ORAL PRESENTATIONS 01
Long-term results of microsurgical expansive open-door laminoplasty for the posterior longitudinal ligament (OPLL) of the cervical spine - more than 100 cases, average 13-year follow up study.
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Objective: Retrospective study for more than 100 cases of OPLL of the cervical spine was performed to assess the more than 10-year long-term results of our microsurgical expansive open-door laminoplasty.

Method: The study group included 100 patients who underwent microsurgical expansive open-door laminoplasty between 1993 and 2000 in our department. Clinical results, including Japanese Orthopaedic Association scores, recovery rates, complications, experience of the additional operation were investigated. Cervical alignments and progression of OPLL were assessed on plain radiographs.

Results: The average follow up period was 13.1 year. The average JOA score was improved from 12.9 (before operation) to 14.7 (final evaluation) and the recovery rate was 48.0% at the final evaluation. At the final evaluation, the thickness and the extent of OPLL were increased in 60% of the patients and the kyphotic deformity was progressed in 3 patients. Surgical complications included the post-operative bleeding in one patient, the temporal C5 nerve root palsy in one patient and the superficial infection in one patient. Although the JOA score was deteriorated in nine patients at the final evaluation, the causes were not associated with the progression of OPLL and the patient who underwent the additional cervical surgery due to the progression of OPLL were not observed.

Conclusion: The surgical outcome was satisfactory and maintained after 10 years. The deterioration of the JOA score was observed in some patients, however, it was not associated with the progression of OPLL and was considered to be due to the age-related degeneration of the thoracic and lumber spine, the low extremity and the urinary tract.

ORAL PRESENTATIONS 02
Surgically treated cervical myelopathy: a functional outcome comparison study between multiple level anterior cervical decompression and laminoplasty.
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Introduction: Multi-level cervical myelopathy can be treated with anterior cervical discectomy and fusion (ACDF) or anterior cervical corpectomy and fusion (ACCF) via the anterior approach and laminoplasty for the posterior approach. Till date there is no proven superior approach. The aim of our study is to elucidate any potential advantage of one approach over the other with regards to clinical mid-term outcomes.

Methods: A retrospective analysis of prospectively collected data in 116 patients with cervical myelopathy treated with multiple level anterior cervical decompression and laminoplasty. 64 patients underwent anterior cervical discectomy and fusion (ACDF 2 levels and above) or anterior cervical corpectomy and fusion (ACCF one level and above). 52 patients underwent posterior cervical surgery (double trap door laminoplasty C3- C6 or C3- C7). We compare the Japan Orthopaedic Association Scores (JOA), Neck disability index
scores (NDI), SF36 scores, Visual analogue score for neck pain and range of Motion (ROM) pre-operatively to 2 years. Chi-square and 2-sided Student’s t-test were used to analyse the variables.

**Results:** Posterior surgery lasted 62 minutes in average shorter than anterior surgery and showed better improvement in JOA scores at 6 months. Posterior group showed better preservation of neck range of motion though not statistically significant. No statistical difference in neck pain between the 2 groups. Complications were higher for anterior group: 2 post- operative hematoma, 1 vocal cord paresis, 1 superficial wound infection versus 2 superficial wound infection in posterior group. No statistical difference between the 2 groups for JOA scores, SF36 scores, NDI, VAS neck pain and ROM through to 2 years.

**Conclusions:** Our study showed that patients with multilevel disease treated with laminoplasty do well and compare favorably with patients treated with an anterior approach in terms of shorter operating time, better improvement of JOA score at 6 months and a tendency towards lesser complications. No significant difference in neck pain between both groups. There is a need for a larger study that is prospectively randomized with long term follow up before we can confidently advocate one approach over the other in the management of cervical myelopathy.

**ORAL PRESENTATIONS 03**

**Clinical Results of Cervical Laminoplasty for Considerable Cord Compression with Only Slight Myelopathy**

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**Introduction:** There is no established consensus on the indications for surgery in patients with considerable cord compression but only slight myelopathy, because the risk/benefit balance of surgery in these patients is not well known. Objectives. To stimulate discussion about the indications for surgery in patients with considerable cervical cord compression but only slight myelopathy.

**Methods:** The records of consecutive patients who underwent cervical laminoplasty (CLP) during 3.5 years were reviewed. Those patients whose preoperative Japanese Orthopaedic Association score (JOA score, maximum 17) for cervical myelopathy was 16 points or more, indicating that they had very slight myelopathy, were selected. Before surgery, all patients were well informed about the risks of the operation including major complications such as mortality and or permanent quadriplegia, and the limitation of the surgery. The postoperative JOA scores of these patients were checked via a chart review, and they were sent a survey regarding to history of trauma, duration of myelopathy (over 2 years or less) and age at surgery (over 70 y/o or less). Mann-Whitney U test and Fisher Exact test were used for statistical analysis.

**Results:** Of 143 patients who underwent CLP (89 males and 54 females, 120 CSM and 23 OPLL), 14 (9.7%) presented with a preoperative JOA score of 16 or more. The mean age of patients with a JOA score of 16 or more was 51.9 years old, while that of reminder was 68.2 years. No patients showed a postoperative deterioration in JOA score. The number of patients with the maximum score increased from four preoperatively to 11 postoperatively. Nine patients complained of postoperative hand numbness and this symptom disappeared postoperatively in seven cases. However, the number of patients with axial symptoms increased from 7 preoperatively to 9 postoperatively. Most patients were satisfied with the results of the surgery: “very satisfied” in 11 cases and none selected “slightly dissatisfied” or “very dissatisfied.”

**Conclusions:** We believe that surgery can rescue well-informed and deliberately selected patients with only slight myelopathy, because their symptoms improve and they are freed from persistent anxiety. However, we should always be cautious not to expand the indications for surgery without consideration.

**ORAL PRESENTATIONS 04**

**Long-term follow-up results of laminoplasty for ossification of cervical posterior longitudinal ligament (OPLL) and comparison with non-OPLL.**

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**Introduction:** We investigated long-term follow-up results of expansive open-door laminoplasty for ossification of cervical posterior longitudinal ligament (OPLL) and non- OPLL. We compared the clinical results between OPLL group and non-OPLL group.

**Methods:** Clinical results were collected for 70 patients with OPLL (36 patients) or non-OPLL (34 patients) who underwent expansive open-door laminoplasty. These were estimated with using the Japanese Orthopaedic Association score (JOA score) and the recovery rate. The image analysis consists of conventional radiographic and CT. We checked kyphotic change and alignment of cervical spine (C2-7 angle). In OPLL group, we investigated the progression of OPLL and evaluated the impact of the kyphotic change and progression of OPLL on clinical results.

**Results:** The mean recovery rate of JOA score at final follow-up was 34.3%. Laminoplasty showed satisfactory results during first year and declined at final exam in some cases because of aging and other health problems. The mean preoperative C2-7 angle was 10.8 and final C2-7 angle was 6.4 degrees. In OPLL group, kyphotic changes (over 5 degrees) were found in 22 patients during follow-up. The recovery rate of kyphotic group was 29.9%. It was not significantly Different. In non-OPLL group, focal instability was one of the main causes for deterioration. The progression of ossification were found in 16 patients, especially in mixed-type features. The mean sagittal progression was 15.8mm and axial progression was 2.1mm about one vertebral length. The recovery rate at final was 20.5% in OPLL progression group and 40.9% in static group.

**Conclusions:** Expansive open-door laminoplasty is one of the great options for cervical OPLL and non-OPLL. Kyphotic change didn't cause deterioration of clinical result. Progression of OPLL was one of the main risk factors after laminoplasty. On the other hand, focal instability was main causes in non-OPLL group.

**ORAL PRESENTATIONS 05**

**Risks and benefits of anterior extirpation of OPLL foci and arthrodesis for cervical myelopathy caused by ossification of the longitudinal ligament (OPLL): A prospective Study**

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**Objective:** We have prospectively performed anterior extirpation of OPLL foci and arthrodesis for cervical myelopathy caused by OPLL since 1997. The objective of this study was to survey clinical outcomes and to discuss risks and benefits of this procedure.

**Materials and Methods:** 143 patients out of 145 patients who underwent this procedure between 1997 and 2009 were studied. There were 105 males and 38 females and mean age at surgery was 59 y/o with 67 months F/U periods on average. Patients were divided into 2 groups using K-line (Fujyoshi, SPINE 2008) : K-line + (KP group) and K-line - (KM group). Developmental Segmental Sagittal Diameter (DSSD), Residual Space Available for the spinal Cord (RSAC), occupational ratio (%R), perioperative complications and JOA score were evaluated. In KM group, JOA score was also estimated in subdivided groups such as group regarding to history of trauma, duration of myelopathy (over 2 years or less) and age at surgery (over 70 y/o or less). Mann-Whitney U test and Fisher Exact test were used for statistical analysis.
Result: There were 118 cases in KP group and 25 cases in KM group. Mean DSSD (KP group/KM group), mean RSAC and mean %R were 14.5mm/14.7mm, 9.5mm/9.9mm (p<0.05) and 40%/63% (p<0.05) respectively. JOA score (KP/KM) before surgery was 11.1/9.3, improved to 15.7/14.5 with a mean recovery rate of 79%/68% respectively. JOA score (trauma +/_) before surgery was 6/10, improved to 13/15. JOA score of duration were 7.3/9.8, improved to 11.5/15.6 (p<0.05) and that of age at surgery were 9.4/9.2, improved to 12.3/15.5 (p<0.05). With respect to complications (KP/KM), we had CSF leakage in 16 cases/15 cases (p<0.05), C5 palsy in 13/3, pneumonia 5/4, prolonged (over 1mo after surgery) dysphagia in 6/2, dislodgement of grafted bone in 1/1 respectively and VA injury in 1/0. Revision caused by neurological deterioration was carried out in one case.

Conclusion: This current study revealed that anterior surgery is most effective surgical treatment for cervical myelopathy caused by OPLL, regardless of its size or neck alignment although there may be some serious risks related to surgeon’s experience.

ORAL PRESENTATIONS 06
Cervical multilevel spondylotic myelopathy: evaluation of clinical and neurophysiological outcome after wide cervical laminectomy and posterior fixation.
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Purpose of this study was to evaluate the outcome after cervical instrumented laminectomy in patients affected by compressive cervical myelopathy. Wide laminectomy and posterior lateral mass screw fixation was our standard procedure for the majority of patients with multilevel spondylotic cervical myelopathy. Cervical laminectomy and instrumentation, although more demanding and expensive compared to laminoplasty, allows for a stable fixation, preventing continuous microtrauma on the cervical cord and, therefore, preventing progression of the neurological impairment. Major concern exists about residual discomfort such as axial pain and disability of the cervical spine due to the postoperative rigidity of neck motion. In our institution 68 pts (51 male, 17 female), affected by multilevel cervical spondylotic myelopathy, underwent cervical laminectomy and lateral mass screw fixation. Patients were followed up for a minimum of 3-y, while 48 pts completed follow-up at 5-y. 5 pts were lost at follow up. Neurological assessment was obtained using modified-Japanese Orthopaedic Association (mJOA) scoring system and MEP (Motor Evoked Potentials). Functional status and quality of life were evaluated using SF-36, VAS, NDI (Neck Disability Index) and Axial neck pain. Sagittal alignment of the cervical spine and survival of the instrumentation were assessed by plane lateral radiograms. Decompression of the cervical cord was evaluated using pre and postoperative MRI. Neurological function, assessed by mJOA score, improved significantly in all patients at final follow-up. No changes were seen in the sagittal alignment of the fused cervical spine in lateral x-rays and no failure of the implants was observed. A severe axial pain persisted after surgery only in 2 pts, although both of them were affected by rotator cuff tear with severe functional impairment of the shoulder. A moderate axial pain easily relieved by medical therapy was observed in 3 pts. Despite the functional limitation, the majority of patients complained only a slight disability without daily activity restriction. In our opinion cervical spine laminectomy and fixation is a safe and reliable procedure for the treatment of multilevel degenerative spinal stenosis. It stands for a stable fusion and it allows for a durable neurological improvement avoiding microtrauma causing significant insults to the spine cord.

ORAL PRESENTATIONS 07
Complications and outcome of posterior fusion in children with atlanto-axial instability
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Objective: Atlanto-axial instability is uncommon in children. When we performed posterior fusion for these patients, the incidence of complication increases because of a small vertebral size in children and in the risk group including children with Down syndrome, for which the application of surgery is difficult. In this study, we investigated to determine the complications and long-term outcome after posterior fusion in children with atlanto-axial instability.

Materials and Methods: 12 patients underwent posterior fusion in children with atlanto-axial instability. The average age at surgery was 8.3 years (4-13 years), and the mean follow-up period was 4 years and 3 months (7 months-9 years and 1 month). The indication for surgery was AARF in 5 patients, os odontoideum in 4 patients, AAS associated with Down syndrome in 2 patients, and AAS in 1 patient. The surgical procedure, levels of attempted fusion, union rate, complications, and re-operation were investigated. Autogenous iliac crest bone graft was used in all patients.

Results: The procedure of the initial surgery was C1-C2 fusion in 7 patients and O-C fusion in 5 patients. The bone union rate was 75% (9/12) (92% after re-operation). Complications related to the operation occurred in 7 patients (58%). They included neurologic deterioration (3 patients), nonunion in 3 patients, fusion extension to adjacent vertebra in 2 patients, pedicle fracture with pedicle screw insertion in 1 patient, C1 posterior arch fracture with lateral mass screw insertion in 1 patient, and perforation of the skull with a head pin placement in 1 patient. Re-operation was performed in 2 patients.

Conclusion: 12 children with atlanto-axial instability underwent posterior fusion. Successful fusion was achieved using screw and rod system, however the complication rate related to the operation was high (58%) and complications were various. So when a child who suffered from atlanto-axial instability needs posterior fusion, the parents should understand the risk of complications, and we should pay much attention to the surgical treatment of lesions associated with atlanto-axial instability in children.

ORAL PRESENTATIONS 08
Atlanto-axial joint of atlanto-axial subluxation patients due to rheumatoid arthritis before and after surgery, morphological evaluation using CT reconstruction
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This study investigated the pre-operative morphology and post-operative fusion of the atlanto-axial joint (AAJ) in patients with atlanto-axial subluxation (AAS) due to RA using CT. Furthermore, we examined the relationship between the pre-operative morphology of AAJ and other radiographic results. Thirty patients with AAS due to RA treated by C1-2 transarticular screw fixation were reviewed. The morphology of the AAJ was evaluated using sagittal reconstruction views on CT before and 1 year after surgery. Thereafter, the atlanto-dental interval (ADI) value and atlanto-axial angle (AAA) was assessed in preoperative lateral cervical
radiographs. The preoperative CT reconstruction views was graded as follows: Grade 1 showed maintenance of the joint space, Grade 2 showed the joint space narrowing and Grade 3 showed the destructive abnormality of subchondral bone. The preoperative CT image of the AAJ demonstrated Grade 1 in 12 cases (Group A), Grade 2 in 9 cases (Group B) and Grade 3 in 9 cases (Group C). The average ADI value at the flexion position was 11.0 mm in Group A, 12.3 mm in Group B and 12.7 mm in Group C (p=0.313). The average ADI value at the neutral position before surgery was 4.5 mm in Group A, 7.3 mm in Group B and 11.4 mm in Group C (p<0.033). Fusion in the AAJ after surgery was demonstrated in 14 cases (46.7%). According to the preoperative grading of the AAJ, the postoperative fusion in the AAJ was demonstrated in 0 of 32 joints (0%) in Grade 1, 7 of 18 joints (38.9%) in Grade 2 and all of 10 joints (100%) in Grade 3. In conclusion, this study showed that a destructive abnormality of subchondral bone in the AAJ induced an enlargement of the ADI and anterior inclination of the axis in patients with AAS due to RA. Fusion in AAJ was easy to recognize in AAS patients whose joint destruction extended to the subchondral bone.

**ORAL PRESENTATIONS 09**

**C1-lateral mass screw fixation: Usage of a C1-trocar facilitates screw placement in atlantoaxial instabilities**

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**Introduction:** Posterior instrumentation according to Goel&Harms with the use of C1-lateral mass screws (C1-LMS) is advantageous regarding its construct stability, reduction ability and easy incorporation within occipito-cervico-thoracic instrumentation. However, C1-LMS placement can be cumbersome because the entry point is covered by a large venous plexus surrounding the C2-nerve root, which frequently bleeds diffusely. Therefore, we produced a customized C1-trocar system (C1-TS) enabling straightforward C1-LMS placement.

**Material:** Report on the first experiences with a C1-trocar system in 13 patients with C1-2 instabilities. Intraoperatively, after blunt dissection along the bottom of the C1-arch and control of the venous plexus at its postero-lateral extents, the C2-nerve root was retracted caudally and the C1-TS placed with its footprint on the posterior C1-lateral mass surface. The C1-TS allowed drilling and C1-LMS placement (self-threading screws, Synapse/Synthes) without changing position. Afterwards, the C1-TS was removed, the screw-rod system assembled (self-threading screws, Synapse/Synthes) without changing position. Iliac crest grafts placed postero-laterally. We prospectively assessed characteristics regarding handling of a C1-TS, patients’ demographics, surgical parameters and perioperative complications and now report on early outcomes.

**Results:** Sample included 8 male and 5 female patients, age 58.6±18.4 years.

C1-2 fusion was indicated for instability related to odontoid non-union (5x), os odontoideum (2x), atlantoaxial osteoarthrosis (2x), C2-burst fracture (2x), odontoid tumor (1x), old Jefferson-burst fracture (1x) and C1-3 non-union following posterior wire-based fusion. 1 patient had previous posterior and 2 anterior surgery. C1-TS usage facilitated C1-LMS placement, particularly regarding the process of drilling and C1-LMS placement in patients with venous plexus bleeding. Likewise, blood-loss was 385±217 ml in 12 patients (467±361 ml, including 1 case with profound plexus bleeding after C1-LMS placement and construct assembly). Operative time was 187±47.3 min. Comparing surgical characteristics to those few studies offering data, blood loss could be reduced and handling of the C1-venous plexus simplified. There were no perioperative complications or revision surgeries. At follow-up of 7.9±3.8 months, patients’ self-perceived clinical results were judged good or excellent in all cases. CT-based follow-up identified osseous-union posteriorly in 12 patients and at the lateral C1-2 joints in a rheumatoid.

**Conclusion:** We report our first results with a C1-TS reducing surgical fiddling-factor with C1-LMS placement. Results are encouraging improving surgeon’s comfort with C1-2 instrumentation in the technique of Goel&Harms.

**ORAL PRESENTATIONS 10**

**New atlanto-axial fixation procedure for the axis to preserve all muscular attachments to the spinous process**


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**Purpose:** Deep neck extensors of the cervical spine attaching to spinous process, especially to C2 process, are very important as lever arm of the cervical spine to maintain its mobility and stability. Now we report posterior fixation of atlanto-axial interarticulars with muscle preserving technique without damaging all 5 muscular attachments to the C2 spinous process using screw, hook and rod systems.

**Methods:** Surgical technique using an operating microscope: After mid line posterior skin incision, the nuchal fascia is divided longitudinally to expose the deep extensor muscles. After identification the C2 spinous process, the atlanto-axial membrane and C1 posterior arch are exposed by bluntly spreading the interval between the right and left rectus capitis posterior major muscles. To expose the C2 lamina, the plane between the oblique capsitis inferior muscles and semisinalis cervics is bluntly spread. Lateral mass screws, pedicle screws, laminar screws or hooks were inserted into C1 posterior arch and C2 laminae respectively, and fixed with rods passed beneath the bulky obliquus capsitis inferior muscles.

**Patient Data:** Twelve patients underwent PAAIM. Mean age at surgery was 64 years old. Evaluation of surgical outcomes for each patient: Flexion-extension range of motion was measured by radiographs. Postoperative MRI was taken one year after surgery to measure muscle volume.

**Results:** All patients had neurological recoveries without loss of range of neck motions and axial pains. In MR images, there was no significant difference between the cross-sectional area of the deep extensor muscles on the affected side and those on the opposite side.

**Conclusion:** PAAIM is one of the hopeful methods of atlanto-axial fixation which have the following advantages. 1. Wound pain could be diminished due to preservation of the muscular attachments to the large C2 spinous process. 2. Richly-vascularized muscular tissue can minimize dead space formation, and diminish the incidence of infection. 3. Bone union could be facilitated because blood circulation to the floor of bone graft is well maintained.

**ORAL PRESENTATIONS 11**

**Fusion Level Elongation after Occipitocervical Reconstruction Using Cervical Pedicle Screw: Long Term Follow-up of 154 Patients**

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**Objective:** The purpose of this study was to review the cases required additional surgery of fusion level elongation after occipitocervical reconstruction using cervical pedicle screw fixation (CPS) and to discuss the causes of salvage surgery.
Methods: Between February 1994 and Dec 2007, occipitocervical reconstruction (O-C fusion) using CPSS was conducted for 134 patients. Original disorders were rheumatoid arthritis (RA) in 129 patients, odontoid resection in 10, spinal tumors in 6, congenital anomaly in 4, and others in 5. We measured pre- and postoperative angles of occipital to the most caudal fixed vertebra (O-CFV angle), angle of the most caudal fixed vertebra to C7 (CFVC7 angle) and O-C7 angle.

