resolution Peripheral Quantitative Computed Tomography — A Pilot Study

EMS Tam,¹ FWP Yu,¹ L Shi,² J Griffith,³ JCY Cheng,¹ TP Lam¹

¹*Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong, Hong Kong*

²*Department of Medicine and Therapeutics, The Chinese University of Hong Kong, Hong Kong*

³*Department of Imaging and Interventional Radiology, The Chinese University of Hong Kong, Hong Kong*

Introduction: Low bone mass has been reported in about 30% of girls with adolescent idiopathic scoliosis (AIS). Quantitative computed tomography (QCT) could provide differential assessment of cortical and trabecular volumetric bone mass densities (vBMDs) which cannot be measured by areal dual-energy X-ray absorptiometry. However, regular assessment with QCT in adolescents is not appropriate due to high radiation exposure. High-resolution peripheral QCT (HR-pQCT) has been used as an alternative measurement for axial vBMD. This pilot study aimed to test whether the vBMD measured with HR-pQCT correlates with that from QCT in AIS.

Methods: A total of 14 severe AIS girls aged 13 to 19 years with preoperative computed tomographic scan of the spine for planning of navigation surgery (Cobb's angle $\geq 45^\circ$) were recruited. Lumbar spine (L2-L4) and non-dominant distal radius were measured by QCT and HR-pQCT, respectively.

Results: Of these 14 patients, 3 (21.4%) were osteopenic with z-score of femoral neck ≤ -1 . Significant correlations were found between L2 vertebra and distal radius including cortical vBMD ($r=0.550$) and trabecular vBMD ($r=0.645$). Correlations between L3 vertebra and distal radius were marginally significant ($p<0.1$).

Discussion: The vBMD measured by QCT at L2 vertebra (central skeleton) was correlated with that of HR-pQCT at non-dominant distal radius (peripheral skeleton), which indicates that HR-pQCT, with very low radiation and capable of trabecular microarchitecture measurement, could be used for routine assessment for systemic bone quality. Further studies with larger sample size would be carried out to validate the findings.

4.7

Comparison of Surgical Outcome of Adolescent Idiopathic Scoliosis and Young Adult Idiopathic Scoliosis: A Matched-pair Analysis of 160 Lenke I Patients

F Zhu,¹ HD Bao,² Y Qiu,² BKW Ng,¹ JCY Cheng¹

¹Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong, Hong Kong

²Department of Orthopaedics and Traumatology, Nanjing Drum Tower Hospital, Nanjing, China

Introduction: Despite numerous reports on the satisfactory surgical correction of adolescent idiopathic scoliosis, some patients still have the consumption that delay of surgery into young adulthood may be more beneficial. This study aimed to investigate if the surgical outcome of young adults was equivalent to adolescents.

Methods: This is a retrospective 1:1 matched cohort study with minimum 2-year follow-up. A total of 80 pairs were recruited with the following inclusion criteria: (1) female idiopathic scoliosis with Lenke type 1 curve; (2) undergoing selective fusion; (3) adolescents aged from 10 to 18 years (AIS group) and young adults aged from 19 to 29 years (AdIS group); (4) 1-stage posterior approach; and (5) with major Cobb's angle of 45 to 80 degrees. The AIS and AdIS patients were matched for apex, major thoracic curve magnitude, lumbar curve magnitude, as well as time of surgery and follow-up.

Results: The age at the time of surgery in AdIS patients was significantly older than that of AIS patients. The AdIS patients were observed to have significantly lower mean curve flexibility (48.22% vs. 56.62%, $p=0.006$). Accordingly, lower mean (\pm standard deviation) correction rate ($71.41\% \pm 0.10\%$ vs. $79.49\% \pm 0.09\%$) and greater mean postoperative major Cobb's angle ($15.63^\circ \pm 4.76^\circ$ vs. $11.27^\circ \pm 3.89^\circ$) were found in AdIS patients ($p=0.002$ and 0.002 , respectively). Regarding quality of life, no significant difference was observed during follow-up.

Conclusion: The AIS patients would gain greater benefit from surgery compared with paired AdIS patients with no difference of health-related quality of life during follow-up.

4.8

Halo-gravity Traction Combined with Assisted Ventilation: An Effective Preoperative Management for Severe Adult Scoliosis Complicated with Respiratory Dysfunction

F Zhu,¹ HD Bao,² Y Qiu,² BKW Ng,¹ JCY Cheng¹

¹Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong, Hong Kong

²Department of Orthopaedics and Traumatology, Nanjing Drum Tower Hospital, Nanjing, China

Introduction: Preoperative halo-gravity traction (HGT) has been reported as a helpful management to achieve improvement in both neurological and pulmonary functions. This study aimed to investigate the change of pulmonary function in adult scoliosis patients with respiratory dysfunction undergoing HGT combined with assisted ventilation.

Methods: A total of 21 adult patients were retrospectively reviewed with a mean age of 26.2 years. Inclusion criteria were age >18 years, coronal Cobb's angle of >100 degrees, had respiratory failure, and duration of HGT of >2 months.

Results: The mean Cobb's angle was 131.21 degrees and was slightly reduced to 107.68 degrees after HGT. After surgical correction, the mean (\pm standard deviation) Cobb's angle was 74.38 ± 26.81 degrees with a mean correction rate of $43.93\% \pm 18.4\%$. At the completion of HGT, pulmonary function was significantly improved. Significantly increased mean forced vital capacity (FVC) was found after HGT (1.36 L vs. 1.13 L, $p=0.003$) with significantly improved percentage predicted values for FVC (39.10% vs. 49.90% , $p<0.001$). Meanwhile significantly increased forced expiratory volume in 1 second (FEV_1) was also observed (1.18 L vs. 0.96 L; $p<0.001$) with significantly improved percentage predicted values for FEV_1 (46.29% vs. 36.87% , $p=0.003$) after HGT.