Results: 8 of 134 patients required additional surgery of fusion elongation. Except 1 case with Os odontoideum who developed pseudoarthrosis, 7 cases suffered from rheumatoid arthritis (RA) developed subaxial lesions with neurological deficit. The most caudal fixed vertebra was C2 in 3 patients, C3 in 1, C4 in 1, C5 in 1, and C6 in 2. Regarding RA patients, the most caudal fixed vertebra was C2 in 89 patients, C3 in 10, C4 in 5, C5 in 3, C6 in 4, and C7 in 2. Therefore, the ratio of fusion level elongation in RA was 3.4% (3/89) in group with O-C2 fusion, and 21% (5/24) in O-C3, O-C4, O-C5 and O-C6 fixation. The difference between pre and postoperative O-C7 angle (O-C7 angle) was 17°in salvaged group and 0.8°in non-salvaged patients. The difference between pre and postoperative O-CFV angle (O-CFV angle) was 22.4°in salvaged group, and 6.5°in non-salvaged group. In non-salvaged group, the mean correction angle was almost equal in O-C2 fusion cases (6.3°), and in O-C3, O-C4, O-C5, O-C6 fusion cases (7.0°). In non-salvaged group with O-C2 fusion, the correction angle ranged from -14°to 31°. In O-C3 to O-C6 fixation group, the correction angle ranged from 0°to 11°.

Discussion and Conclusion: In non-salvaged group, O-C7 angle were maintained as preoperatively. It means that the correction angle at O-CFV was compensated by CFV-C7 segments. If mobile angles in the residual unfixed segments reduced, residual mobile segments may be unable to compensate corrected angle of O-CLEV. In the present series, possible correction angle was more strictly restricted in the cases of O-C3, O-C4, O-C5, O-C6 fixation than in O-C2 fixation cases. Possible correction angle may be decided by residual unfixed segment. Therefore, the word of ‘Over correction’ means over correction for unfixed mobile segment. We might consider more caudal fixation of occipitocervicotratic reconstruction for the case requiring the most caudal fixation anchor in the lower cervical vertebra.

ORAL PRESENTATIONS 12
Type II Odontoid Fractures in the Elderly Patient: is surgery mandatory?
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Introduction: Type II odontoid fractures pass through the odontoid itself or at its basis and have because of the relatively small mating surface the tendency nearly always to develop a pseudarthrosis. The odontoid plays an important role in the atlantoaxial stability and chronic mobility due to a pseudarthrosis can lead to myelopathy. Therefore this type of lesion is usually stabilized operatively either with an anterior screw fixation or a posterior atlantoaxial fusion. The risks of such an operation are high, especially in the elderly population with a mortality rate of up to 10% (White et al, Spine 2010). We therefore rise the question if a type II odontoid fracture in the elderly, particularly in inactive patients with several comorbidities, may as well be treated conservatively considering the fact, that a cervical myelopathy due to a dens pseudarthrosis evolves if at all with a latency of 10 or more years. Is this rather small risk acceptable?

Material/Methods: In this retrospective cohort study, we followed up all patients with a type II odontoid fracture treated conservatively in our hospital from 2000 to 2009. All were at the time of the fracture (mostly falls) 70 years of age or older (70-93 years, average 84.5). The reasons for a conservative treatment at the time were inactive patients with comorbidities causing a high perioperative risk or a refusal of the suggested surgery. These patients were treated with a SOMI-Brace, a Philadelphia collar or a soft collar for 8-12 weeks after an informed consent. For the radiologic evaluation, ap, lateral and open mouth as well as lateral radiographs in extension and flexion were done. The clinical assessment consisted of a thorough history and clinical exam and the European Myelopathy Score, the Neck Disability Index and Walking Test after Crockard were obtained.

Results: At the time of follow up in 2010, 19 of 32 patients had died of non fracture-related causes (i.e. cardiac, pneumonia, tumors, etc.). The mean survival time was 13.5 months (2 to 37 months). The mean follow up of the 13 patients who survived was 54 month (17-109 months). Only 3 patients reported some mild neck pain with no regular use of analgetics. In none of the patients there was clinical evidence of a cervical myelopathy. All fractures developed a pseudarthrosis with a maximal translation of 6mm.

Conclusion: Our conclusion is that a conservative treatment of a type II odontoid fracture in elderly, low demand patients especially with comorbidities and a high risk of peripoperative complications is acceptable even considering the fact that a more or less mobile pseudarthrosis will almost certainly develop. In all other patients an operative stabilisation should be the treatment of choice.

ORAL PRESENTATIONS 13
The utility of a multicolor full-scale 3D model in complicated cervical spine surgery
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Introduction: Full-scale 3D models are accepted as a useful tool for patient education, surgical planning and intra-operative navigation, as they accurately reproduce complicated anatomy. Owing to recent developments of the fabrication technique, it is also possible to produce multicolor objects, providing more realistic and informative models.

Materials and Methods: Thin-section plain and contrast-enhanced CT scans, occasionally after myelography and/or angiography, were obtained from three complicated cervical spine surgery patients including two patients with RA and one with kyphotic instability. The first RA patient manifested one-sided destruction of the atlantoaxial lateral mass accompanied by positional occlusion of vertebral artery (VA). The second RA patient presented grade 3 spondylolisthesis at C4-5 following posterior occipitocervical (O-C2) fusion. In this patient, the rod end of the right side invaded the spinal canal, and that of the left side invaded the transverse foramen of C5. The third patient manifested severe instability and kyphosis at C7/Th1 after posterior release and anterior cervical corpectomy and fusion from C4 to C7. As a result of a previous procedure in another hospital, this patient had lost almost all posterior structures from C3 to C7 including pedicles. The CT image data were transferred to commercially available image-processing software, which was used to reconstruct a 3D model of the anatomical structures. In this model, bone, metal instrument, VA, and dural tube were colored yellow, grey, red, and blue, respectively. The data were utilized to generate the final full-scale 3D model with a plaster-based multicolor 3D printer.

Results and Discussion: Posterior cervical fusion was performed in all patients. The models successfully demonstrated the three-dimensional relationships among the structures, and were useful in each scene of
preoperative planning, navigation during surgery, and communication with patients. They gave us intuitively understandable orientation, which is quite different information from that obtained by any of the conventional imaging or navigation techniques. In revision surgery, they were particularly useful in preventing us from being lost in the postoperative scar. The operations for all three patients were successfully performed as planned without complication.

**Conclusion:** Multicolor full-scale 3D models were particularly useful in complicated cervical spine surgeries.

**ORAL PRESENTATIONS 14**

**Impact of the O-C2 Angle on the Oropharyngeal Space in Normal Subjects**


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**Background:** Our previous study showed dysphagia and/or dyspnea after occipitocervical fusion was caused by oropharyngeal stenosis resulting from the fixation with the reduced O-C2 angle. Other independent researchers demonstrated that development or improvement of obstructive sleep apnea in RA patients was related to the O-C2 alignment. However, there are limited basic data demonstrating the relationship between the O-C2 alignment and the oropharyngeal space.

**Objective:** The purpose of this study was to analyze the relationship between the cervical alignment and the oropharyngeal space using normal subjects.

**Methods:** Plain lateral cervical radiographs in five tested positions: neutral, flexion, extension, protrusion, and retraction of 40 asymptomatic volunteers were collected. The O-C2 angle, the C2-C6 angle, and the anterior-posterior distance of the narrowest oropharyngeal airway space (nPAS) were measured, and the changes in value from the neutral to the other four positions were calculated for each subject.

**Results:** According to the multiple regression analysis, there was an extremely strong linear correlation of the change in the O-C2 angle with the percentage change in the nPAS. Referring to the multiple regression equation, a decrease of 10 degrees in the O-C2 angle caused a 37% reduction in the nPAS in the neutral position. In contrast, no significant correlation was found between the change in the C2-C6 angle and the percentage change in the nPAS.

**Discussion and Conclusions:** The present study clearly demonstrates that the occipito-upper-cervical alignment, not the middle-lower cervical alignment, has a great impact on the oropharyngeal space. We speculate that the reduction of O-C2 angle shifts the mandible posteriorly, which reduces the space surrounded by the mandible and the C-spine at the oropharyngeal level, resulting in an airway stenosis. Our results also clarify that a small change in O-C2 angle has a great impact on the oropharyngeal space. This fact stresses the importance of the accurate measurement of the O-C2 angle during surgery because it is very difficult to detect such a change macroscopically. The O-C2 angle is easily measured; therefore, it will be a simple and practical parameter in the diagnosis and treatment of the upper cervical lesion.

**ORAL PRESENTATIONS 15**

**Bulging of spinal cord was one reason for spinal canal stenosis in cervical spondylotic myelopathy - Dynamic MRI examination of cervical spine in 100 asymptomatic subjects**

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**Introduction:** The purpose of this study was to elucidate the mechanism of spinal canal narrowing in a symptomatic subject and to reveal the pathology of stenosis in cervical spondylotic myelopathy.

**Materials and Methods:** We performed MRI examination of cervical spine in 100 asymptomatic volunteers. They included 20 persons in each decade from 20’s to 60’s. T2-weighted sagittal and axial images were obtained using 3.0T MRI scanner. MRI was taken with neck at three position; neutral position, anterior flexed position and posterior extended position. Cross-sectional area of spinal cord and intradural space were measured at each disc and vertebral level from C2 to C7.

**Results:** Averaged cross-sectional area of spinal cord with neck anterior flexed position were, as neutral position was defined as 100%, 96.5% for female (20’s:96.9, 30’s:97.3, 40’s:96.6, 50’s:96.7, 60’s:94.8) and 97.3% for male(20’s:97.3, 30’s:96.0, 40’s:101.4, 50’s:95.6, 60’s:96.4). Averaged cross-sectional area of spinal cord with neck posterior extended position were, as neutral position was defined as 100%, 105.1% for female (20’s:107.0, 30’s:104.8, 40’s:107.0, 50’s:104.9, 60’s:101.7) and 104.9% for male (20’s:104.0, 30’s:102.3, 40’s:107.3, 50’s:104.9, 60’s:106.3). Averaged occupancy rate of spinal cord in intradural space with neck anterior flexed position were, as neutral position was defined as 100%, 92.9% for female (20’s:95.4, 30’s:94.6, 40’s:93.6, 50’s:91.2, 60’s:89.5) and 96.4% for male (20’s:96.5, 30’s:95.2, 40’s:104.4, 50’s:94.6, 60’s:91.3). Averaged occupancy rate of spinal cord in intradural space with neck posterior extended position were, as neutral position was defined as 100%, 99.7% for female (20’s:103.7, 30’s:101.1, 40’s:105.7, 50’s:93.5, 60’s:94.4) and 105.7% for male (20’s:104.5, 30’s:108.1, 40’s:110.4, 50’s:101.6, 60’s:103.7).

**Discussion:** Spinal cord was shrunk with neck in flexed position, contrary bulged with neck in extended position. Occupancy rate of spinal cord in intradural space was increased with neck posterior extended position, however decreased only for 50’s and 60’ female. This may be one reason why men are affected to cervical spondylotic myelopathy.

**Conclusion:** The spinal cord tends to be compressed with neck in extended position because of its bulging. This mechanism of stenosis is one of the factors for cervical spondylotic myelopathy.
were compared as below, 1. Stimulation intensity, 2. Possibility of eliciting evoked potentials 3. Effect of anesthesia 4. Changes in potentials during surgery and postoperative neurological findings. Transpharyngeal stimulation was able to elicit CMAP with less intensity (130-300V) than transcranial stimulation (300-550V). 2. Higher amplitude of responses with transpharyngeal stimulation than transcranial stimulation (n=4). Same responses (n=3). Higher amplitude of CMAPs with transcranial stimulation than transpharyngeal stimulation (n=4). Better responses from the proximal muscles following transpharyngeal stimulation and the distal muscles following transcranial stimulation (n=3). 3. Amplitude of CMAPs reduced with changing Propofol to Sevoflurane for both stimulations. Reducing amplitude to less 30% of control was defined significant potential change. There were true negative cases (n=5), false positive cases (n=5), true positive cases (n=1) and false negative case (n=0). Stimulation intensity was up and amplitude of CMAP was recovered and no neurological deterioration was observed. Transpharyngeal stimulation was able to elicit better response with lower intensity stimulation than transcranial stimulation in the 7/11 patients. It was easier to get responses from the proximal muscles with transcranial stimulation, so its combined application with transcranial stimulation was useful for intraoperative spinal cord monitoring. When amplitude of CMAPs recovered after more intensive stimulation, neural tissue was evaluated to be intact. The transpharyngeal stimulation with the nasopharyngeal electrode can be another useful approach for spinal cord monitoring.

ORAL PRESENTATIONS 17
Usefulness of Dynamic Contrast-Enhanced Magnetic Resonance Images for Diagnosing Pathological Vertebral Lesions Due to Metastasis, Pyogenic Spondylitis, and Tuberculous Spondilitis
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Introduction: Obtaining accurate diagnosis of pathological vertebral fractures due to whether metastasis or infection is annoying even using conventional and enhanced MRIs. Dynamic contrast-enhanced (DCE) MRI is used for examining the features of malignant tumor in radiology, and we can obtain more information in terms of the diffusion of the contrast medium along time course. The purpose of this study was to clarify the usefulness of DCE-MRI for distinguishing between metastatic spinal tumor and pyogenic spondylitis (PS), or tuberculous spondylitis (TB).

Methods: We took DCE-MRI for consecutive 67 patients having pathological vertebral lesions due to metastasis, PS and TB. The biopsy samples were all harvested from them. 27 patients were diagnosed as metastasis, 28 as PS, and 12 as TB. Six metastasis, 2 PS, and 2 TB were occurred in the cervical region (66.9±12.3 years old, male 6, female 4). DCE-MRI consisted of serial 6 sagittal images which were taken every 20 seconds after intravenous gadolinium administration. The degree of enhancement, maximum contrast index, the pattern of diffusion, the degree of enhancement, maximum contrast index, and the presence of enhancement at the posterior structure of the spine were examined. We investigated the specific features which respective diseases have in DCE-MRI and whether it could be applied in the cervical spine.

Results: The degree of enhancement, maximum contrast index, the percentage of the diffusion pattern from the disc, the percentage of enhanced disc, and the percentage of enhanced posterior structure were 2.5±0.6; 2.1±0.5; 1.8±0.8; 45.7±33.0; 107.4±22.3; 83.6±35.6 (seconds), 0; 100; 0 (%), 0; 28.6; 0 (%), and 55.6; 0; 0 (%) in respective metastasis, PS and TB with statistical significance. However, in the cervical spine, decision making was somewhat more difficult because of smaller vertebra when the degree of enhancement was weak (1 of 6 in metastasis, 1 of 2 in PS, and 2 of 2 in TB).

Conclusions: This study has indicated the specific features which respective diseases have in DCE-MRI. This less-invasive image technique provides more information for obtaining accurate diagnosis than previous tools. However, in the cervical spine, the accuracy depends on the degree of enhancement.

ORAL PRESENTATIONS 18
MRI and FDG-PET observations of the cervical spinal cord before and after decompressive surgery in patients with compressive myelopathy
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Objective: FDG-PET has been used to investigate neural tissue metabolic activity including that of the spinal cord. We have reported previously that patients with cervical myelopathy have a variable degree of glucose utilization rate in the cervical spinal cord, and that impaired metabolic activity in these patients at the affected spinal cord level correlated closely with the severity of preoperative neurological dysfunction. The present study was designed to define the morphological and intramedullary signal changes on MRI and the glucose metabolic rate measured on FDG-PET in relation to the neurological status and neurological improvement in these parameters after surgery.

Methods: We studied 24 patients who underwent cervical decompressive surgery in terms of postoperative neurological improvement and changes in MRI and FDG-PET. Neurological status was assessed by the JOA scoring system. Signal intensity change in the cord was qualitatively assessed on both T1- and T2-weighted images. The transverse area of the cervical spinal cord on MRIs and glucose metabolic rate (standardized uptake value [SUV]) from FDG-PET were measured digitally.

Results: Neurological improvement correlated with preoperative cervical spinal cord transverse area at maximal compression and at follow-up and with mean SUV before surgery and at follow-up. Preoperative signal intensity change on MRIs (low intramedullary signal intensity abnormality on T1 weighted image and high intramedullary on T2 weighted image) correlated negatively with neurological improvement rate. The transverse area of the cervical spinal cord was significantly smaller postoperatively in patients with preoperative MRI signal intensity changes. The SUV at follow-up tended to normalize in association with neurological improvement.

Conclusion: Our results showed that postoperative neurological improvement in patients with myelopathy correlated with increased transverse area of the spinal cord, signal intensity change on both T1 and T2 weighted image, and the mean SUV. However, it is almost impossible to estimate the potency of spinal cord expansion on preoperative MRI. FDG-PET allows preoperative estimation of spinal cord neural cell function by measurement and visualization of glucose utilization. Signal intensity change within the cord on MRI did not exhibit decreased metabolic rate of glucose utilization, but the latter was found to be parallel postoperative neurological improvement.

ORAL PRESENTATIONS 19
What Is Epidural Membrane in Cervical Spine? Morphological Features and Clinical Significance
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Introduction: Epidural membrane (EM) in cervical spine has been discussed with regard to the morphological features and clinical significance mainly based on the cadaver study.

Methods: Seventy-five patients with cervical spondylotic myelopathy (CSM) were evaluated who had undergone an expansive open-door laminoplasty under microscopy with more than a 2 year follow-up period (mean, 37.4 months). Clinical outcomes were estimated with the Japanese Orthopaedic Association scoring system (JOA score). The age at surgery averaged 64.4 years, which had a negative correlation with the recovery rate calculated by Hirabayashi’s method (mean, 46.2%); and the preoperative JOA score (mean, 12.1); rs = -0.38, p < 0.01 and rs = -0.44 and p < 0.01, respectively. The symptom responsible level was determined from the preoperative neurological and image findings along with the remaining symptoms at follow-up; then, 12 cases at the C3-4 level, 32 at C4-5, 27 at C5-6, and 4 at C6-7. The morphology of the EM was observed and recorded in each patient during surgery. For histology, the EM specimens obtained from 12 patients were examined. The purpose of this study is to elucidate the morphological features and clinical significance of EM in CSM.

Results: Overall, the EM is an adipo-fibro-vascular tissue, being continuous with periradicular sheath with various morphological features. The noteworthy features were: containing a generous venous plexus with easy bleeding, 17 cases (22.7 %); appeared to obstruct the dural expansion, 12 cases (16%); and appeared to compress the nerve root and/or disturb its mobility, 4 cases (5.3%). The latter two were located between the one above and the one below the responsible level. Compared to 12 patients with the EM obstructing the dural expansion, 63 patients without that EM were prone to be younger (p = 0.051) and had a significantly higher preoperative JOA score (p = 0.043) with no significant difference in the recovery rate (p = 0.17).

Conclusions: The EM is a various morphological featured fibrovascular tissue, some of which may cause postoperative symptomatic epidural hematoma and scar tissue formation with aging-related degeneration, leading to unsatisfactory surgical outcomes.

ORAL PRESENTATIONS 20
Outcomes of palliative surgery in metastatic disease to the cervical and cervicothoracic spine
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Aim: This prospective study was undertaken to assess the clinical outcome of 26 consecutive patients who underwent surgery on symptomatic metastases to the cervical or cervicothoracic spine.

Methods: All patients suffered axial or radicular pain, with or without neurological deficit including radicular weakness (23%), quadriplegia or paraplegia (12%), and urinary sphincteric dysfunction (8%). All patients underwent palliative decompression and stabilization surgery via an anterior (n = 18), posterior (n = 7) or combined (n = 1) approach depending on the topography of the metastases, and were prospectively followed up for one year. 13 patients had adjuvant chemotherapy and 7 patients had radiotherapy to the cervical lesion. Clinical data and data from the European Organization for Research and Treatment of Cancer (EORTC) QLQ30 questionnaire were obtained pre- and post-operatively and at regular follow-up intervals.

Results: Median survival was 6 months and 10 patients were known survivors at 12 months. Post-operatively, one patient developed neurological deterioration and died whilst an inpatient. There was no other early postoperative complication in any other patient. From pre-to post-operatively, there was an immediate and significant improvement in axial and radicular pain and overall quality of life. There was also overall improvement in cognitive, emotional, social, role and physical functioning. The observed improvement in pain, function and quality of life was maintained for the duration of the follow-up period. Furthermore, neurological function was improved or preserved until death in the majority of patients.

Conclusions: Together with adjuvant medical management, surgery for cervical metastases has low morbidity and can achieve good symptomatic palliation in the majority of patients for their remaining lifetime.

ORAL PRESENTATIONS 21
Osteoid Osteoma and Osteoblastoma of the Cervical Spine: The Cause of Unusual Persistent Neck Pain
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Background: The most important symptom in patients with osteoid osteoma and osteoblastoma of the cervical spine that were surgically treated over a 7-year period and to emphasize the unusual persistent neck pain associated with osteoid osteoma and osteoblastoma of the cervical spine.

Study Design: Retrospective study.

Methods: Six patients, 3 male and 3 female, with a mean age of 21 years (range 16-31) diagnosed with osteoid osteoma or osteoblastoma during 2003 to 2009 were analyzed retrospectively. The preoperative neurological and clinical symptoms, neck pain duration, preoperative deformity, location of lesion, radiological findings, surgical technique and clinical follow-up outcomes of each patient were evaluated.

Results: The average follow-up duration was 40.5 months (range, 19 to 83 months). Three patients had osteoid osteoma (2 female and one male), and 3 patients had osteoblastoma (one female and 2 male). Two male patients had recurrent osteoblastoma. The locations of the lesions were as follows: C7 (2 patients), C3 (one patient), C2 (one patient), C3-C4 (one patient) and C5-C6 (one patient). The most common symptom was local neck pain in the region of the tumor. Among all patients, only one patient, who had osteoblastoma, had neurological deficits (right C5-C6 root symptoms). The other patients had no neurological deficits. All patients were treated with surgical resection using microsurgery. Two patients underwent only tumor resection, one patient underwent tumor resection and fusion, and the other 3 patients underwent tumor resection, fusion and spinal instrumentation. No perioperative complications developed in any of our patients. There was no tumor recurrence during the follow-up period.

Conclusion: Surgical treatment of osteoid ostema and osteoblastoma of the spine has been standardized. The most common symptom of osteoid osteoma and osteoblastoma of the cervical spine is local persistent neck pain in the region of the tumor. This symptom can be significant in the diagnosis of these tumors.

ORAL PRESENTATIONS 22
Results of Surgical Treatment of Cervical Schwannoma
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Objective: This study is to report our experience of 29 cases of cervical schwannoma.

Materials and Methods: Between 1970 and 2009, a total of 116 spinal schwannomas were treated surgically at our hospital. Among these cases, 29 cervical schwannomas in 28 patients were examined. The mean
patient age was 46 years (range 12 to 79 years). The patients included 17 males (61%) and 11 females (39%). All cases were surgically excised, and they were confirmed to be schwannomas by pathologists. Functional outcome was assessed using the motor grade and scoliosis change.

**Results:** Of 29 cervical schwannomas, there was one intramedullary tumor (3%), 13 intradural-extradural tumors (45%), eight intradural-extradural tumors (28%) and seven purely extradural tumors (24%). There were 10 dumbbell tumors (34%). Based on Eden classification, Type 2 was diagnosed in four cases, Type 3 in five cases and Type 4 in one case. Tumors were located in 1 segment in 20 cases (69%) and multiple segments in nine cases (31%). Post operative histological findings were schwannoma in all cases. Total removal was achieved in 18 cases (62%) but subtotal removal to avoid nerve damage and bleeding were done in 11 cases (38%). Among 11 cases, one case was recurved locally. This was a dumbbell tumor classified as Eden Type 3, arose from the C-5 nerve root and located in multiple segments C2-6. Radicular pain and motor weakness developed 4 years later and underwent second operation. Tumor-involved C-5 nerve root was transected and total removal was achieved, but it showed persistent symptom.

**Conclusion:** Spinal schwannoma is mostly benign and extramedullary tumor. Intradural-extramedullary schwannomas are extremely rare. However, there was one intramedullary schwannoma. There was one reoccurred case (3%) that had history of previous subtotal removal at first operation and had shown worse prognosis compared with the cases without recurrence. To reduce the recurrence of cervical schwannoma, total excision of tumor mass should be done.

**ORAL PRESENTATIONS 23**

**Scoliosis with Cervical Spine Pathologies**

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**Objective:** The aim of this study was to evaluate any cervical spine pathologies in patients with scoliosis using MRI.

**Method:** We retrospectively reviewed scoliotic patients (2000 - 2010) using MRI. Patients were diagnosed with idiopathic, congenital, neuromuscular and syndromic scoliosis. All patients were examined for cervical spinal pathologies.

**Results:** Of 402 patients 290 were diagnosed with idiopathic scoliosis (IS) (72%) 48 congenital (12%), 44 neuromuscular (11%) and 20 syndromic (5%). The cervical spines of all patients were evaluated with MRI. Results revealed pathologies in the cervical spine for every group. IS - 10 patients (8 female, 2 male) age 14.9 (11-22); pathologies: 6 syringomyelia, 1 cerebral tonsillar hernia, 2 posterior vertebral fusion, 1 cervical arachnoid cyst. Congenital scoliosis: 13 (10 female, 3 male) age 15 (5-35); pathologies: 8 congenital vertebral anomalies (segmentation or formation), 4 syringomyelia, 2 cerebral tonsillar hernia, 1 vertebral hipoplasia, 1 split cord, 1 neuroenteric cyst. Neuromuscular scoliosis: 17 patients (12 female, 5 male) age 15.3 (4-30): 7 syringomyelia, 7 cerebral tonsillar hernia 2 atlantoaxial dissociation, 4 congenital vertebral anomalies, 2 arachnoid cyst, 1 myelomalasia, 1 diastematomyelia, 1 decrease in the cranioservical angle. Syndromic scoliosis: 4 patients (4 male) age 14 (10-18); pathologies: 2 syringomyelia, 1 atlantoaxial dissociation, 1 dermoid cyst. Of all patients 44 (11%) had cervical spine pathologies. The most common pathologies were: 19 syringomyelia (4.7%), 12 congenital vertebral anomalies (%2.9), 10 cerebellar tonsillar hernia (2.4%), 3 arachnoid cyst (%0.7), 3 atlantoaxial dissociation (0.7%), 2 split cord (0.4%), 2 posterior vertebral fusion (0.4%), 1 vertebral hipoplasia (0.2%), 1 neuroenteric cyst (0.2%), 1 myelomalasia (0.2%) and 1 dermoid cyst (0.2%). 69.7% of all patients were female and 30.3% were male and average age was 13.

**Conclusion:** Cervical spinal pathologies vary according to the type of scoliosis. Only 3.4% of 290 IS patients were diagnosed with cervical spinal pathologies but the percentage was much higher for neuromuscular patients - 38.6%, 44 patients. The most common occurring pathology was syringomyelia, followed by congenital vertebral anomalies and cerebral tonsillar hernia. Preoperative MRI scan can provide vital information regarding cervical spinal pathologies.

**ORAL PRESENTATIONS 24**

**Surgery For TB of Cervical Spine**

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Spinal tuberculosis is the commonest extrapulmonary manifestation of tuberculosis. We looked at 60 consecutive cases of cervical spine tuberculosis, treated surgically at Department of Neurosurgery at Liaquat National Hospital from 2000 to 2010. Majority of patients presenting with cervical TB were treated conservatively at our spinal unit. The mean age was 35 years ranging from 4 - 70 years. Average follow up was 3 years. Only 4 % of TB spine patients had disease in cervical spine. Clinical features included neck pain, restricted neck movements, pain, kyphosis, motor and sensory disturbance. All of our patients presented with neurologic deficits for short duration with average of 2 months. Indications for a surgery were neurologic deficit, spinal instability and failure of medical treatment. All patients had anterior cervical approach for decompression. Transoral decompression was performed in 3 cases and only one of them had posterior C1/2 screw and fusion. Only drainage of pus was done in 2 cases each of upper cervical spine and retropharyngeal TB. Anterior decompression followed by fixation by iliac/ fibular bone graft and cervical plating was performed in rest of cases. All patients received antituberculous medications for 9-12 months. Postoperative follow up showed good clinical and radiological outcome. Kyphotic deformity was corrected from an average of 26 degrees to 7 degrees. Surgery for decompression and stabilization of tuberculous spondylitis of the cervical spine is an effective method with good neurologic and radiologic outcome.

**ORAL PRESENTATIONS 25**

**The impact of working length of occipital screws on the pullout resistance of the screw-plate construct. A biomechanical cadaver study**

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**Introduction:** Modern cervical screw-rod constructs enable rigid occipital screw-plate fixation using several screws. Studies observed resistance to pullout (POS) increased with occipital screw length. Insertion of longer screws place risks concerning the cerebellum and venous sinuus, while use of shorter screws is clinically safer and might be equivocal biomechanically. But there are no biomechanical data whether increased osseous engagement of several screws significantly increases a plate’s resistance to pullout.

**Methods:** Biomech.study on 12 human occipital bones.2 groups of each 6 BMD matched-pairs were reconstructed and occipital thickness below the level of external occipital protuberance (EOP) measured. Bones were potted in PMMA with a void prepared anterior to the inner...
cortical bone table. In Group-1, occipital plates (Synapse/Synthes) were fixed with a clinically safe set of three 4.5mm-diameter screws (unicortical fixation). Screw length ranged 10-16mm at the cephalad hole, 8-12mm at the middle and caudal holes. In Group-2, maximum screw lengths (8-16mm,bicortical fixation) at the level of the EOP were selected. All screws were evaluated clinically & using fluoroscopy prior to pullout testing. Sections were measured in an electromechanical testing machine (ETM) and plates connected to the ETM with screw axis coaxial with the pullout force. Pullout-loading was conducted at a rate of 2mm/min. Load-displacement data were taken continuously. Peak load-to-failure was measured in Newton and reported as POS. Postop, all bones were cut sagitally along the screws to rule out radiographically invisible breaches of the occipital bone or screw fixation into PMMA, accordingly one pair of plates tested was excluded.

**Results:** BMD for specimens in Group-1 was 206.5±26.7 for Group-2 224.1±673mg Ca-HA/ml. Osseous purchase, defined as [Summed screw lengths-plate thickness(mm)×3(screws)] was 20.0mm for Group-1 and 30.5±2.5mm for Group-2. Summed screw length was 26.0mm for Group-1, 36.6±2.5mm for Group-2, the differences yielded significance (p<0.001). The POS in Group-1 was 524.9±260.8N, 1867.8±594.4N in Group-2, difference was significant (p=0.001). Statistics revealed a strong correlation between summed screw lengths, osseous purchase and POS (p<0.001, r=0.9).

**Conclusion:** Increasing screw length in the merely cortical occipital bone increased POS of a modern occipital screw-plate construct. Differences were striking resembled by a 3-fold increased POS with a strategy using longest screws where possible as compared to a 'shorter-and-safe' strategy. Although clinical studies showed that loosening of occipital plates is rare, our study offers biomechanical data for surgeons intending screw placement at the occiput.

**ORAL PRESENTATIONS 26**

Cervical spondylodiscitis is becoming more aggressive: a review of 50 patients

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Cervical spondylodiscitis is a quite rare finding regarding the common location of infection in the lumbar and thoracic regions. Between 2004 and 2009 thirty consecutive patients (group B) suffering from cervical spondylodiscitis underwent surgical treatment in our institution. These were compared to another group consisting of 20 patients (group A) undergoing surgery for the same disease between 1994 and 1999 again in our institution. The aim was to study the behaviour of the disease over the two decades. The mean age at presentation increased from 50.7 (group A) to 64.5 years (group B). Male predominance was noticed in both groups. Accompanying neurological deficit was almost the same (40-45%), while septicemia increased from 15% (group A) to 40% (group B). Radiologically, epidural abscess formation increased in group B (80%) in comparison to group A (60%). Another concomitant non contiguous discitis in the thoracic and/or lumbar spine was found in 14 patients (47%) in group B. The disease was mostly monosegmental in group A (85%), while in group B, the disease became more aggressive affecting two and three segments in 36.6% of the cases. All patients in both series underwent surgical debridement followed by antibiotic therapy for 8-12 weeks. There was an increased tendency toward anterior alone surgery in group B (56.7%) in comparison to group A (35%). Staphylococcus aureus were isolated most frequently in both groups. Mean period of follow-up was 3 years in group A and 2.5 years in group B. Healing of the inflammation was the rule. Residual neurological deficit was almost the same (33-42%). Advanced septicemia leading to death increased from 5% in group A to 10% in group B. Revision surgery was necessary in 5-6% due to metal failure or deep infection.

**Conclusion:** Cervical spondylodiscitis is increasing in the ageing community and is becoming more aggressive. MRI of the whole spine is recommended in all cases so as not to miss another infection in the spinal column. Anterior alone surgery is becoming more applicable; may be due to the advance in implant designs.

**ORAL PRESENTATIONS 28**

Is conservative treatment as good as surgery for patients with cervical radiculopathy? A prospective randomized study with a two year follow-up by an unbiased observer.

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**Introduction:** Knowledge concerning the effect of different interventions for patients with cervical radiculopathy is scarce and the aim of this study was to evaluate if physiotherapy alone is as effective as anterior cervical decompression and fusion (ACDF) followed by physiotherapy.

**Methods:** 63 patients referred for surgery were randomized into two treatment groups: surgery in combination with physiotherapy or physiotherapy alone. Inclusion criteria were one- or two-level cervical disc disease with radiculopathy and a symptom duration of 8 weeks to 5 years. The surgical group (n=32) was treated with ACDF using a titanium implant (BAK/C) and subsequent physiotherapy and the patients in the nonsurgical group (n=31) were treated with physiotherapy for a minimum of 3 months. Outcome measures were disability assessed with Neck Disability Index (NDI 0-100%) and neck- and arm-pain assessed with Visual Analogue Scale (VAS 0-100mm). Patient questionnaires and clinical examination were performed before randomization and at one- and two-years follow-up. The proportion of men was 54.0%. The mean age was 46.1 ± 8.9 (SD) years.

**Results:** There were no significant differences between the two groups before randomization. At the 1-year follow-up, NDI was reduced with a mean difference of 15.7 ± 16.8 score% (mean ± SD) in the surgical group and 7.5 ± 13.4 in the non-surgical group (p=0.047). Likewise, neck-pain was reduced by 37.8 ± 29.3 mm compared to 16.1 ± 27.3 (p=0.007), and arm-pain by 30.7 ± 32.0 mm compared to 21.2 ± 26.1 (p=0.22). At the 2-year follow-up, NDI reduction in the surgical group was 15.6 ± 16.7 score% compared to 12.1 ± 16.7 (p=0.45). Neck-pain reduction was 37.2 ± 31.8 mm compared to 18.4 ± 30.6 (p=0.033) and arm-pain 19.7 ± 36.8 mm compared to 21.6 ± 32.4 (p=0.84).

**Conclusions:** In this patient group, anterior cervical decompression and fusion in combination with physiotherapy was more effective in reducing neck-pain than physiotherapy alone at one- and two-years follow-up. The reduction in disability was significantly greater in the surgical group at one year, but there was no significant difference at two years. There was no significant difference in arm-pain at either one or two years.

**ORAL PRESENTATIONS 29**

Surgical treatment for cervical spondylotic myelopathy in cerebral palsy patient


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Athetoid cerebral palsy (CP) accompanies hypermobility and involuntary motion which aggravates cervical spondylotic myelopathy (CSM). CP...
patients sometimes have significant neurological deterioration due to CSM. The management of CP cervical spine is still challenging issue.

**Materials and Methods:** 48 CP patients were enrolled in this study. The average age at operation was 47.6 years old and average follow-up duration was 5.4 years. Surgical outcomes were measured by image and clinical analysis. Clinical results were estimated by daily living function and Japanese Orthopaedic Association score (JOA score).

**Results:** We detected two main reasons for CSM. One was whole cervical hyper motion. The other was focal instability. In cervical hyper motion case, MRI showed specific spinal cord atrophy. We have performed long fusion with spinal process splitting laminoplasty (Kurokawa) and bone graft in 35 CP patients. Neurological improvement was reliable. 30 out of 35 patients have returned to their daily living. Laminoplasty could not prevent further kyphotic changes. Therefore we added anterior release and fusion in 10 kyphotic cases. 8 out of 10 patients had great view. Radiograph and MRI revealed focal instability and compression in 13 patients. We had performed ABF in 9 cases. After these anterior fusion cases, we have performed pedicle screw fixation because of rigid fixation and early rehabilitation. Short fusion achieved good bone union in all cases and made fairly good results in 10 /13 cases.

**Conclusion:** Dynamic factor is main cause for CSM in athetoid CP. The aim of surgery is to get static condition at cervical spine. Long fusion is usually considered for whole cervical spine. We have performed laminoplasty with bone graft. Though pedicle screw has been more popular in these days, we restrict the usage of screw in short fusion because the hyper mobility might affect bony fusion and lead implant failure. Our surgical strategy is: 1) Posterior decompression and stabilization according to laminoplasty and bone graft is appropriate procedure for cervical spine. 2) Laminoplasty following anterior release and realignment is good for kyphotic case. 3) In regional instability, short fusion with instrumentation is also available.

**ORAL PRESENTATIONS 30**

C5 palsy as the complication of anterior cervical discectomy and fusion (ACDF)

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**Introduction:** Postoperative C5 palsy after cervical decompression surgery is well-known complication. Although C5 palsy after ACDF is thought as rare, it is not clear. Previous reports show the complication after ACDF surgery. Materials and Methods: Of 191 ACDF cases between 2006 and 2010, 73 patients with C3/4 and/or C4/5 level included in this study; equivalent the level of C5 root or spinal cord segment. The numbers of fusion were 1-, 2-, 3-levels in 12, 48, and 13 cases, respectively. Posterior approach was selected because decompression was enough, and finally the symptom fully recovered. Preoperative cervical alignment of the 3 cases was kyphotic, straight and lordotic, respectively. Intradural T2 high signal intensity was seen only 1 of 3 cases preoperatively. And there was no intramedullary lesion on MRI of the 3 cases.

**Conclusion:** Postoperative C5 palsy is not so low occurrence as be thought. Preoperative cervical alignment and intradural T2 high signal do not influence postoperative C5 palsy. Although the reason is not clarified yet, some mechanisms are suggested; tethering effect, reperfusion injury, etc. One of our case with insufficiency supports tethering theory. However, in the present case, another case can’t be explained by tethering; nerves are well decompressed, and anterior shift seldom occur in lordotic or straight cervical spine with ACDF. These cases support reperfusion theory. Further study should be performed in other levels of ACDF.

**ORAL PRESENTATIONS 31**

Anterior Cervical Microdiscectomy With or Without Fusion


Neurosurgery Department, American Hospital, Istanbul, Turkey

Anterior cervical microdiscectomy (ACD) is commonly applied in the surgical treatment of cervical disc herniation. However, following discectomy procedure to perform a fusion process is still controversial. Therefore, a controlled, multicentric, prospective, randomized study was designed. Totally 20 patients were operated. Eleven patients were operated with applying simple anterior microdiscectomy technique. Nine patients were operated via ACD and fusion with a semirigid plate technique. Preoperative and postoperative [mean (13.95 mo)] computed tomography studies and plain x-rays were obtained. The cervical disc and bilateral neural foramen heights of the operated level and adjacent segments were calculated. Pain assessment was performed using visual analog pain scale. Mann-Whitney statistical analysis method was applied to compare the outcomes for both groups. Satisfactory result was achieved in both groups. The pain scores for major complaint (arm pain) were decreased significantly in all patients after surgery regardless of the type of technique applied. The improvement in neck pain scores was significant only in patients who were treated with fusion procedure. There were no significant changes in disc height and neural foramen height measurements for both groups in adjacent levels in immediate and 1 year postoperative periods. The patients who were operated with simple ACD technique showed a significant decrease at postoperative first day in disc height and neural foramen height. However, the 1-year postoperative radiologic studies showed a significant decrease in disc height and neural foramen dimensions compared with preoperative values. The patients who were operated with fusion process showed a significant increase in disc height and nonsignificant increase in neural foramen heights at immediate postoperative study. However, with time, all dimensions showed significant decrease compared with preoperative values. ACD technique offers satisfactory outcome regardless of whether fusion process is applied or not. Fusion with semirigid plate offers an advantage at operated level in immediate postoperative period in regard of disc height and neural foramen height. However, semirigid anterior plates by definition do not stop subsidence and the advantage that is offered by this technique is not persistent. On the other hand to apply fusion process with semirigid plate system offers significantly less narrowing in disc height compared with simple ACD technique.
Granulocyte colony stimulating factor (G-CSF) reduced neuropathic pain in patients with rapidly aggravating compression myelopathy: analyses of clinical trial cases.

Orthopedic Surgery, Chiba University Graduate School of Medicine, Chiba City, Japan

Introduction: In patients with spinal cord lesions, neuropathic pain frequently develops. However, therapeutic treatments have not been fully established. We conducted a clinical trial of neuroprotective therapy using granulocyte colony stimulating factor (G-CSF) for rapidly aggravating compression myelopathy. In these cases, we unexpectedly encountered pain-relieved patients, simultaneously with the relief of myelopathy. From this finding, we have hypothesized that G-CSF has a therapeutic effect on neuropathic pain with spinal cord lesions. In the present study, we analyzed the reduction of neuropathic pain in patients who underwent the G-CSF clinical trial.