Conclusion: This is the first study reporting the combined utilisation of HGT and assisted ventilation in treating severe adult scoliosis. The results also revealed that HGT may be beneficial to avoiding neurological complications and achieving a favourable surgical correction rate.

4.9

Unmasking Risk Factors for Postoperative Coronal Decompensation in Adult Lumbar Scoliosis after Posterior Correction with Osteotomy

F Zhu,¹ HD Bao,² Y Qiu,² BKW Ng,¹ JCY Cheng¹

¹*Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong, Hong Kong*

²*Department of Orthopaedics and Traumatology, Nanjing Drum Tower Hospital, Nanjing, China*

Introduction: Despite improper surgical strategy associated with postoperative sagittal imbalance, analysis of postoperative coronal imbalance is unavailable. This study aimed to investigate the potential risk factors for postoperative coronal imbalance following posterior osteotomy for adult scoliosis.

Methods: This study consisted of 74 patients with rigid adult lumbar scoliosis. A group of 20 patients with postoperative coronal imbalance was identified, in whom C7 plumb line shifts of >3 cm on coronal plane occurred. The clinical data and surgical strategies were compared between groups to investigate the risk factors, including age, gender, aetiology, Cobb's angle, preoperative coronal balance distance, direction of preoperative imbalance, T1 tilt, tilt of upper instrumented vertebra (UIV), UIV translation, location of UIV, fusion to L5 or S1, tilt of lower instrumented vertebra, lowest instrumented level (LIV) rotation, screw density, osteotomy procedure, and the use of iliac screws.

Results: Comparison between patients with and without postoperative coronal imbalance showed that postoperative coronal imbalance was observed in patients who had older age, degenerative scoliosis as aetiology, UIV above T6, preoperative LIV rotation, preoperative LIV tilt, preoperative coronal imbalance towards convex side, and Smith-Petersen osteotomy. All 7 parameters were included into the logistic regression analysis. A UIV above T6 ($p=0.010$), LIV rotation ($p=0.012$), and preoperative coronal imbalance towards convex side ($p=0.005$) were finally identified as risk factors.

Conclusion: Patients with preoperative coronal imbalance towards convex side, UIV above T6, and LIV rotation were more likely to develop coronal imbalance.

4.10

6-Minute Walk Test: A Simple Objective Test in Screening and Monitoring of Spinal Claudication: Prospective Study on 1182 Patients**YK Chan,¹ S Kwong²**¹*Department of Orthopaedics, Pamela Youde Nethersole Eastern Hospital, Hong Kong*²*Department of Physiotherapy, Pamela Youde Nethersole Eastern Hospital, Hong Kong*

Introduction: The diagnosis, disease severity, and outcome assessment of spinal claudication depend on patient's subjective report. Simple quantitative test is lacking. The present study used 6-minute walk test (6MWT) to solve these problems.

Methods: Patients suspicious of spinal claudication were prospectively tested on standing and walking ability. Time when symptom became intolerable constituted the tolerance time. They were tested on distance (6MWD) they could maximally walk on level ground in shuttle between a 15-metre distance in 6 minutes, and screened for standing and walking instability with Tinetti score. Patients undergoing surgery were monitored.

Results: Since 2004, 1182 patients were included. The age-matched 6MWD correlated with 20-minute standing tolerance well with sensitivity and specificity of >0.7. Using receiver operating characteristic curve, the 6MWDs that distinguished 20-minute claudication tolerance in different age-groups were 392 metres (41-50 years), 377 metres (51-60 years), 330 metres (61-70 years), 267 metres (71-80 years), and 236 metres (81-90 years). For those who underwent surgery, their standing and walking tolerance significantly improved in first 3 months but not later. The balance and gait score improved significantly only 3 months postoperatively. The 6MWD increased significantly at both 3 and 6 months postoperatively, implying that 6MWD was more sensitive in picking up changes.

Discussion and Conclusion: The 6MWT is a simple, practical method in screening for spinal claudication. The age-matched 6MWD for incapacitating claudication was found. The test can also provide useful quantitative data for disease progression and treatment outcome monitoring.

4.11

*(Japanese Orthopaedic Association Ambassador Paper)***More than 10-Year Follow-up after Total En-bloc Spondylectomy for Spinal Tumours****S Kato, H Murakami, S Demura, K Yoshioka, K Tomita, H Tsuchiya***Department of Orthopaedic Surgery, Kanazawa University School of Medicine, Japan*

Total en-bloc spondylectomy (TES) is a surgical procedure to achieve complete resection en bloc of a spinal tumour. This study aimed to examine the clinical outcomes of patients surviving for >10 years after TES. We reviewed 82 patients who had undergone TES in our institute before January 2002 and identified 29 patients (with 19 primary and 10 metastatic tumours) who had survived for >10 years after surgery. We evaluated the clinical outcomes including patient-based outcomes using a questionnaire which included subjective assessment of surgery and 36-item Short-form Health Survey (SF-36). There was only 1 tumour recurrence in the patient who underwent TES as the revision procedure after the initial surgery in another hospital. Ten-year survival rates of the patients with metastases from kidney and thyroid cancer were 33% and 25%, respectively. These results were better than that previously reported in the literature. Approximately 90% of the patients were satisfied with the results of TES. The SF-36 results demonstrated that both physical and mental health of primary tumour patients and the mental health of metastatic tumour patients were equivalent to those of healthy individuals. This study showed the long-term clinical outcomes after TES to be favourable and it played an important role even for isolated metastases.