Methods: 57 patients with rapidly aggravating myelopathy underwent G-CSF neuroprotective therapy. Among them, 13 patients complained of neuropathic pain. Age at administration ranged 32 to 78 years old. Diagnosis was OPLL in 8 patients, ossification of the yellow ligament in 2 patients, and other in 3 patients. G-CSF 10 μg/kg/day was intravenously administered for 5 consecutive days, and followed-up for 6 months or more. The grade of pain was evaluated using a visual analog scale (VAS) before and after administration. Neurological status was evaluated from the JOA and ASIA scores. In MR images, T2 high intensity lesions and compression of spinal cord were evaluated.

Results: In 11 of the 13 patients, pain was relieved within several days after G-CSF administration. The mean VAS was 65.4 mm before administration, and it decreased to 35.4 mm at 1 week after administration. In 8 of the 11 patients, pain recurred 4 to 6 months after administration (mean: 4.1 months). The mean VAS increased to 47.7 mm at 6 months. In patients in whom satisfactory improvement of myelopathy was obtained after administration, a pain-relieving effect was evident. No relationship was found between the pain-relieving effect and others.

Conclusions: The present results demonstrate that G-CSF has a pain-relieving effect for neuropathic pain in patients with rapidly aggravating compression myelopathy. Interestingly, the pain-relieving effect was maintained for approximately 4 months. In addition, there were patients in whom no pain-relief was obtained after G-CSF administration. A randomized controlled double blind clinical trial will be required to establish the clinical usefulness of G-CSF for neuropathic pain.

Cervical posterior foraminotomy -A comparison among direct (naked eye), microscopic and endoscopic visualization-

Orthopedic Surgery, Chiba University Graduate School of Medicine, Chiba City, Japan

Introduction: The purpose of this study is to compare the usefulness of cervical posterior foraminotomy performed under direct (naked eye), microscopic, or endoscopic visualization.

Methods: One hundred and fifty-three patients (191 disc levels) were included. Nineteen patients (21 disc levels) underwent the operation with the surgeons' eyes naked (Group N), 104 patients (133 levels) with the microscope (Group M) and 30 patients (37 levels) with the endoscope (Group E). Causes of radiculopathy were spondylosis in 118 levels and disc hernia in 73 levels. Investigated factors were operation time (/level), blood loss (/level), complications, CRP (at P.O.1W), time of analgesic usage (within P.O.1W), duration of hospital stay after surgery, degree of neurological recoveries, and percentage of facet joint preservation.

Results: The averaged operation time was 89 minutes in Group N, 76 in Group M, and 92 in Group. The averaged blood loss was 14μl, 65, and 75. As complications, temporary deterioration of C5 and C7 motor weakness was observed in 1 patient each (N) and C7 motor weakness in 1 patient (M). And dural tears were seen in 6 patients (1 in N, 4 in M, 1 in E). CRP was 1.0, 0.9 and 0.3μg/ml. The time of analgesic usage was 2.5, 2.3, and 1.1. The hospital stay was 23, 15, and 11 days. Preoperative severe radiating pain in 140 patients disappeared completely in 138 patients. Preoperative motor weakness seen in 94 patients disappeared completely in 76 patients. The neurological recoveries were not significantly different among 3 groups. The percentage of facet joint preservation averaged 70% (43-100%) and was not significantly different among 3 groups.

Discussion: Operation time, neurological recoveries and the percentage of facet joint preservation were not significantly different among 3 groups. With naked eyes, it is advantageous to perform surgeries without special tools. However, blood loss was significantly more and the risk for temporary deterioration of motor weakness was relatively high due to lack of visualization of microstructure. Therefore foraminotomy with microscope or endoscope is a safe and effective procedure.

Granulocyte colony stimulating factor (G-CSF) reduced neuropathic pain in patients with rapidly aggravating compression myelopathy: analyses of clinical trial cases.

Orthopedic Surgery, Chiba University Graduate School of Medicine, Chiba City, Japan

Introduction: In patients with spinal cord lesions, neuropathic pain frequently develops. However, therapeutic treatments have not been fully established. We conducted a clinical trial of neuroprotective therapy using granulocyte colony stimulating factor (G-CSF) for rapidly aggravating compression myelopathy. In these cases, we unexpectedly encountered pain-relieved patients, simultaneously with the relief of myelopathy. From this finding, we have hypothesized that G-CSF has a therapeutic effect on neuropathic pain with spinal cord lesions. In the present study, we analyzed the reduction of neuropathic pain in patients who underwent the G-CSF clinical trial.

Methods: 57 patients with rapidly aggravating myelopathy underwent G-CSF neuroprotective therapy. Among them, 13 patients complained of neuropathic pain. Age at administration ranged 32 to 78 years old. Diagnosis was OPLL in 8 patients, ossification of the yellow ligament in 2 patients, and other in 3 patients. G-CSF 10 μg/kg/day was intravenously administered for 5 consecutive days, and followed-up for 6 months or more. The grade of pain was evaluated using a visual analog scale (VAS) before and after administration. Neurological status was evaluated from the JOA and ASIA scores. In MR images, T2 high intensity lesions and compression of spinal cord were evaluated.

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Conclusions: The present results demonstrate that G-CSF has a pain-relieving effect for neuropathic pain in patients with rapidly aggravating compression myelopathy. Interestingly, the pain-relieving effect was maintained for approximately 4 months. In addition, there were patients in whom no pain-relief was obtained after G-CSF administration. A randomized controlled double blind clinical trial will be required to establish the clinical usefulness of G-CSF for neuropathic pain.
Conclusion: Although tandem spinal stenosis occurred relatively infrequent, its potential presence should not be overlooked. A remarkable incidence of thoracic stenosis (22% of all tandem cases) has been observed and the diagnosis might be difficult especially in patients with concurrent cervical stenosis.

ORAL PRESENTATIONS 35
Preservation of Segmental Motion With Anterior Contralateral Cervical Microdiskectomy And Interbody Fat Graft: Prospective Study
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Objectives: The aim of our study is to evaluate the results and effectiveness of this minimal invasive technique with or without interbody fat graft replacement in patients with cervical paramedian disc herniations.

Methods: This prospective observational study was undertaken for the analysis of 330 patients with cervical paramedian disc herniation who underwent one -or adjacent two-level anterior contralateral microdiskectomy without fusion between 1992 and 2009. Interbody fat graft replacement were performed on 91 of 340 patients (Group 2). The mean follow up time was 10 years (range 1-16 years). Preoperative and postoperative lateral dynamic cervical radiographs were obtained and, the presence of a reduction in the height of interspace and spontaneous osseous union at the disectomy level were investigated. Surgeries were done by the senior author (YA). Clinical outcomes were assessed using the Neck Disability Index and Short Form-36.

Results: Despite fusion procedures were not performed, spontaneous radiological fusion signs were obtained in 12% of group 1 patients. Follow-up radiological studies revealed healing without fusion in group 2 patients. There was no significant change in the mean overall cervical curvature (C2 -7) angles postoperatively in late follow-up findings (p = 0.77). It represented a statistically significant mean loss of 2.24° of segmental lordosis (p < 0.0001). The NDI scores decreased significantly in both early and late follow-up evaluations and the SF-36 scores demonstrated significant improvement in late follow-up results in two groups. Analysis of clinical outcome showed no statistical differences between two groups (p = 0.77).

Conclusions: Anterior contralateral microdiskectomy without fusion achieves better exposure for resection of the offending foraminal or far lateral lesions, ventral osteophytes, or a disc fragment under direct microscopic visualization. Collapse, loss of motion and, instability of the involved disc level can also be avoided via this less invasive technique. Collapse, loss of motion and, instability of the disc level can also be avoided via this less invasive technique with or without interbody fat graft replacement in patients with cervical paramedian disc herniations.

Keywords: Anterior cervical disectomy; Contralateral approach; Fat graft; Kyphosis; Spinal alignment

ORAL PRESENTATIONS 36
The impact of sarcopenia, the muscle decreasing disease, in cervical compressive myelopathy diagnosed by dual energy X-ray absorptiometry
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Introduction: As populations are aging worldwide, degenerating spine disease such as cervical compressive myelopathy (CCM) is increasing, and surgical treatment is becoming more common. Meanwhile, sarcopenia, the disease of attenuating skeletal muscle due to aging, is known to increase imbalance and frailty in elderly individuals and estimated to affect more than 40% people over 70years. However, the impact of sarcopenia in cervical myelopathy patient is still unknown. This study is aimed to estimate muscle mass and prevalence of sarcopenia in male patients who underwent surgical procedure for cervical compressive myelopathy and to compare them with osteoporotic males.

Methods: A total of 580 male patients from single hospital cohort were involved in this study. Twenty one patients (71±10 years old) who underwent laminoplasty for CCM were assigned to the myelopathy group and performed whole body dual energy X-ray absorptiometry (DXA) preoperatively. 559 male patients (66±12 years old) in outpatient clinic who performed with whole body DXA for diagnosing osteoporosis were assigned to the osteoporosis group. Muscle mass was evaluated with DXA method. Bone mineral content, fat mass, and lean mass were measured separately for each part of the body with DXA. Appendicular skeletal muscle mass index (ASMI) defined as [arm and leg lean mass (kg)/height squared (m2)] was caluculated. Sarcopenia was defined according to the criteria of Sanada as ASMI below 6.87 kg/m2 in men. This criterion value was of 2 standard deviations below healthy young normal. We evaluate the ASMI and prevalence of sarcopenia by using a general linear model and then the Bonferroni test to adjust for covariates as age and whole body BMD.

Results: ASMI and prevalence of sarcopenia were 7.43kg/m2 and 29% in the CCM group, and 6.83kg/m2 and 50% in the osteoporosis group. (P<0.001, P<0.001) After correction with age and BMD, ASMI were 6.88kg/m2 in the CCM group and 6.18kg/m2 in the control group (P<0.0001).

Conclusion: Prevalence of sarcopenia was less and ASMI was higher in the males with CCM who undergoing surgery compared with the osteoporotic males. Higher ASMI was considered to reflect the better general condition of preoperative patients. ASMI or sarcopenia can be the useful barometer of frail condition of elderly patients.

ORAL PRESENTATIONS 37
Subaxial sagittal alignment and adjacent segment degeneration following atlantoaxial fusion using posterior screw fixation
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We retrospectively reviewed 65 patients having atlantoaxial instability treated with atlantoaxial fixation by C1 lateral mass-C2 pedicle screw fixation (30 patients, Groups A) or a combination of transarticular screw fixation and posterior wiring (35 patients, Groups B). Angles of O-C1, C1-2, C2-3, and C2-7 were determined from an upright lateral radiograph in flexion, neutral and extension positions. The range of motion (ROM) at O-C1 and C2-3 was also determined. All patients were examined before and 2 years after surgery. Mean preoperative atlantoaxial angles in Groups A and B were 20.9 ± 8.3o and 18.3 ± 7.2o, respectively. Mean postoperative atlantoaxial angles in Groups A and B were 23.5 ± 5.6o and 29.7 ± 6.3o, respectively, with a statistical significance between the 2 groups (p < 0.05). Mean preoperative angles of C2-7 in Groups A and B were 15.4 ± 7.8o and 13.7 ± 9.5o, respectively. After surgery, the angles were 11.8 ± 12o and 2.48 ± 12o, respectively, with a statistical significance between the 2 groups (p = 0.05). The postoperative angle of C1-2 showed a negative correlation with the extent of change observed in the C2-7 angle pre- and postoperatively in each of these 2 surgical procedures. O-C1 ROM increased after surgery in both groups, but the difference was not statistically significant (p = 0.38). C2-3 ROM decreased after surgery in both groups, and the difference was statistically significant.
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(p < 0.05). Atlantoaxial fixation in a hyperlordotic position produced kyphotic sagittal alignment after surgery in both groups. Reduction of the atlantoaxial joint can be easily achieved through screw fixation at an optimal angle, thereby ameliorating the risk for subsequent subaxial kyphosis. Degeneration of lower adjacent segments appeared to be less with this procedure compared with using a combination of transarticular screw fixation and posterior wiring.

**ORAL PRESENTATIONS 38**

Comparison of revision strategies for failed C2-pedicle screws - A biomechanical study

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**Introduction:** Cervical pedicle screws (CPS) in C2 have become a mainstay in occipito-cervical-thoracic instrumentations because they have superior biomechanical characteristics. But with increasing usage within biomechanical challenging constructs failures of CPS fixation will occur. We therefore investigated the biomechanical characteristics of 2 revision CPS fixation techniques.

**Methods:** Biomechanical study on 12 human C2-vertebrae w/ BMD of 211.2±41.3mg Ca/HA/mL. Instrumentations were as follows: 1) C2 instrumented using unicortical 3.5mm-CPS bilaterally (Synapse/Synthes). Screw insertion depth was 24mm. Insertion accuracy was verified by fluoroscopy, 2 screws revealed a pedicle breach and were excluded. Thus 22 C2-CPS were eligible for testing. C2-vertebrae were potted and fixed in an electromechanical testing machine w/ screw axis coaxial to pullout direction. Pullout was conducted at a rate of 2mm/min. Load and displacement data were taken continuously, peak load-to-failure was measured in Newton(N) and reported as pullout strength(POS). After pullout 2 revision strategies were tested in each vertebra alternating on left and right sides. Group-1: Revision with 4.0mm C2-CPS. Group-2: Revision with C2-pedicle bone-plastic by filling mashed sticks of cancellous bone into the C2-pedicles combined with use of 4mm C2-CPS. For statistics, POS between screws was compared using absolute values (N) and POS of revision technique normalized to that of primary procedures (%).

**Results:** POS of primary 3.5mm-CPS was 1140.5±539.6N for group-1 & 1007.7±362.5N for group-2, not reaching significance. In revision setting, POS in group-1 was 822.9±492.1N, resembling a reduction of 24.4±30.1% compared to that of the primary screw fixation. For group-2 POS was 875.3±367.9N, an 11.2% reduction. Statistics showed a significant increase of POS when using the combination of larger C2-CPS with application of C2-pedicle bone-plastic as compared to using just larger diameter screws (p=0.02). Although statistics showed significantly reduced POS for both revision strategies compared to the primary fixation (Group-1 p<0.001, Group-2 p=0.001), loss of POS (in %) in Group-1 was significantly higher compared to Group-2 (p<0.04).  

**Conclusion:** With increasing use of C2-CPS in biomechanically challenging constructs, loss of fixation must be dealt with. We offer first biomechanical rationales for revision C2-CPS fixation: Using a larger diameter screw combined with application of a pedicle bone-plastic, POS can be significantly increased compared to just increasing screw diameter. Notably, with the bone-plastic technique, POS of the revision screw albeit reached the anchorage characteristics of the primary screw fixation.

**ORAL PRESENTATIONS 39**

**Dropped head syndrome~A case series**

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**Introduction:** Dropped head syndrome (DHS) is characterized by a chin-on-chest deformity in standing. The cause of this disease is still unknown. The present study presents a series of 15 cases of DHS with their pathophysiological features, disease management and outcomes.

**Material and Methods:** Conditions associated with DHS were spondylosis (6 patients), Parkinson disease (5 patients), RA (1 patient), ALS (1 patient), disk herniation (1 patient) spondylotic myelopathy (1 patient). Their ages ranged from 62 to 86 years. The cervical sagittal alignment and curvature were quantified by the C2-C7 Cobb angle and C2 to vertical angle. Olisthesis was assumed when the slippage of one vertebra over the other exceeded 2mm. The intervertebral disc degeneration at C5/6 was evaluated on the grading system by Wallraeven. 13 patients were treated with physiotherapy. 2 patients underwent C2-T3 posterior fusion surgery.

**Results:** The C2-C7 Cobb angle and C2 to vertical angle were 48.9±18.2° and 2.7±19.2° respectively. C2 to vertical angle was measured below 10° in 11 patients (severe deformity) and above 10° in 4 patients (mild deformity). Olisthesis was confirmed in 8 cases. With respect to physiotherapy, we noted its remarkable remedial effects on 4 of 7 olisthesis-free patients. They proved, however, ineffective against all of the 8 olisthesis cases. Radiographic grading system to evaluate the degree of intervertebral disc degeneration registered no degeneration (0 point) in 1 patient, mild (1-3 point) in 2, moderate (4-6 point) in 1 and severe (7-9 point) in 11. The last group had severe deformity. 2 patients underwent successful surgical correction of DHS. Both patients are satisfied with the surgical outcomes, in particular regaining of their horizontal gaze.

**Conclusion:** The results of this study indicated the link between DHS and spondylosis in the lower cervical segment. That was, severe deformity concurrent invariably with aggravated spondylosis, as against mild deformity cases tied with minor cervical deformity. The results of this study points to another link between olisthesis and the effectiveness of physiotherapy. The cases with olisthesis failed completely to respond to the physiotherapy. These results leaves surgical correction to be our option for severe DHS patients with spondylosis and olisthesis.

**ORAL PRESENTATIONS 40**

**Impact of a novel technique of anterior pedicle screw fixation for multilevel cervical corpectomy and spinal fusion on surgical outcome**

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**Introduction:** We have developed a novel technique of anterior pedicle screw (APS) fixation for multilevel cervical corpectomy and spinal fusion (Acta Neurochir 150: 575-582, 2008). In this study, we investigated the impact of this novel technique on surgical outcome.

**Methods:** The study group comprised 29 patients who underwent multi-level cervical corpectomy and spinal fusion using APSs. Mean age at surgery was 56.6 years old. All patients had cervical myelopathy of varying causes, including 13 patients with OPLL. Fusion levels were as follows: C3-C6 (1 case), C4-C7 (7 cases), C5-T1 (1 case), C3-C7 (18 cases), C2-C7 (1 case), and C3-T1 (1 case). Autologous fibula grafts were used in all cases. Screw malpositioning was classified using CT either as screw exposure (<50% of the screw outside the pedicle) or pedicle perforation (>50% of the screw outside the pedicle boundaries). Bony union of the grafted fibula was evaluated by flexion-extension radiographs and CT reconstruction images.
Results: No cases of vertebral artery injury or graft dislodgement occurred. All patients showed neurological improvement following surgery. The mean JOA score for the 24 patients with at least one year follow-up after surgery improved from 9.7 points before surgery to 14.4 points at final follow-up (mean recovery rate: 67.0%). Spinal fusion was achieved in 15 of the 17 patients with at least two years follow-up after surgery; the mean period required for bony union in these 15 patients was 15.1 months. A total of 80 APSs were placed in the 29 study patients, 78 of which (97.5%) were positioned precisely in the pedicles. The two APS malpositionings consisted of one (1.25%) screw-exposure and one (1.25%) pedicle-perforation.

Conclusion: The present results demonstrated that our technique enabled safe APS insertion. To improve the accuracy of APS insertion, we would recommend a wider corpectomy to shorten the distance between the APS insertion point and the pedicle entrance zone. We conclude that APS fixation can safely provide rigid constructs for multi-level cervical corpectomy and spinal fusion and that our APS fixation technique may be useful in reducing the frequency of graft dislodgement in anterior cervical spine surgery.

ORAL PRESENTATIONS 41
Natural course of CSF leakage secondary to anterior corpectomy for cervical degenerative diseases
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Objective: The objective of this study was to analyze a natural course of CSF leakage secondary to anterior decompression and arthrodesis for cervical myelopathy.

Materials and Methods: 32 cases out of 505 consecutive anterior surgical cases for cervical myelopathy between ‘97 and 2009 were involved in this study. There were 4 levels corpectomy in 8 cases, 3 levels corpectomy in 14 cases, 2 levels corpectomy and one corpectomy in 5 cases respectively. All cases, having a cover of damaged dura mater by fibrin glue during surgery were observed with no subarachnoidal drainage after surgery. Complications related to CSF leakage such as air-way obstruction, swelling of neck and cutaneous fistula were investigated. Change of distance in retropharyngeal space was assessed on consecutive 7 days after surgery, 2 weeks, 3 weeks, and 4 weeks using a lateral radiogram. MRI was also taken in 1 month, 3 months, 6 months, 1 year and 2 years after surgery to find a change of CSF cyst. JOA score was used for neurological outcome. Mann-Whitney U test was used for statistical analysis and p< 0.05 was considered to be statistically significant.

Result: There was no patient who needed re-intubation for air-way obstruction caused by CSFoma or swelling of retropharyngeal space after surgery. All patients showed neck swelling on approach side due to CSF cyst which subsided between 4 and 6 weeks after surgery except one case that had undergone 2 times previous anterior and posterior surgery. Distance of retropharyngeal space increased between 2nd and 5th day after surgery then downsized gradually in 26 cases although it happened to increase again between 1 and 2 weeks in 6 cases. According to MRI, CSF cyst downsized until 3mo in all cases and disappeared except one case. JOA score before surgery was 9.2 ±2.9, improved to 14.1±1.8 (p< 0.05).

Conclusion: Natural course of CSF leakage had no adverse effects to air-way obstruction or neurological improvement. We concluded that subarachnoidal drainage is not always necessary to treat CSF leakage if we can spare the arachnoid membrane almost intact during surgery.

POSTER PRESENTATIONS 01
An Objective Case Controlled Study: Does Cervical Muscle Adaptation in Male Rugby Players Aged 13-18 Occur When Compared to Age matched Controls?
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Background: Since Rugby becoming professional during the South Africa World Cup in 1995, it is now being played in 100 Countries Worldwide[1]. It is a physical game the most catastrophic of which is the Cervical spine injury (CSI), resulting in tetraplegia or even death. The adolescent cervical spine is affected in 60-80% of spinal cases compared to only 30-40% in Adults[2]. With a childhood cervical injury associated with up to a 75% mortality[3]. The biomechanics of children may play a role in the incidence of CSI Currently the Rugby Football Union guidelines differentiates between age alone and not strength.

Objective: The primary outcome goal is to investigate the cervical strength of adolescent rugby playing individuals versus age match controls.

Methods: Rugby players were evaluated for their strength, using isometric contraction until eccentric failure.

Results: Cervical circumference and strength is significantly stronger in rugby players versus age matched controls and also in 17-18 year old rugby players compared with their 14-16 year old counterparts P<0.05. The difference in strength is not just age related but also sport specific as 17-18 year old controls were not significantly stronger than 14-16 year old rugby players P>0.05.

Conclusion: The results indicate that rugby players go through cervical adaptation and are stronger than age matched controls and increase in age alone does not produce increase cervical strength. Urgent RFU regulations need to be addressed before the coming season to make sure U16 players are not playing for U18 teams unless having both sufficient strength and skill.

Results: The mean period between the onset and halo vest fixation was 84 days (31-169 days). Preoperative 3D CT and sagittal image of CT disclosed deformation of the C2 superior articular process in all patients. The mean duration of halo vest fixation was 67 days (46-91 days). At the last follow-up examination, remodeling of the deformed C2 superior articular process was noted in 6. Torticollis recurred after removal of the halo vest in 1 patient, and as no remodeling of the C2 superior articular process was observed, surgical treatment was selected.

Discussion: In this study, Halo vest fixation was effective in 6 of the 7 patients and alleviated torticollis. Particularly, of the 7 patients who exhibited the deformation of the C2 before halo vest fixation, 6 showed remodeling of the process after treatment. The stability of the atlantoaxial joint is considered to have been restored as the articular surface of the deformed C2 superior articular process was remodeled by long-term halo vest fixation. Thus, in patients with refractory AARF resisting conservative treatment and exhibiting the remodeling of the deformed C2 superior articular process on 3D CT, treatment with a halo vest for 2-3 months may induce remodeling of it.

POSTER PRESENTATIONS 03
Bone Resorption Markers as Subsidiary Diagnostic Tools for Spinal Metastasis
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Introduction: There are lots of difficulties in the differential diagnosis of spinal fractures (Fx) at the early stage only by X-ray images except when clear pathological changes are found. The changes on X-ray are not recognized as spinal metastasis when bone materials are less than 50%. On the other hand, osteoclasts are activated in bone materials when the tumor expands by clarifying the proliferation mechanism of the metastatic tumor. We evaluate another method to detect pathological changes by using bone turnover markers and the efficacy of the markers as subsidiary diagnostic tools for bone metastasis.

Object and Method: This study included 46 patients with new vertebral Fx. The pathological Fx is caused by tumor in 14 patients (T-group) and Fx with osteoporosis in 32 patients (O-group). Urine NTx is measured at the diagnosis of compression Fx. The bone scintigraphy was performed in T-group. Previous patients’ histories were also evaluated.

Results: Urine NTx showed statistically significantly higher in T-group (109.2) than in O-group (70.2mmolBCE/mmolÂECr) (P<0.05). In male, u-NTx was 100.5 (n=8) in T-group and 55.5 (n=5) in O-group (P=0.601). In female, u-NTx was 110.2(n=5) in T-group and 30.1(n=27) in O-group (P<0.05). There was no significant difference in NTx values between T-group(A) and the patients (NTx:118.6) who had typical osteoporosis deterioration factors ( steroids 3, ovariectomy 3 and gaastic resection 2 patients). In contrast, NTx of patients who had no deterioration factors (NTx:54.9) was significantly lower than that of T-group (P=0.0005).

Consideration: We still have difficulties in differential diagnosis of spinal Fx at the early stage because of the resolution level of simple X-ray examination. We sometimes too much rely on X-ray examinations. Osteoclasts are activated when the tumor expands by clarifying the proliferation mechanism of the metastatic tumor. The bone resorption marker can reflect the state of bone turnover because it measures metabolism in osseous tissue. In this study we found the significantly high NTx values in T-group. We suggest that bone resorption markers are useful as the subsidiary diagnostic tools for spinal metastasis. We should suspect the existence of pathologies when NTx values are highly elevated.

POSTER PRESENTATIONS 04
A Case with Disseminated Carcinomatosis of Bone Marrow from Breast Cancer (Atypical features on MRI)
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Introduction: Recent advances in technologies i.e. MRI, CT and PET have improved diagnostic rate of malignant lesions. However, X-ray examination still plays a main role as the initial test in daily clinics. Common pathological findings on X-ray images are pathological fractures, osteolysis and osteosclerosis. These findings could be evaluated on the X-rays when bone mass decreases more than 50%. MRI has an advantage on screening the entire cervical, thoracic or lumbar at once, and it can reveal the type of the pathological lesions such as focal, scattered or disseminated (infiltrated). Morphological changes of the former two types are able to be distinguished due to comparison with normal. On the other hand, there are difficulties in detection of pathologies in the disseminated (infiltrated) lesions because these lesions lack of morphological changes except the alteration of the intensity on MRI. A case report We report a case of skeletal metastasis with rare pathological manifestations on MRI (Disseminated Carcinomatosis of Bone Marrow: DCBM). We had interpreted it as normal because whole bone marrow had been involved diffusely on MRI with low signal intensities on T1. Three months later, she referred more severe low back pain with left hip pain without any episodes. Lumbar X-ray demonstrated the more severe bone dystrophy than before in whole lumbar spine especially with loss of L2 and L3 pedicle shadows. Serum laboratory data remarkably jumped up (ALP of 1023 IU/L, LDL of 455U/L). Tumor markers showed remarkable high levels as follows: BCA225; 16000(<160), CA15-3; 40(<30) and NCC-ST-439; 25(<7.0). Finally the metastases were diagnosed as DCBM from the breast cancer. But she died of DIC four months later.

Discussion: Disseminated carcinomatosis of bone marrow is first reported as “diffusely infiltrative carcinoma” in 1936. The pathogenesis is explained as the metastasis of the diffusion of the cancer cells. At the beginning radiography shows no apparent pathological changes, and MRI (T1 w.i.) shows the diffused low signal intensities in bone marrow. Therefore lots of cases were reported as the cases with difficulties in early diagnosis. We suggest that we should suspect DCBM when MRI shows decrease of signal intensity.

POSTER PRESENTATIONS 05
Neurosurgical Care of Children with Combined Malformations of The Spinal Cord and Spine
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Introduction: The urgency of the problem of the study with combined malformations of the spinal cord and spine due primarily to the increased share of the abnormalities in the structure of causes of infant mortality, child morbidity, disability, and high frequency of cases.

Material and methods: We analyzed 13 children with associated malformations of the spinal cord were treated in a regional children's hospital in Shymkent for 3 months of 2010 age of patients ranged from 1 day to 1 year. The boys have been - 5, girls - 8. Children from birth to 1 month were - 7 (53,8%), from 1 month to 3 months - 3 (23,1%) from 3 months to 6 months - 2 (15,4%), from 6 months 1 year - 1 (7,7%). Among patients with spinal hernias majority were children with meningomieloradikulotsele (69,2%). Patients with rahishizism was 3 (23,1%), and one child with a terminal mielotsiotsete. For diagnosis
of pathology used clinical-instrumental techniques (spondylography, ultrasound), but not always carried out CT, MRI, which could provide new opportunities for visualization of congenital spinal pathology.

**Results:** Unfavorable to the life and future mental and physical development outlook exacerbated by concomitant hydrocephalus (46.1%), disorders of pelvic organs (84.6%), osteoarticular deformities (77%), pronounced neurological deficits in the lower extremities (100%), had a negative impact on the formation and growth of the organism leads to dysfunction of internal organs. In all cases liquorhrea and lack of progressive hydrocephalus was an indication for urgent surgical intervention on the spinal cord. The success of treatment of associated malformations of the spinal cord is largely dependent on the nature of anatomical and functional disturbances, which began early in the treatment and prevention of postoperative complications.

**Conclusions:** Thus, children with associated malformations of the spinal cord and spine requires early neurosurgical intervention. For neurosurgical operations newborns need modern medical-institutional framework to ensure costly plastic materials and special devices. Requires in-depth study of the epidemiology, genetic factors, early diagnosis and newborns with anomalies of the nervous system.

**POSTER PRESENTATIONS 06**

**Bow Hunter's syndrome secondary to cervical spondylolisthesis: case report**

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**Introduction:** Vertebro-basilar insufficiency (VBI) diagnosis and testing is a controversial topic. VBI associated with voluntary turning of the head is known as Bow Hunter's syndrome. This syndrome is rare and difficult to diagnose. The authors report a case of VBI caused by vertebral artery (VA) compression due to a C6 spondylolisthesis.

**Case Description:** A 27-year-old man presented with a 12-month history of vertigo and dizziness when he turned his head. Ruling out other causes of neurological and cardiac status, he was remitted to orthopedic evaluation. Radiologic imaging tests showed a well-margined cleft between the facets of C6 and C7, anterior displacement of C6 and spina bifida at C6. Stress view showed instability between C6 and C7. A clinical suspicion of Bow Hunter's syndrome secondary to cervical instability by C6-C7 Spondylolisthesis was made. Standard MRI and angio MRI showed anomalous course of right VA at C6, just before to enter in transverse foramina but without stenotic points. A dynamic angiography was made for diagnosis of positional stenosis, and the result was not conclusive. Given the high clinical suspicion, ruling out other diagnosis and great disability the patient was successfully treated by means of anterior cervical arthrodesis C6-C7. The patient is free of symptoms at 15 months follow-up, fully restoring its basic activities and labor.

**Discussion:** The compression of the VA caused by spinal lesions such as osteophytes, tumors, herniated disc and other musculoskeletal factors has been reported as its underlying pathogenesis. Cervical spondylolysis/spondylolisthesis is a rare condition, with over 100 cases described worldwide. It is usually diagnosed in patients after minor trauma or as an incidental finding on routine radiography. Cervical spondylolisthesis can cause Bow Hunter's syndrome. Stress arteriography sedation is not always diagnostic since not accurately reproduce the conditions that cause vertebral artery stenosis. Having ruled out every other causes of the symptoms, surgical treatment of spondylolisthesis can solve the clinical. To the best of the authors' knowledge this is the first report of a cervical spondylolisthesis causing bow hunter stroke.

**POSTER PRESENTATIONS 07**

**Heterotopic ossification after cervical disc arthroplasty. A prospective study**

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**Summary of Background Data:** Heterotopic ossification (HO) occurring after lumbar and cervical disc replacement is a well-known complication. Data regarding HO after CDR is sparse.

**Objectives:** The goals of this study was to determine the incidence of heterotopic ossification (HO) after cervical disc replacement (CDR) with Mobi-C® artificial disc (LDR, Troyes, France), to identify the associated risk factors for HO, and to investigate whether HO affects clinical outcome and range of motion (ROM).

**Methods:** This is a unicenter, prospective and non-comparative study. 71 patients were included in this study. 55 patients underwent a single cervical disc replacement, 4 patients underwent a hybrid fusion, and 12 patients underwent 2-level cervical disc replacement. The mean follow up was 21 months (range 12 to 36 - SD: 8.5 month). Radiological evaluation included classification of HO and ROM for each level treated. Quantitative measurements were performed with Spineview® software (LBM, LIO, Surgiview Company). Clinical outcomes were assessed using the SF-36 questionnaire, Neck Disability Index and a Visual Analog Scale. Statistical analysis was performed using SPSS software 17.0 (SPSS Inc., Chicago, IL). Statistical analysis was performed using t tests, Wilcoxon tests, χ² and Fisher exact test. The significance was accepted at the 0.01 level.

**Results:** HO was detectable in 23 treated segments (27.7%). Of these two had grade 1 ossifications, twelve had grade 2, five had grade 3 and four had grade 4 ossifications. The mean ROM was 8,1° (min -3,6 - max 22,3 - SD 4,2) in the preoperative period and increased to 10,2°(min -2,9° - max 25,3° - SD 5,7°) in the postoperative period at the last follow up visit (p=0,001). ROM was diminished in grade 3 and grade 4 ossifications. Four prostheses were immobile and all had grade 4 ossifications. Nevertheless, HO does not appear affect clinical outcome. We did not find any risk factors associated with the development of HO.

**Conclusion:** HO seems to be a common complication after CDR. No risk factors have been clearly identified in our study. Long-term follow-up will be needed to assess the clinical significance of HO.

**POSTER PRESENTATIONS 08**

**Sagittal alignment after cervical disc arthroplasty**

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**Summary of Background Data:** Clinical outcomes and ROM after CDR with Mobi-C® (LDR, Troyes, France) prosthesis have been documented in few studies. No previous report of this prosthesis has studied correlations between static and dynamic parameters or those between static parameters and clinical outcomes. Objectives: To analyze the sagittal balance after single-level cervical disc replacement (CDR) and range of motion (ROM). To define clinical and radiological parameters those have a significant correlation with segmental and overall cervical curvature after CDR. Methods: This is a unicenter, prospective and non comparative study. 40 patients were evaluated. Clinical outcome was assessed using the SF-36 questionnaire, Neck Disability Index and a Visual Analog Scale. Spineview® software (Surgiview, Paris, France) was used to investigate sagittal balance parameters and ROM. The mean follow up was 24,3 months (range 12 to 36).
Results: Clinical outcomes were satisfactory. There was a significant improvement of SF36, NDI and VAS scores. Mean ROM was 8.3° preoperatively and 11.0° postoperatively (p<0.013). Mean preoperative C2C7 curvature was 12.8° and 16.0 at last follow-up (p=0.001). Mean preoperative FSU angle was 2.3° and 5.3° postoperatively (p<0.0001). Mean postoperative shell angle was 5.5°. There was a significant correlation between postoperative C2C7 alignment and preoperative C2C7 alignment, change of C2C7 alignment, pre and postoperative FSU angle, and prosthesis shell angle. There was also a significant correlation between postoperative FSU angle and preoperative C2C7 alignment, preoperative FSU angle, change of FSU angle and prosthesis shell angle. Regression analysis showed that prosthesis shell angle and preoperative FSU angle contributed significantly to postoperative FSU angle. Moreover, preoperative C2C7 alignment, preoperative FSU angle, postoperative FSU angle and prosthesis shell angle contributed significantly to postoperative C2C7 alignment. No significant correlation was observed between ROM and sagittal parameters. Few correlations were found between sagittal alignment and clinical results.

Conclusion: CDR with this prosthesis provided favorable clinical outcomes and maintains ROM of the FSU, overall and segmental cervical alignment. Long-term follow-up will be needed to assess the effectiveness and advantages of this procedure.

POSTER PRESENTATIONS 09

Analysis of postoperative iliac crest bone graft harvest site pain in instrumented 3- and 4-level anterior cervical fusions. A prospective non-randomized comparison of the efficacy of intraoperative local administration of Ropivacain.

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Introduction: Multilevel plated anterior cervical fusions(ACDFP) can go with non-union rates of 20-30%. Therefore, several surgeons use autogenous iliac bone to keep union rates high. However, a high incidence of early and late donor-site related pain is claimed. We made different experiences in a prospective comparison of 2 techniques used for anterior iliac crest bone graft harvesting (AIGH) and want to report the results.

Material: 40 consecutive 3- and 4-level ACDFP for DDD were prospectively assessed for postoperative pain-VAS at site of AIGH during 5 days after surgery. In all pat bicortical corticocancellous grafts were taken from the inner iliac tablet ~2cm proximal to the anterior superior iliac spine using osteotomes. In Group-A, additional 5-10ml Ropivacain (2mg/ml) were administered after abdominal fascia relaxation. The other patients resembled Group-B. Morphine-use during ICU-stay was calculated. Only patients with 2-day ICU-stay no previous AIGH and appropriate responsiveness postoperatively were included. At 6-months FU any patient's pain at AIGH was noted.

Results: 40 patients were dichotomized in Group-A and -B. Patients' age in was 56±7.6 and 52.6±10.4 years, number of previous surgeries was 0.6±0.7 and 0.8±1.0/patient, number of levels fused was 3.6±0.7 and 3.7±0.9. In Group-A, Ropivacain-volume was 8.4±1.5ml/VAS at AIGH in Group-A and -B was: 1st-day:1.4±2.3 vs 3.9±2.4; 2nd-day:2.5±1.7 vs 4.6±2.1, 3rd-day:3.5±2.2 vs 4.2±2.1; 4th-day:3.0±2.1 vs 3.9±2.0; 5th-day:3.1±2.7 vs 3.5±2.3. No patient claimed chronic pain after 6-months. There were no anaesthesiologic complications, patients had successful 3- and 4-level ACDFPs. Statistics showed weak correlation between morphine-use and patients' age (p=0.02, r=0.3). Number of previous fusions or levels fused had no impact on VAS or morphine-use. In Group-A, Ropivacain-volume had no impact on VAS. There was no significant difference between VAS on 1st- or 2ndday compared to other days, but between day 3 to 5. In Group-B, there was no significant difference between VAS on 1st-and 2nd-day, but between 2nd and other days. Comparing Group-A and -B, we observed significant differences for VAS on 1st-day (p=0.004) and 2nd-day (p=0.005), but not for day 3 to 5. Morphine-use was not significantly different (p=.38).

Conclusions: Multilevel-ACDFP can have high success rates when using autogenous bone. Notably, in 3- and 4-level ACDFP, postoperative VAS-assessment showed overall low morbidity of AIGH. The early donor-site pain can be ameliorated by administering Ropivacain.

POSTER PRESENTATIONS 10

Historical foundation for use and justification of instrumented cervicothoracic osteotomy correction in ankylosing spondylitis - A clinical rationale based on the results with segmental osteotomies C7-T1 and gradual Halo-Thoracic-Cast correction.

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Introduction: With progression of cervicothoracic kyphosis (CKT) in ankylosing spondylitis (AS), patients suffer loss of horizontal gaze and functional disability. Cases series are scant and surgical correction poses high neurologic risks. There is yet no ideal osteotomy technique or instrument completely preventing neurologic lesions. We offer results with non-instrumented correction, because with increasing instrumentation used for CKT a historical control is beneficial.

Methods: 18 AS patients with CKT. After application of Halo-Thoracic-Cast (HTC) patients underwent posterior non-instrumented osteotomy-C7/T1 and approximation of osteotomies by threaded HTC-rod adjustments. Postoperatively, gradual HTC-correction was continued. Medical charts were reviewed for demographics, surgical details, complications and outcomes. Preoperatively, before HTC-removal and at follow-up patients’ pictures were analyzed for Chin-Brow-Vertical-Angle (CBVA) and radiographs for CKT-angles calculating clinical and radiographic corrections. To capture postoperative CKT-correction we calculated time dependent interrelations. Statistics are reported if data sets were complete for ≥10 patients.

Results: Age at index surgery was 49.5±10.3 years, radiographic follow-up 37.3±47.4 months. Duration of HTC was 4.5±2 months. Preoperative CBVA was 43.1±16.3°, before HTC-removal 18.3±12.7° (p<0.001), with correction of 25±9°. Preoperative CTK-angle measured 20±17.3°, postoperatively -9±19.6° and at follow-up -18.3±16°. The difference between postoperative and follow-up CTK-angle was just not significant (p=.07). During gradual HTC-correction the minimal CTK-angle measured -21±16.2° resembling a loss between maximal and follow-up correction. The difference between clinical-CBVA and maximum radiographic correction was not significant. At radiographic follow-up 3 patients judged their outcome as excellent, 9 good, 3 moderate and 1 poor. Upon invitation at 86.7month, NDI in 7 patients was 8.4±13.5%, 2 patients had died, 3 were lost, 1 had revision elsewhere and 5 had recent follow-ups. 6 patients had minor and 10 major complications. Revisions were done in 5 patients for wound infection, C8-radiculopathy, neurologic events, translation at osteotomy level. 3 patients had revision posterior decompression and instrumentation for sagittal translation at osteotomy. 2 patients revealed intraop-instability at osteotomy causing instrumented fusion.

Conclusion: With the HTC sufficient correction and patient satisfaction could be achieved. However, results with regard to loss of correction, HTC-morbidity and lack of control at osteotomy side indicates that...
instrumentation-based correction should be aimed for as it is current practice.

POSTER PRESENTATIONS 11

Sexuality in Patients with Cervical Disc Herniation
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Objective: Sexual activity may be affected in cervical disc herniation (CDH) through different mechanisms due to pain or the use of analgesics. The aim of this study is to evaluate sexual problems and sexual behavioural patterns in a group of patients with CDH who underwent ACDF procedure.

Material and Method: Thirty patients were included in the study. Pain and sexual dysfunction were evaluated using Visual Analog Scale (VAS), Oswestry Disability Scale (ODS), Hospital Anxiety and Depression Scale (HAD) and a Sexual Assessment Scale before surgery.

Results: The mean age of the patients was 44.0±10.11 years. Mean duration of neck pain of study group was 26.93 months. Duration of neck pain was found to be statistically significant when compared cases of less than 40 and over 41 years old (p=0.04). Frequency of neck pain was statistically different between male and female groups (p=0.02). 65.5% of cases defined decreased frequency of sexual intercourse after the onset of neck pain. 51.7% of cases defined decreased sexual desire, and 58.6% of cases had orgasmic disturbance. 65.6% of patients defined pain during sexual intercourse. 17.2% of cases reported no sexuality disturbance.

Conclusion: This study revealed that all phases of sexuality can be affected in patients with CDH, requiring a closer attention.

POSTER PRESENTATIONS 12

A retrospective radiographic analysis of subaxial sagittal alignment after posterior C1-C2 fusion
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Introduction: C1-2 fusion has been used for patients with C1-2 instability and provided satisfactory clinical results. However, there are patients showing unexpected development of kyphotic kyphosis after surgery. To evaluate the association between C1-2 fusion angle and postoperative subaxial sagittal alignment.

Methods: A retrospective review was conducted for patients who underwent C1-2 fusion at Okayama University Hospital and National Okayama Medical Center within the last 10 years. Sixty-three patients with C1-2 subluxation who underwent posterior fusion were involved. There were 48 women and 15 men. The causes of C1-2 subluxation were rheumatoid arthritis in 55, MCTD in 1, trauma in 5, and others in 2. The methods of posterior fusion consisted of Gallie procedure in 19, Magerl procedure in 38 and Wright procedure in 6. Angles at C1-2 and C1-C2 should not be fixed in a hyperlordotic position.

Results: When data of post operative C2-7 angle were analyzed pertaining to a subgroup of kyphotic group (27 cases), which angle were 5 degrees or more kyphotic and a subgroup of lordotic group, which angle were lordotic or less than 4 degrees or kyphotic (36 cases). The mean angles of C1-2 before surgery in kyphotic group and lordotic group were 20.6 degrees and 19.1 degrees, respectively. There were no statistically significant differences in C1-2 angles of two groups. The mean angles of C2-7 before surgery in kyphotic group and lordotic group were 19.2 degrees and 19.9 degrees, respectively. The mean angles of C1-2 at the final follow-up in kyphotic group and lordotic group were 23.7 degrees and 19.5 degrees, respectively. There were statistically significant differences in those of two groups. These results indicated that C1-2 fixation in a hyperlordotic position led to a subaxial kyphosis after surgery.

Conclusion: Surgical fixation of C1-2 in a hyperlordotic position will lead the lower cervical spine to a kyphotic sagittal alignment after surgery. C1-C2 should not be fixed in a hyperlordotic position.
Study Design: An anatomic study investigated the attachment of the nuchal muscles to the spinous process.

Objective: To investigate the anatomical details of the attachment of the nuchal muscles to the spinous process, and the relationship between the length of the C6 spinous process and anatomy of the nuchal muscles.

Summary of Background Data: Previously, there have been few detailed anatomic studies of the attachment of the nuchal muscles to the spinous process at the cervicothoracic junction. In addition, although individual differences in the length of the C6 spinous process are known to be present in the morphology of the cervical spine, the relationship between the length of the C6 spinous process and the nuchal muscles has not been elucidated.

Methods: The morphology of the attachment of specimen rhomboid eum of the trapezius, rhomboid minor, rhomboid major, serratus posterior superior, splenius capitis and splenius cervicis to the spinous processes was investigated using 25 cadavers. Further, we measured the length of the spinous process of C6 and C7, and determined the ratio of the C6 spinous process length and the C7 spinous process length (the C6 spinous process length / the C7 spinous process length; C6/C7 ratio). Also, the relationship between the C6/C7 ratio and attachment of each muscle to the spinous processes was investigated.

Results: In the morphology of the attachment of the nuchal muscles to the spinous process at the cervicothoracic junction, there were a lot of individual differences. When the C6/C7 ratio was less than 0.8, the level of attachment of the nuchal muscles to the spinous process was the same and there was little individual difference in the specimen rhomboid eum, rhomboid minor, and serratus posterior superior. However, when the C6/C7 ratio was more than 0.8, there were a lot of individual differences in all muscles.

Conclusions: These findings suggest that there is a difference in the risk of surgical invasion to the nuchal muscles depending on the length of the C6 spinous process. To reduce the surgical invasion at the cervicothoracic junction, it may be necessary to consider the ratio of the C6/C7 spinous process length preoperatively.

POSTER PRESENTATIONS 16
Is laminoplasty the optimal surgical procedure for any type of ossification of the posterior longitudinal ligament (OPLL) in cervical spine?
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Introduction: Laminoplasty is generally accepted as a standard procedure for OPLL because of its favorable outcomes. However, some cases of massive OPLL can exhibit unsatisfactory results. The purpose of this study is to find out whether specific types of OPLL lead to poor clinical results after laminoplasty.

Methods: Ninety OPLL patients underwent laminoplasty from 2005 to 2009. The occupying ratio of OPLL was measured at the largest OPLL level on horizontal CT slices. Of 90 cases, 39 patients (28 men and 11 women with a mean age of 62.7 years) with occupying ratio greater than 50% (massive OPLL) were included in this study and followed more than one year (average 2.2 years). Surgical results were assessed by Japanese Orthopaedic Association score (JOA score) and their recovery rates. Image parameters, such as a segmental angular movement in functional radiograms at the disc occupied with the largest OPLL, were measured. The shapes of the largest portion of OPLL in sagittal CT were classified into two types; \( \text{\textbackslash \text{beak-type}\textbackslash} \) (projection of the angular edge) and \( \text{\textbackslash \text{plateau-type}\textbackslash} \) (projection of gently-sloping, wide-based and plateau-like lump). The factors which affected the surgical outcomes were investigated by statistical analysis.

Results: Concerning visual analog scale and Japanese Orthopedics Association results, the 2 postoperative mean scores were both significantly better than the preoperative mean but were not statistically different. The postoperative mean results for cervical and segmental lordosis angles and spinal canal diameter were all significantly better than the respective preoperative means for these parameters. Comparisons of postoperative means revealed no significant change in cervical lordosis, segmental lordosis, or cervical spinal canal diameter from short-term to long-term follow-ups. Five patients showed mild degeneration at adjacent segments in long-term follow-up.

Conclusions: Long-term follow-up indicates that OWC yields satisfactory clinical and radiologic outcomes in patients with anterior compressive cervical spondylosis and/or OPLL. OWC technique creates a more stable construct with 3-point fixation and offers better load sharing among implants and healthy vertebral. Our observations suggest that OWC is a good surgical option for this patient group.

POSTER PRESENTATIONS 15
Long-term Follow-up After Open-window Corpectomy in Patients With Advanced Cervical Spondylosis and/or Ossification of the Posterior Longitudinal Ligament
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Study Design: Prospective study was performed in case with cervical spondylosis and ossification of the posterior longitudinal ligament (OPLL).

Objective: A novel anterior approach was defined and some patients were operated in this study. The late results of open-window corpectomy (OWC) were documented in a group of patients.

Methods: 15 patients at 3 time points: preoperatively and at 15 months and 92 months postoperatively. The clinical parameters were pain (assessed by visual analog scale) and upper extremity function (assessed by Japanese Orthopedics Association) score. The radiologic parameters recorded from magnetic resonance imaging and computed tomography were lordosis angles (cervical and segmental) and cervical spinal canal diameter. Group means were calculated and findings at the 3 time points were statistically compared. Adjacent-segment degeneration was also evaluated at 92 months.
POSTER PRESENTATIONS 17
Effect of cervical spondylectomy to survival
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Objective: To demonstrate effectiveness of spondylectomy to survival of cervical vertebral malign lesions.

Material and methods: Four cases operated in Diskapi Yildirim Beyazit Education and Research Hospital, Ankara explained and discussed with special emphasis on operative techniques. Case 1: The patient with chordoma of third cervical vertebra operated previously another hospital admitted to our clinic with progressive muscle weakness. Recurrent lesion was seen on imaging techniques, and a spondylectomy of the third cervical vertebra was performed. Case 2: Eighteen-year-old patient with severe neck and bilateral upper extremity pain was admitted to our clinic. Expansile lesion in the third cervical vertebra was seen on MRI. A biopsy performed percutaneously and the pathological diagnosis was a chondrosarcoma. A spondylectomy of the third cervical vertebra was performed. Case 3: Forty-five-year-old patient with a metastasis of adenocarcinoma of lung of the fourth cervical vertebra. The lesion was destructive in nature. A spondylectomy of the fourth cervical vertebra was performed. Case 4: Nine-year-old patient with an expansile bone lesion in the cervical 4, 5, 6 segments. After the diagnosis of aneurysmal bone cyst with percutaneously biopsy, three level cervical spondylectomy was performed.

Results: Lesion free survivals of these four patients are more than expected of the natural history of the disease mentioned above.

Discussion: Cervical enblock spondylectomy is generally a difficult procedure because of the vertebral artery course and peripheral complex anatomy of the region. Detailed anatomical knowledge and appropriate surgical technique are necessary to performing spondylectomy in the cervical region. Anterior and posterior vertebrectomy and macroscopic tumor excision is a safer and easier method compared to enblock spondylectomy. As this technique allows total excision of the lesion, survival of the patient may be longer.

POSTER PRESENTATIONS 18
Cervical Spondylotic Myelopathy in Patients with Injured Femoral Fracture by Falling
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Introduction: Although patients with femoral fracture increase by falling in countries in which society is aging, little has been reported on mechanism of falling and prevention for falling. The purpose of this study was to clarify how many patient with femoral fracture have cervical spondylotic myelopathy (CSM) or brain disease.

Patients & methods: From May 2010 to January 2011, sixty-two patients (50 women and 12 men) were enrolled in this study. The average age was 79.2 years old (58-93years old). Inclusion criteria were the patient who injured femoral fracture by falling in the past one year, agreement to this study. Exclusion criteria was pathologic femoral fracture. All patient were performed brain CT and cervical spine MRI (1.5 Tesla), and when cervical stenosis exist on MRI, the stenosis rate was obtained. Cervical stenosis were divided into 4 grades: Grade I (normal), Grade II (disappearance subarachnoid space), Grade III (stenosis under 20%) and Grade IV (stenosis over 20%). Gripping power, biceps tendon reflex (BTR), triceps tendon reflex (TTR), patella tendon reflex (PTR), Achilles tendon reflex, Hoffman sign, Wartenberg sign, Babinski sign and ankle clonus were obtained.

Results: Twelve (19%) patients showed cervical high-intensity intramedullary lesions, and they had significantly more positive for Hoffman sign, Wartenberg sign and Babinski sign more than non-CHII patients ( p < 0.05). Combining these 3 signs, sensitivity was 83% and specificity was 58% for CHII. Grade I included 28 patients, Grade II stenosis included 9, Grade III included 11 and Grade IV included 14. Grade IV included 7 (50%) positive patients for Wartenberg sign, and there was significant difference between Wartenberg sign and stenosis grades (p < 0.01). There was no significant difference between age and CHII, nor between age and stenosis grades. On brain CT, 10 patients had old brain infarctions, 3 had subdural hematomas, 2 had clipping for subarachnoid hemorrhage.

Conclusion: This study indicates a possibility that Hoffman sign, Wartenberg sign and Babinski sign may predict CSM who will injure femoral fracture in their future.

POSTER PRESENTATIONS 19
Temporo-parietal neuralgia as a clinical manifestation of C1 dorsal root compression
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Introduction: Pain in the temporo-parietal region is rarely found in patients, and its origin is not clear. We report two impressive cases with severe temporo-parietal pain who had a unique pattern of lesions at CVJ.

Clinical Cases: Case 1 was a 47-year-old female with strange complex osseous anomaly at CVJ. Occipitalization of the atlas with C2 fused vertebrae was revealed, and rt. side laminae/articulations complex of C0-C1C2 was connected osseously with the lateral aspect of the odontoid. Case 2 was a 59-year-old female with rheumatoid arthritis. Rt. side C0/C1 joint and C1 lateral mass were severely destroyed. As a consequence, rt. side lower margin of the occiput and C1 posterior arch contacted directly. Both cases had temporo-parietal severe pain, while the posterior aspect of the auricle was not involved. The pain was aggravated by bending to the symptomatic side, whereas vertical traction or side bending to the asymptomatic side relieved the pain, similar to cervical subaxial radiculopathy.

Surgical results: In case 1, decompression by removing abnormal excessive bone at rt. C0-C1-C2 was accomplished, and we could see the rt. C1 posterior root directly. CVJ was reconstructed by instrumented occipito-cervical fusion. Case 2 was treated by direct skull traction to widen the C0-C1 interspace followed by occipito-cervical fusion with instrumentation. Their temporo-parietal pain disappeared immediately after the surgeries in both cases, and had not recurred by the final follow up (post-op. 6 yrs, and 2 yrs, respectively).

Discussion & Conclusion: The C1 root is generally recognized not to have a sensory component. In our cases, pain originated from the temporo-parietal region, and the back of the auricle was not invaded. This means that the scalp pain in these cases was not due to C2 posterior root, which distributes sensory fibers in the occipital region including the area behind the ears. In addition, pre-op. neuroradiological investigation, clinical features, and surgical results suggested that C1 posterior root is the main cause of this pattern of scalp pain. Temporo-parietal area can be recognized as a C1 dermatome in some cases.
POSTER PRESENTATIONS 20

Increased expression of NF-κB/p50, NF-κB/p65, MMP-and MMP-9 in a new animal model of cervical spondylotic myelopathy
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Introduction: Cervical spondylotic myelopathy (CSM) is the most common cause of spinal cord dysfunction in adults. However, little is known about the pathobiology of the disease. Nuclear Factor-kappa B (NF-κB) is a key transcription factor which regulates important cellular processes such as proliferation, apoptosis, vascular permeability, and neovascularisation while participating in extracellular matrix remodelling in physiologic as well as pathologic situations. Moreover, it has been shown that NF-κB regulates the expression of MMP-2 and MMP-9 which are important key factors in modulation of spinal cord extracellular matrix.

Methods: In this report a new animal model of CSM was used. Following, C7 laminectomy, gradually increasing compression (20 weeks) was achieved by introducing a piece of aromatic polyether 0.5mm thick under the C6 lamina in 15 New Zealand rabbits (1.5-2 kg). We used as controls 15 animals in which a sham operation was performed. Using immunohistochemistry, the expression levels of p50 and p65 subunits of NF-κB as well as that of MMP-2, MMP-9 were evaluated in paraffin embedded spinal cord sections coming from all animals. The intensity and the distribution of the immunostaining for all the antibodies were scored. To test the significance of the differences among groups of clinico-pathologic parameters, ordinal data were analyzed with non-parametric Mann-Whitney tests, whereas correlation between the levels of proteins expression were evaluated by Kendals Tau test. The significance level was defined as P < 0.05.

Results: Elevated expression of p50 and p65, MMP-2 and MMP-9 was demonstrated in animals with CSM in comparison with control animals. Moreover, a statistically significant positive correlation was observed between the expression levels of p65 and p50 for both nuclear and cytoplasmic localization. Additionally, a strong positive correlation was revealed between the expression of p65 and p50 and MMPs.

Discussion: This study suggests a possible role for NF-κB and MMPs in the pathobiology of CSM. Additional molecular studies are needed to evaluate the precise role of this pathway in CSM and the possible development of therapeutic interventions that could be used as complementary approaches to decompressive surgery.

POSTER PRESENTATIONS 21

Reinforcement of a C2 Laminar Screw by a C2 Infralaminar Hook
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Introduction: Although a C1-C2 transarticular screw (TAS) or a C2 pedicle screw (PS) is the most rigid anchor for C2, each entails the risk of vertebral artery (VA) injury. It is sometimes risky or impossible to insert a TAS or PS when there is a high-riding or distorted VA. Although a C2 laminar screw (LS) is often used as an alternative anchor in such cases, its anchoring strength may be inadequate, particularly in osteoporotic patients. We have utilized a C2 LS in combination with an ipsilateral C2 infralaminar hook (LH) as an anchor on C2. The C2 LS and LH are connected to the rod separately, with or without a lateral connector. Slight compression force is applied between the LS and the LH. This combination should provide more rigid anchoring strength than an LS alone.

Methods: Five patients, for whom a unilateral TAS or C2 PS was risky or impossible, were treated with this technique. C1-2 fusion was performed in two patients, and occipit-C2 fusion in three patients. In all cases, this technique was applied only unilaterally in combination with a contralateral TAS, because bilateral C2 LSs and LHs leave little space for the bone graft onto C2.

Results: In all patients this technique was feasible, resulting in no spinal cord nor VA injury. Among three patients followed more than 9 months, bone union was achieved in two patients, which was confirmed by CT. However, bone union was not confirmed after one year in one malignant RA patient, who had very poor general condition, while no instability was observed on flexion and extension radiograms.

Conclusions: This technique is not technically demanding and entails no risks of VA injury. It should provide a more rigid anchor on C2 than an LS alone, although we have no biomechanical data. This technique would be a useful option when the placement of a TAS or PS is risky or impossible.

POSTER PRESENTATIONS 22

The radiological analysis of total spinal alignment at standing position related to anterior translation of cervical vertebra in cervical spondylotic myelopathy.
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Introduction: Anterior translation (AT) of cervical vertebra plays an important role on pathology of aged cervical spondylotic myelopathy (CSM). The pathogenesis of AT might be explained by the aging changes of total spinal alignment besides local disc degenerations. The purpose of this study is whether the analysis of standing total spinal alignment of CSM in radiograms elucidates the occurrence of AT.

Methods: Sixty-two CSM cases surgically treated from 2009 to 2010 (41 men and 21 women with a mean age of 66.5 years) were involved. Cervical and total spinal lateral radiograms at standing positions were analyzed; AT (more than 3mm at neutral position), position of C7 plumb line (anterior to, within, or posterior to L5/S1 disc), inclination angle of D3 (IA-D3), thoracic kyphosis angle (D3-D12), and lumbar lordosis angle (L1-L5).

Results: AT was observed at 13 disc levels in 11 cases (17.7%), where 72.7% was significantly aged patients over 70 years (p=0.01). 54.5% of AT cases exhibited less than 25 degree thoracic kyphosis and less than 17 degree of IA-D3, which was significantly higher than 19.6% of the cases without AT (p=0.02). Those 54.5% of AT cases also exhibited the plumb line within or posterior to L5/S1 disc. The cases with less than 17 degree of IA-D3 showed significantly higher rate (89.3%) of the plumb line within or posterior to L5/S1 (p=0.01).

Conclusions: AT was a key for cervical instability in aged CSM. Parallel with aging, the increase of thoracic kyphosis angle has been considered to provoke the anterior shift of C7 plumb line and anterior inclination of D3, which might induce AT. However, this study provided over a half of AT had the posterior shift of plumb lines with small kyphosis angle and small inclination angle of D3. These results indicate that their thoracic spines with relatively straight curvature leaned to posterior direction and the plumb lines shifted posteriorly with horizontally oriented upper thoracic vertebra. In compensation for this posteriorly shifted imbalance of thoracic spine, the skull and cervical spine shift and lean to anterior direction, therefore these changes might induce AT with this anteriorly directed force.
**POSTER PRESENTATIONS 23**

Comparison of cervical OPLL classification between lateral radiographs and CT sagittal reconstruction images  
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**Introduction:** In 1984, Tsuyama classified cervical OPLL into four types based on lateral radiographs: continuous, mixed, segmental and localized. Since its publication, Tsuyama's classification has been widely used to evaluate OPLL morphology. Recently, however, we often find ourselves encountering discrepancies between lateral radiograph-based OPLL classifications and CT sagittal classifications based upon CT sagittal reconstruction images. In this study, we evaluated OPLL morphology from lateral radiographs and compared the results with CT sagittal reconstruction images.

**Methods:** We analyzed a total of 40 cervical OPLL patients who underwent surgery at our institute from April 2002 through July 2008. Four orthopaedic surgeons specializing in cervical spine surgery independently read the cervical lateral radiograph of each patient, made a schematic pencil drawing of the OPLL morphology, and determined the Tsuyama's classification type. These data were compared with the patient's CT sagittal reconstruction images.

**Results:** The correspondence rates between the OPLL classifications obtained from lateral radiographs and from CT sagittal reconstruction images for the four reviewers were 65%, 43%, 47.5% and 45%, respectively. The correspondence rates between the OPLL morphology based on the schematic drawings drawn from the lateral radiographs and the CT sagittal reconstruction images for the four reviewers were 10%, 12.5%, 10%, and 12.5%, respectively. In no instance did all four reviewers find consistency between the schematic drawings and the CT sagittal reconstruction images. In contrast, in six cases, all four reviewers found that the schematic drawings were inconsistent with the CT sagittal reconstruction images.

**Conclusion:** The results demonstrate that, in most cases, lateral radiograph-based OPLL classifications are inconsistent with OPLL classifications based on CT sagittal reconstruction images. Because cervical OPLL has a 3-dimensionally complicated structure, accurate evaluation of OPLL morphology from lateral radiographs alone is difficult, and we are finding that CT MPR images are necessary to accurately determine the OPLL classification. The combination of CT MPR sagittal reconstruction images and flexion-extension lateral cervical radiographs should enable us to more accurately evaluate spinal mobility in OPLL patients and determine the correct OPLL classification, which in turn will better equip us to decide on the most appropriate surgical procedure.

**POSTER PRESENTATIONS 24**

Cinematic of cervical progressive degenerative diseases  
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**Introduction and aim:** Despite whole clinical trials and clinical results, there is still ongoing debate on whether if neighbouring segmental degeneration is a part of the progressive process or depend on increased stress due to upper and lower segmental motion after postoperative fusion. The aim of this study, focusing on the follow up results, is to understand whether the segmental degeneration is a part of this continuing process or depend on fusion induced increased stress.

**Materials and methods:** This study includes a total number of 60 patients, 26 female and 34 male with an age range of 23 to 68 who were operated due to cervical disc disease and cervical myelopathy and mean follow-up period was 32.8 month, between 2004-2006 in Inonü University Turgut Özel Medical Center. There are five groups where, Group I is those cases with one level simple cervical discectomy, Group II with one level segmental anterior fusion using autogen bone graft and plate and screw fixation, Group III with arthroplasty to protect segmental motion, Group IV with cervical spondylotic myelopathy operated by posterior stabilization and fusion using lateral mass screw and rod, and Group V with cervical spondylotic myelopathy treated with laminoplasty. Neutral, hyperflexion and hyperextension cervical x-rays were performed for all patients. Disc height, flexibility, segmental angle and segmental flexibility were compared for each patient.

**Results:** On postoperative measurement for upper and lower neighbouring segmental disc height, only in group II lower segmental disc height was decreased with statistical significance (p = 0.001). Flexibility degree measurement was significantly decreased in group IV (p = 0.017). Segmental angle measurement in group II disclosed upper (p = 0.025) and lower (p = 0.008) segmental angles were significantly increased and in group IV upper (p = 0.046) and lower (p = 0.046) segmental angles were significantly decreased. Segmental flexibility measurement in group II showed upper (p = 0.049) and lower (p = 0.013) segment values were significantly increased and statistically significant decreased in upper (p = 0.046) and lower (p = 0.043) values were remarked in group IV.

**Conclusion:** According to our study results there is no statistical differentiation at group I and group III, so we think that, degeneration is a progressive process and fusion is increasing the degeneration speed and contributes this process. We believe that our results will contribute for future studies.

Key words: Cervical degenerative disease, cervical cinematic, neighbour segmental disease.

**POSTER PRESENTATIONS 25**

Outcome of deep surgical site infections in the cervical spine and risk factors of necessitating aggressive debridement surgery  
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**Objective:** The numbers of surgical site infection (SSI) in spinal surgery is rising because of more frequency of applying instrumentation and having immunocompromised patients. It is reported that SSI in the cervical lesion is relatively rare, and its clinical features have not been thoroughly discussed. Therefore, we investigated clinical outcomes of SSI occurred in the cervical spine, and discuss the therapeutic strategy for this.

**Methods:** Between 2004 and 2010, 1779 spinal surgeries were performed at our institute, and 14 patients (0.8%, 57.4±16.8 years old ; 10 male, 4 female.) were diagnosed as deep SSI occurred in the cervical spine. Posterior instrumentation was used in 8 patients (57%). Nine patients (64%) were immunocompromised host such as rheumatoid arthritis (RA). In 79% (11 of 14), bacteria culture was positive; 6 gram-positive organisms including one methicillin-resistant Staphylococcus aureus (MRSA) and two methicillin-resistant coagulase-negative Staphylococcus (MRCNS); 5 gram-negative organisms including 4 Serratia marcescens. The severity of the disease was classified as follows; (1) healed with administration of antibiotics, (2) healed with debridement, and (3) healed with removal of implant. This classification was investigated on respective patients with several clinical backgrounds.

**Results:** Five patients (36%) could be treated with antibiotic therapy alone. Eight patients (57%) required a single debridement to clear the SSI.
Only one patient (7%) required the second debridement. There was no patient required removing instrumentation. Surprisingly, one MRSA and two MRCNS were healed with antibiotics administration (intravenous vancomycin with oral rifampicin) alone. All of 5 patients suffered gram-negative organisms infection required debridement surgery. Six of 8 (75%) patients with posterior instrumentation, and 4 of 5 (80%) patients suffering RA required debridement surgery.

Discussion: This study has indicated that the risk factors of surgical debridement were (1) gram-negative organisms infection, (2) usage of posterior instrumentation, (3) immuno-compromised host such as RA. Therefore these patients initially should be treated by surgical debridement rather than conservative treatment. On the other hand, antibiotic therapy with vancomycin combined with rifampicin was effective, and can be tried for MRSA or MRCNS infection.

**POSTER PRESENTATIONS 26**

The effect of foramen magnum decompression with duraplasty on cervical ROM for Chiari Type 1 patients, when cerebellar tonsillar descent grading is based.

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**Objective:** In this retrospective study, the effect of foramen magnum decompression (FMD) (with or without duraplasty) to the cervical range of motion (ROM) and lordotic angle based on cerebellar tonsillar descent were investigated in Chiari Malformation Type 1 (CM-1).

**Methods:** The 79 patients with CM-1 patients were divided into two groups; duraplasty (Group 1), and non-duraplasty (Group 2). Each group was divided into three subgroups based on the cerebellar tonsillar descent (CTD) grades. The ROMs and lordosis angles were obtained by pre- and postoperative X-ray measurements.

**Results:** The means of the JOA scores were 14.18±2.23 and 15.78±2.24 (p<0.001) in Group 1, 14.75±2.36 and 16.08±2.04 (p=0.002) in Group 2 respectively in pre- and postoperative period. There was no significant difference in any lordotic angle measurements in duralosty and non-duralosty group. There was significant increase in Oc-C2, C2-7 and Oc-C7 ROM (p=0.03; p=0.03 and p=0.01 respectively) in duralosty group with grade 3 CTD. No significant change was observed in any lordotic angle measurements in duraplasty and non-duraplasty groups; duraplasty (Group 1), and non-duraplasty (Group 2). Each group was divided into three subgroups based on the cerebellar tonsillar descent (CTD) grades. The ROMs and lordosis angles were obtained by pre- and postoperative X-ray measurements.

**Conclusions:** FMD might be performed without duraplasty in cases of CTD grades 1 and 2 because of the possible complications and the lack of differences between ROM opening and cervical lordosis angle. In contrast, FMD reinforced with duraplasty might be a better option in cases of CTD grade 3 because of its positive effect on cervical ROM.

**POSTER PRESENTATIONS 27**

Radiographic analysis of C1-2 fusion for upper cervical lesion

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**Introduction:** There are many patients with subaxial changes after C1-2 fusion. We analyzed the radiographic change after upper cervical fusion retrospectively.

**Patients & Methods:** 28 patients (7 males, 21 females) who underwent C1-2 fusion (Mageal procedure), minimum 2 years follow-up, were enrolled in this study. The mean age at surgery was 56.9 years. Main cause of atlantoaxial subluxation was RA. The study consists of clinical and image analyses. We checked clinical results with Japanese orthopedics association score (JOA score) and recovery rate. We evaluated radiological feature after C1-2 fusion. We checked ADI and C1-2 angle to assess the reconstruction. We also investigated the alignment changes with using C2-7 angle. Finally, we evaluated the relationship between C1-2 correction and postoperative changes of cervical alignment. Bone fusion was checked by CT scan.

**Result:** JOA score was improved from 12.5 to 14.6 at the final examination, and improvement rate was 46.7%. In radiological evaluation, bone union was accomplished in all cases. Average C2-7 angle changes was -8.1°. So there was progression of subaxial kyphosis after C1-2 fusion in many cases. Average pre-op ADI was 6.5mm (range 0~12mm) which was corrected to 3.1mm (67% correction). Kyphotic change was revealed in cases that ADI was not corrected sufficiently. In 6 out of 25 cases, over correction was revealed. Kyphotic deformities occurred in most of the patients who has over 25° C1-2 angle after fusion. On the other hand, some patients that post-op C1-2 angle was under 15° resulted in hyperlordotic deformities or “S” shape.

**Conclusion:** The progression of subaxial kyphosis after C1-2 fusion resulted from insufficient correction of ADI and extreme correction of C1-2 angle in this study. Undercorrection also changed the cervical alignment after C1-2 fusion. Our study suggests that to maintain normal cervical alignment, we should better correct C1-2 alignment within range 15 ~ 25°.

**POSTER PRESENTATIONS 28**

Neuroprotective therapy using granulocyte-colony stimulating factor for patients with rapidly aggravating compression myelopathy: a phase I and Ila clinical trial

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**Introduction:** Rapidly aggravating compressive myelopathy results in severe neurological deficits with poor functional recovery due to limited axonal regeneration. To date, early surgical treatment is the only effective therapy. In previous reports, we have shown that granulocyte-colony stimulating factor (G-CSF), a hematopoietic growth factor, has neuroprotective effects against experimental spinal cord injury. Based on these experimental results, we began a phase I and Ila clinical trial to evaluate the safety of neuroprotective therapy using G-CSF for patients with rapidly aggravating compression myelopathy.

**Methods:** Patients whose Japanese Orthopaedic Association (JOA) score for cervical myelopathy had decreased two points or more during a recent one-month period were eligible for entry in this study. After giving informed consent, patients received intravenous G-CSF (10μg/ kg/day) for five consecutive days. We monitored the study patients for adverse events related to G-CSF therapy and also evaluated their motor and sensory functions.

**Results:** A total of twelve patients were enrolled in the first stage of this trial, including six with cervical and/or thoracic ossification of the posterior longitudinal ligament and ossification of the ligamentum flavum, four with cervical spondylotic myelopathy, one with a cervical extradural tumor, and one with spinal cord herniation. One month after administration, the mean JOA recovery rate was 41.3%, and ASIA motor scores had significantly improved compared with the corresponding scores before G-CSF administration. Eleven patients underwent surgical treatment at one month or later after G-CSF administration. Six months after G-CSF administration, the mean JOA recovery rate was 65.0%.
and ASIA motor, light touch, and pin prick scores showed significant improvement compared with the corresponding scores before G-CSF administration. No adverse events occurred during or after G-CSF administration.

**Conclusions:** These study results indicate that G-CSF administration at 10 μg/kg/day for five days is safe for patients with rapidly aggravating myelopathy and may be effective in promoting neurological improvement. We are planning next to proceed with a phase llb clinical trial (randomized double-blind study) in order to more precisely determine the efficacy of G-CSF therapy.

**POSTER PRESENTATIONS 29**

**Clinical application of 3D full-scale model for the surgery of cervical spine.**

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**Introduction:** Rapid prototyping (RP) has been widely accepted as a useful tool for the pre- and perioperative planning or simulation of surgeries, mainly in the craniofacial, neurosurgical, and orthopedic field. We report a clinical application of 3D full-scale model manufactured by inkjet printing method, one of the RP technologies, to the cases of cervical lesion that were required surgical treatment.

**Materials And Methods:** Fifteen consecutive patients (seven females and eight males, mean age: 62.7 years, ranging 17 to 82 years) were included in this study. The diagnoses were as follows; rheumatoid arthritis, os odontoideum, trauma, degenerative spondylosis, dumbbell tumor, and ossification of posterior longitudinal ligament (OPLL). 3D models were manufactured preoperatively by 3D inkjet printer, which builds full-scale model from DICOM data of CT using plaster powder and binding material. We utilized models for preoperative and intraoperative aid and evaluated its efficacy.

**Results:** Each model was brought into operating room during surgery and was effective as orienting assistance. Fourteen cases except for one case of tumor underwent reconstructive surgery with instrumentation such as Magerl’s method. In the instrumentation cases, screw holes were made on the model to confirm the feasibility of instrumentation setting at the level that seemed to be difficult or complex from the data of CT image. In the case of OPLL patient, we carried out a simulation of anterior decompression using a model. In five cases, each vertebral body was separately manufactured in addition to the whole model of cervical spine and utilized to recognize an alignment after correction.

**Discussion And Conclusion:** Inkjet printing method has several advantages compared to another RP technology or milling and cutting method. This method provides shorter time of manufacturing and lower cost. Furthermore, we could use this printer in our hospital because of its size and low noise. Duplication of model is so easy that we could simulate surgical approach in several ways. 3D full-scale model that allows the surgeon to comprehend the patient’s anatomy within no time would be a useful aid in the complex spinal surgery, especially in cases with instrumentation.

**POSTER PRESENTATIONS 30**

**Histology and Surgical Results for Retro-odontoid Mass**


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**Introduction:** A retro-odontoid soft tissue mass has been reported to be formed due to an atlantoaxial instability, causing myelopathy. Several surgical treatments have been performed for this lesion.

**Method:** Sixteen patients were evaluated who had undergone the surgery for myelopathy due to this mass lesion between January 2002 and October 2010. The mean age at surgery was 71.7 years (range, 52-88 years); 13 males and 3 females. In this study, the atlantoaxial instability was defined as the increase of an atlanto-dental interval (ADI) between extension and flexion _3.0mm on the lateral radiograph. Surgical method was: Posterior decompression (PD) alone in 10 patients, transdural mass removal (TDR) in 3 patients, posterior fixation (PF) alone in 2 patients, and PF following TDR was in 1 patient. The clinical outcomes were estimated with the Japanese Orthopaedic Association scoring system (JOA score) and the recovery rate was calculated using the Hirabayashi method. The change of the mass size was evaluated with MRI. For histology, specimens obtained from 4 patients (TDR group) were examined under light microscopy.

**Results:** Six patients had the atlantoaxial instability and other 6 patients had fusion of the upper cervical vertebrae. In 9 patients (4 patients in the PD alone group, 2 patients in the PF alone group, and 3 patients in the TDR group) the size of the mass was unchanged or reduced. Pre- and post-operative JOA score averaged 9.6 and 13.3, respectively, with a significant improvement (p < 0.01), and the recovery rate averaged 85.7%. Histological findings showed that the mass consisted of degenerative fibrous tissues containing fibro and hyaline cartilages, calcified debris, and necrotized tissues.

**Discussion:** The retro-odontoid soft tissue mass is considered to be derived from a degenerative and hypertrophic change of the transverse ligament of atlas. This pathology has been ascribable to the repetitive damage and repair of the ligament due to the atlantoaxial instability. In this study, this instability, the fusion of upper cervical vertebrae, and the histological findings supported this pathology. However, this study demonstrated that the PF is not necessarily required and the PD alone can provide satisfactory surgical results.

**POSTER PRESENTATIONS 31**

**Osteochondroma of the axis: A rare cause of occipito-cervical pain due to compression of the second cervicle nerve**

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Osteochondroma seldom involves the upper cervical spine, being commonly reported as a cord compression case when growing into de canal. Our case posed questions on diagnosis and surgical indication, either on the approach as on the necessity of adding a fusion.

**Clinical case:** A 26 year-old woman consulted with left sided occipital/ sub-occipital pain for 17 years. She was previously diagnosed of osteochondroma of C2, with a localisation which made difficult and dangerous any surgical attempt for resection. Wait and see was indication. The quite constant pain was localized mainly at the "Arnold's point", being more intense with head movements. Simple radiographs did not allow to define the tumour. CT scan axial views showed an osteoid osteoma- like lesion affecting the lateral aspect of the posterior arch of the atlas. CT scan sagittal views showed a bony prominence in the upper-posterior part of the left isthmus of the axis, compatible with a small osteochondroma growing vertically against the arch of C1. Sagittal views showed fusion of the C1C2 left inter-aphyseal joint. Tri-dimensional CT reconstruction allowed to define the lesion clearly. Scintigraphic studies showed high uptake at C1C2 left joint level, being negative in the lesion itself. Surgical treatment (midline posterior approach) consisted of simple resection by osteotomy at the base, being
the lesion easily detached from C1. The pathological report confirmed the diagnosis: osteochondroma. The second root of C2 was “anchored” by the osteochondroma at its division point, the posterior branch being hardly mobilized. Pain was immediately relieved, at wake up, remaining the patient asymptomatic through the follow-up.

**Comment:** Pain at the “Arnold’s point” and occipital area may be due to a variety of conditions including degeneration at C1C2. Our osteochondroma grew leading the patient to feel pain for 17 years and the degeneration observed (quite a fusion) in the ipsilateral joint could be reactive, as observed in some cases of cervical osteoid osteoma. Doubts on a spontaneous fusion would lead to controversy on the indication of adding or not a C1C2 fusion. Once fusion option was not considered, a postero-lateral approach would be also taken into account as an alternative.

**POSTER PRESENTATIONS 32**

**Accuracy in the introduction of screws in trough pedicle of C2: multidetector CT morphometry.**

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**Study Design:** The morphometry of C2 pedicle was analyzed by using a multidetector computed tomography (CT).

**Objective:** To accurately assess the axial pedicle width, height and spatial orientation by using the most precise radiological technology available today.

**Summary of Background Data:** Transarticular screw fixation is the most effective stabilization method in case of C1C2 fusion and there are other indications for C2 fixation which may need the introduction of a screw trough the pedicle of C2. Surgical technique is always demanding and complications may be life-threatening. A precise anatomic knowledge of the pedicle anatomy would decrease surgical risks. There is a paucity of studies evaluating C2 pedicle morphometry with CT but no one using 64 multidetector CT scan.

**Methods:** Cervical CT study was done in 100 consecutive patients. Submillimetric slices of axial and sagittal longitudinal axes of C2 pedicle were acquired. The collected data were: external and internal pedicle width and height at proximal, distal and central zones, axial and sagittal internal and external angles, laminae angles and distances to spinous process and C2-C3 joint. The obtained values were analyzed comparing male and female populations, intraindividual variations and external categorised width at central point.

**Results:** We found significant statistical differences (p<0.05) between all categorised width at central point.

**Comment:** Patients undergoing surgery for cervical spine disease may require future surgery for several reasons like degenerative changes. The objective of this review is to identify the character and rates of reoperation after initial cervical spine surgery. Materials and methods Between 1999 and 2009, 1417 patients at a single institution underwent cervical spine surgery. 74 patients needed additional operations during follow-up. This study presents a clinical and radiological evaluation to assess the feature of revision surgery.

**POSTER PRESENTATIONS 33**

**Analysis of 115 fractures of the odontoid process. A retrospective study of the university orthopaedic departments of Athens**


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In the past 40 years, 115 fractures of the odontoid process have treated in our departments. All these cases were analyzed in order to better understand the behavior of these lesions. The total of the 115 cases had a minimum follow-up of 7 years (ranged 7-35 years). The analyses of all these cases lead to valuable results: a. A new classification, tested for reliability and validity, was development based on the structural, anatomical and biomechanical properties of the odontoid process (Type A, B, C, D). b. The indications for operative treatment were defined e.g. a patient younger than 45 years with a severe fracture, with displacement and instability, is considered as candidate for operative treatment. c. The prevalence of pseudarthrosis was evaluated. Operative treatment was not necessary in early diagnosed cases. Fibrous union was developed mainly in the elderly patients. d. The relationship between the structure properties of the dens, other factors e.g. smoking and the short term/long term prognosis was assessed. In the older patients the changes in the internal structure of the axis have influenced the prognosis of the different types of fractures.

**Keywords:** odontoid process fracture, dens fracture, classification, pseudarthrosis
Conclusion: The overall revision surgery rate was 5.2%. Research evaluating revision surgery following primary surgery is likely to have an important impact on robust information of surgical risk. Degenerative change was the most common etiology in this series. Disease-specific condition, progressive course like OPLL, RA and CP, accelerated the need for revision surgery. We should make surgical plan in consideration of future condition and make discreet survey after primary operation. In early phase iatrogenic problem was one of the main reasons. We should avoid this unfavorable condition.

POSTER PRESENTATIONS 35
Clinical evaluations of the improved technique of Magerl and Brooks procedure for atlantoaxial subluxation
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Introduction: The combination Magerl (C1-2 transarticular screw fixation) & Brooks (interlaminar fusion with wiring) procedure is widely used for the rigid three-point fixation. It is, however, technically demanding, requiring the utmost precision. The purpose of this study is to evaluate clinical results and complications in our improved technique of M & B cases.

Cases and Methods: We modified the conventional procedure as follows: (1) preoperative evaluation of vertebral artery (VA) anomalies by MR angiography and high riding VA on reconstructed CT images; (2) using our original 90° flexion device; (3) a new Mayfield fixator and two-dimensional image; (4) an ultra-high molecular weight polyethylene (UHMWP) cable and tensioner; (5) unilateral screw fixation. We had 32 improved M & B procedures and evaluated clinical symptoms, Ranawat grade, and JOA scores, C1-2 angle and C2-7 angle and bony union.

Results: A total of 32 patients had preoperative occipital headache or posterior neck pain, and 95% were relieved by this surgery. In 27 patients the Japanese Orthopedic Association score (maximum score: 17) for cervical myelopathy improved from 9.5 to 13.7 after surgery. On radiography, the average AADI decreased from 7.4 mm to 1.8 mm, the C1-2 angle improved from 12.2 to 23.0 degrees and the C2-7 angle from 25.2 to 20.1 degrees postoperatively. Bony union was completed within three months in all cases. Comparing the conventional technique with the new technique, the latter led to a shorter operating time and less blood loss, no VA injury and spinal cord injury.

Discussion: Although M & B procedure is one of the most useful posterior C1-2 fixations, there is a high rate of VA injury. We realized that VA injury causes include incomplete identification of VA, insufficient identification of screw direction and unsatisfactory screw insertion devices. Therefore, we improved the conventional procedure: preoperative CT field evaluations for high-riding VA and using our original 90° flexion device for precise and safe screw insertion, UHMWP cable and tensioner to reduce subluxation, maintain the reduction and unilateral C1-2 transarticular screw fixation.

Conclusions: This method is safe, secure, less technically demanding, and achieves rigid three-point fixation while avoiding the serious complications of the conventional method.

POSTER PRESENTATIONS 36
Relationship Between C1 Lateral Mass and Internal Carotid Artery: A Preliminary Morphometric CT-Angiographic Study
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Background: C1 lateral mass-C2 screw fixation is indicated for the treatment of many craniovertebral junction disorders. Anatomical structures potentially at risk are the vertebral artery, hypoglossal nerve and the internal carotid artery. However, risk of internal carotid artery (ICA) injury due to penetration of C1 lateral mass screw is frequently underestimated.

Objective: The aim of this study is to analyze anatomical relationship between C1 lateral masses and ICA and to assess the value of preoperative CT-angiography in planning C1 lateral mass screw trajectory and depth.

Materials and Methods: 21 individuals without craniovertebral junction abnormality (12 female / 9 male) were included in the study. The diameter of ICA, distance between midline (ML) and medial wall of ICA, distance between ML and lateral wall of ICA, distance between anterior arch of atlas (C1) and ICA, and distance between transverse foramen of C1 and ICA were measured for both right and left sides.

Results: The mean diameter of right ICA was 5.01±1.12 mm, the mean distance between ML and medial wall of right ICA was 28.62±5.99 mm, the mean distance between ML and lateral wall of right ICA was 28.62±5.99 mm, the mean distance between posterior arch and right ICA was 4.05±2.11 mm and the mean distance between transverse foramen of C1 and right ICA was 18.01±3.41. The diameter of left ICA was 4.92±0.77 mm, the mean distance between ML and medial wall of left ICA was 23.42±4.68 mm, the mean distance between ML and lateral wall of left ICA was 28.35±5.01 mm, the mean distance between anterior arch and left ICA was 3.91±2.39 mm and the mean distance between transverse foramen of C1 and left ICA was 16.81±1.1. There were no statistical significance between the measurements of right and left sides (p>0.05).

Conclusions: Internal carotid artery is in close relationship with the anterior aspect of C1 lateral mass. The possibility of internal carotid artery injury should be kept in mind when planning C1 lateral mass screw fixation and preoperative CT-angiography should be performed whenever possible to avoid this complication.

POSTER PRESENTATIONS 37
Significance of dynamic MRI to adequately identify spinal cord compression due to cervical spondylotic myelopathy
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Introduction: In cervical spondylotic myelopathy (CSM), spinal cord compression takes place both statically and dynamically within the intervertebral space, and the spinal cord is dynamically compressed while extending the neck. However, there has been no report revealing the deference in findings of spinal cord compression on between MRI with neck in neutral position and that with neck extended. In this study, we will describe the significance of dynamic MRI to adequately identify the levels of spinal cord compression due to cervical spondylotic myelopathy.

Methods: The subjects of this study were 170 CSM patients, 136 males and 34 females, who underwent decompression surgery at our institutes between April 2001 and August 2007. Average age was 65.2 years, ranging between 29 years and 81 years. For each patient, the level/s at which decompression was to be carried out were identified by preoperative MRI with the neck in the neutral position or extended. The level/s at which compression had occurred were identified by complete obstruction of the subarachnoid space both posteriorly and anteriorly of the spinal cord on T2-weighted sagittal MR images. Three experienced spinal surgeons independently studied those MR images and the level was regarded as involved when all agreed.
**Results:** Spinal cord compression was identified as occurring at another level on neck extension which was not visible with the neck in the neutral position in 36 patients (21%) out of the total of 170.

**Conclusions:** Neck extension has a certain impact on the development of spinal cord compression in some CSM patients. Dynamic MRI was helpful in adequately identifying levels at which spinal cord decompression had occurred.

**POSTER PRESENTATIONS 38**

**Innervated patterns of muscles in upper extremities by cervical nerve roots**

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**Purpose:** Purpose was to clarify innervated patterns of muscles in upper extremities by cervical nerve roots.

**Methods:** Seventy-three patients who had undergone single-level posterior foraminotomy for motor weakness due to cervical radiculopathy were included. Causes of radiculopathy were disc hernia in 38 patients and spondylosis in 35 patients. Operated levels were C6/7 in 39 patients, C5/6 in 18, C7/T1 in 8, and C4/5 in 8. Investigated factors were preoperative MMT score of 6 key muscles; Deltoïd (D), Biceps brachii (B), Extensor carpi (E), Triceps brachii (T), Flexor carpi (F), and Intrinsics (I).

**Results:** In C5 root, motor weakness was observed in 1.8 muscles on the average. Incidence of weakness was 100% in D and 75% in B. MMT averaged 2.6 in D and 3.7 in B. In C6 root, motor weakness was observed in 2.6 muscles on the average. Incidence of weakness was 17% in D, 61% in B, 72% in E, 22% in T, 39% in F, and 39% in L. MMT averaged 3.3 in D, 3.7 in B, 3.8 in E, 4 in T, 3.7 in F and 3.9 in L. In C7 root, motor weakness was observed in 2.8 muscles on the average. Incidence of weakness was 8% in D, 10% in B, 23% in E, 79% in T, and 77% in F and 79% in L. MMT averaged 3.3 in D, 3.8 in B, 3.9 in E, T, F, and 3.8 in L. In C8 root, motor weakness was observed in 2.3 muscles on the average. Incidence of weakness was 25% in E and T, 75% in F, and 100% in L. MMT averaged 4 in E and T, 3.8 in F, and 3.3 in L.

**Discussion:** Weakness of D or B highly indicates C5 palsy, likewise, weakness of E C6 palsy, weakness of T C7 palsy, weakness of F C7 or C8 palsy, and weakness of L C8 palsy. There was no overlapping between innervated patterns by C5 and C8 roots regarding motor weakness. On the other hand, C6 and C7 roots have potentialities of weakness in all of 6 key muscles.

**POSTER PRESENTATIONS 39**

**Assessment of Matrix Metalloproteinase Expression in Cervical Degenerative Disc Disease**

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Degenerative disc disease, even though underlying mechanisms are not fully understood, is associated with the vascular, biochemical and anatomical changes of the intervertebral disc. The integrity and the structure of the extracellular matrix provides the functional properties of the intervertebral disc. During the degeneration process, production of normal matrix decreases as the degradation of the matrix increases. Matrix degrading enzymes such as matrix metalloproteinases (MMPs) are assumed to play a pivotal role in intervertebral disc degradation. In this study, 20 herniated cervical discs obtained from 20 patients and 34 cervical discs obtained from 17 fresh cadavers as a control group were used to show the expression of MMP-1, 3, 9 and TIMP-1 by using immunohistochemistry. The number of immunopositive cells were assessed by morphometric analyzes. Thompson grade 3, 4, 5 patients were included as the degenerative disc group. Specimens were also scored for the degeneration according to the formation of clefts and tears, cellular proliferation, granular matrix changes and mucous degeneration. The patient group discs were statistically more degenerative than the control group. Also a significant close relation was found between Thompson grade and the histologic degeneration scores. In the patient group, MMP-1, 9 and TIMP-1 levels were significantly higher than the control group. There was no difference in MMP-3 levels between the groups. For the first time Thompson grading system was applied in the cervical region and a significant correlation between the histological degeneration and Thompson grading was shown. According to this result we think that Thompson Scoring system can be used for the cervical region as well. Our data suggests that major MMPs play an important role in degradation of the intervertebral disc (IVD). This is evidenced by the statistically high levels of MMPs in the degeneration group than the control group. These kinds of studies highlight specific matrix metalloproteinases that might be most efficient to target in developing therapeutics for minimizing the degradation of the extracellular matrix of the intervertebral disc.

**POSTER PRESENTATIONS 40**

**Does the implantation of a cervical total disc replacement reconstruct the physiological Mean Center of Rotation and therefore the physiological movement at the operated and upper adjacent level?**


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**Introduction:** Cervical TDR has become very popular and accepted as an alternative to ACDF in disc herniation and radiculopathy, because a motion preserving implant is supposed to prevent from ASD (adjacent segment decompensation/degeneration). Besides the preservation of mobility, aTDR should reconstruct the Mean Center of Rotation (MCR) of each functional spinal unit and maintain therefore the biomechanic of the cervical spine. Several studies have proved, that arthroplasty can maintain the mobility of the operated segment, but rare studies have been done in vivo about the location of the MCR at the operated and adjacent segment.

**Methods:** Retrospective Data analysis of all patients that underwent cervical TDR between 05/04 - 03/06 for PCM, between 03/06 - 08/07 for Discover at C5/6 or C6/7 at hospital of Karlbad- Langensteinbach. Patients were divided into group A for C5/6 and group B for C6/7. 54 patients received a PCM (PCM-A: n=26 and PCM-B: n=30), and 43 patients a Discover (Discover-A: n=29, Discover-B: n=19). We examined computerassisted (Spinewave) the MCR at the index level (FSU) and the upper adjacent segment (FSUs). Data for the MCR were compared preoperative to 1-year post-operative and also to the average MCR, measured in 51 healthy patients (established by Dr. Nogier).

**Results:** It is interesting, that before surgery at the level above (FSUs), the MCR lies in all groups further anterior and caudally compared to normal values, except group PCM-B. The MCR shifts more cranially at the FSU, and more caudally at the FSUs, but a physiological MCR is not reached. Only trends can be established.

**Conclusion:** At FSU probably due to degeneration the preoperative MCR is more caudally, both types of TDR of this study try to reconstruct the normal MCR. But it is obvious, that this change has its effect on the adjacent level. If this change of the MCR due to the implantation of TDR...
Posters:

**POSTER PRESENTATIONS 41**

Long-Term Results of Axial Symptom after Double Door Laminoplasty with Hydroxyapatite spacer

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Introduction: Laminoplasty for cervical myelopathy have been reported to be almost favorite results about the neurological improvement over 10 years. However, there are few reports of long-term results of clinical symptoms, such as axial symptoms and activities of daily living (ADL). The purpose of this study is to investigate clinical symptoms of patients with cervical myelopathy over eight years after laminoplasty.

Methods: 16 patients with cervical myelopathy caused by ossification of the posterior longitudinal ligament (OPLL) (mean age, 58 years; range, 43-69) and 16 patients with cervical spondylotic myelopathy (CSM) (mean age, 65 years; range, 52-74), who underwent double door laminoplasty with hydroxyapatite spacer reported by Suetsuna, were followed. Clinical parameters included the evaluation of axial symptoms classified into no pain or no stiffness, mild symptom and severe symptom, range of motion (ROM) of neck, the evaluation of limitations of ADL accompanying neck mobility and recovery rate using JOA score. The ADL accompanying neck mobility was investigated using the questionnaire reported by Takeuchi et al. The questionnaire consisted of gabling, watching one’s step when climbing down the stairs, looking the right and left side when driving a car or crossing the street. Radiographic parameters included ROM of the cervical spine, interlaminar bony fusion and bone bonding around the hydroxyapatite (HA).

Results: Of the total of 32 patients, 14 patients had no axial symptoms, 16 patients had mild symptoms, and 2 patients had severe symptoms (OPLL; 1 pts, CSM; 1 pts). Of OPLL group, there were 2 patients with severe ADL limitation on neck extension and one patient on neck rotation and one patient on neck rotation. The generation of axial symptoms did not relate to incidence of ROM of neck, multilevel interlaminar bony fusion and type of bone bonding of HA spacer. However, the decrease of ROM of neck due to multilevel interlaminar bony fusion caused limitation of ADL. Recovery rate of JOA score of the total patients was 56.1%.

Conclusion: We conclude that improvement of the limitations of ADL accompanying neck mobility is necessary for the patients with OPLL.

**POSTER PRESENTATIONS 42**

Surgical outcome of cervical spondylotic myelopathy associated with kyphotic and/or sigmoid sagittal alignment

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Objective: The effects of sagittal kyphotic deformities or kyphotic mechanical stress on the development of cervical spondylotic myelopathy, or the reduction and fusion of kyphotic sagittal alignment have not been consistently documented. To study the effects of kyphotic sagittal alignment of the cervical spine in terms of neurological morbidity and outcome after two types of surgical interventions.

Methods: For this retrospective study, we reviewed the records of 476 patients who underwent cervical spine surgeries for spondylotic myelopathy. Among these, we identified 43 patients who had cervical kyphosis exceeding 10° on sagittal plane lateral radiographs in the neutral position preoperatively, and they were the subjects of the study. Anterior decompression with interbody fusion was conducted in 28 patients, and laminoplasty in 15 patients. Pre- and post-operative neurological, radiographic and MRI findings were assessed in both surgical groups.

Results: The mean preoperative kyphotic angle of all 43 patients was 15.9±5.9° in the neutral position. Segmental instability was noted in 26 (61%) patients and reversed dynamic spinal canal stenosis at an upper level to the local kyphosis in 22 (51%). Preoperative T2-weighted MR images showed high-intensity signals within the cord at and around the level of maximal compression or segmental instability in 28 (65%) patients. The mean kyphotic angle at both neutral and flexion positions was significantly smaller at 4-6 weeks after surgery in the anterior spondylectomy group than the laminoplasty group (p<0.001). Furthermore, the angle in the neutral position was significantly smaller at follow-up in the anterior spondylectomy group than the laminoplasty group. The transverse area of the spinal cord was significantly larger in the anterior spondylectomy group than the laminoplasty group at follow-up. Preoperative neurological scores and improvement at follow-up for more than 2 years (average, 3.3) were not significantly different between the two groups, however, there was a significant difference in neurological score at 4-6 weeks postoperatively.

Conclusion: Kyphotic deformity and mechanical stress in the cervical spine may play an important role in neurological dysfunction. In a selective group of patients with kyphotic deformity ≥10°, adequate correction of local sagittal alignment may help maximize the chance of neurological improvement.

**POSTER PRESENTATIONS 43**

Microarray analysis of cell death-associated genes in rat embryo cultured spinal cord cells exposed to cyclic tensile stresses in vitro

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Objective: The application of mechanical insults to the spinal cord results in profound cellular and molecular changes, including the induction of neuronal cell death and altered gene expression profiles. Previous studies have described alterations in gene expression following spinal cord injury, but the specificity of this response to mechanical stimuli is difficult to investigate in vivo. The present study was designed to investigate the cytobiological responses and candidate gene expression profiles in the cultured rat spinal cord cells subjected to cyclic tensile stress.

Methods: Spinal cord cells were isolated for culture from 13-day Sprague-Dawley rat embryos. We examined cell morphology and viability on various condition of stress levels and rates over a 72 hour time course. Microarray analysis of gene expression was performed using the Affymetrix GeneChip System, where categorization of identified genes was performed using the Gene Ontology (GO) and Kyoto Encyclopedia of Genes and Genomes (KEGG) systems. Changes in expression of 12 genes were validated with quantitative real-time reverse transcription polymerase chain reaction (RT-PCR).

Results: The application of cyclic tensile stress reduced the viability of cultured spinal cord cells significantly in a dose- and time-dependent manner. Increasing either the strain or the strain rate independently was associated with significant decreases in spinal cord cell survival. There was no clear evidence of additive effects of strain level with strain rate. GO analysis identified 44 candidate genes which were significantly related to “apoptosis” and 17 genes related to “response to stimulus”.
INTRODUCTION: In minimally invasive cervical spine surgeries, surgical exposure tends to be limited as compared to conventional surgeries. Under such circumstance, anatomical landmarks for safe and secure procedure sometimes become hard to identify. Recently, we have regarded the lateral edge of tendinous attachment of rotator cervicis muscles to lamina as a novel landmark which indicates the lateral border of the spinal cord. Using this easy landmark, we have successfully performed laminoplasty for spinal cord or nerve root decompressions. Purpose of this paper is to present clinical significance of this landmark.

METHODS: Seventeen patients with cervical spondylotic myelopathy or OPPL who underwent laminoplasty between August 2010 and November 2010 served as subjects of this study. Width of the spinal cord was measured on preoperative myelogram-CT at multi-levels between C3 and C7. In order to expose the targeted laminae or intervertebral joints, the spinous processes were sagittally split, keeping the attachments of the deep extensor muscles to each spinous process undisturbed. We measured the distance between bilateral LTRCs as rotator-rotator-distance (RRD). Percentage of width of spinal cord to RRD was calculated at each level. Spinal cord width on CT and RRD at surgery were measured independently by two experienced spine surgeons.

RESULTS: Age at surgery ranged between 40 years and 80 years. Width of the spinal cord was 14.2±1.4 mm at C4, 14.3±1.2 mm at C5 and 12.8±1.8 mm at C6. RRD was 20.2±1.7 mm, 19.3±2.0 mm, 17.7±2.5 mm and percentage of width of spinal cord to RRD was 71.1±9.1%, 74.3±4.5%, 73.7±6.1% respectively. In all cases, lateral border of laminoplasty was found medially to each LTRC bilaterally, and LTRC inside the medial border of each intervertebral joint bilaterally.

CONCLUSIONS: The spinal cord locates within bilateral LTRCs. Excessive laminar exposure beyond LTRC is not necessary for less invasive laminoplasty. In foraminotomy for nerve root decompression, LTRC serves as a useful landmark for surgeons to prevent spinal cord injury.
the diameters of the C4/5 and C5/6 foramen were evaluated between the 2 groups.

**Results:** The incidence of C5 palsy was 6.4% (9/141 cases). There were 7 males, and 2 females, with an average age of 65 years (40-82 years). The diagnosis was CSM in 4 patients, CSMR in 4 patients, and OPLL in 1 patient. There were no significant difference in the sex, age, diagnosis, operation time, blood loss, level of spinal compression, T2-high signal, and new lesion of T2-high between PG and NPG (P>0.05). Diameter of C4/5 foramen was 1.99mm in the PG, and 2.76mm in the NPG (p<0.005). In contrast, the diameter of C5/6 foramen was 2.35mm in PG, and 2.50mm in the NPG (P>0.05). There was significant difference in C4/5 foramen between PG and NPG.

**Discussion or Conclusion:** There were significant difference in diameter of C4/5 foramen between PG and NPG. The results suggest that the main etiology of C5 palsy is impairment of the C5 nerve root induced by existent C4/5 foraminal stenosis.

**POSTER PRESENTATIONS 47**

Prevention of the development of inflammatory tissue damage and apoptosis of neurons and oligodendroglia after spinal cord injury by tumor necrosis factor-alpha antagonist

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**Objectives:** The cascade of secondary tissue damage following spinal cord injury is accompanied by an inflammatory response marked by infiltration of neutrophils and macrophages, activation of glial cells, and upregulated expression of proinflammatory cytokines. Etanercept (TNF-α antagonist) has been recently used successfully for treatment of inflammatory disorders. However, only a few studies have examined its role in suppressing neuronal and oligodendroglial apoptosis in spinal cord injury. To elucidate the contribution of etanercept to the pathological cascade in spinal cord injury and its possible suppression of neuronal and oligodendroglial apoptosis.

**Methods:** Etanercept or saline (control) was administered by intraperitoneal injection 1 hour after thoracic spinal cord injury in rats. The expressions and localizations of TNF-α, IL-6, IL-1β, TNF receptor 1 (TNFR1), and TNF receptor 2 (TNFR2) were examined by immunoblot and immunohistochemical analyses. Spinal cord tissue damage between saline- and etanercept-treated groups was also compared following haematoxylineosin and luxol fast blue (LFB) staining. The Basso-Beattie-Bresnahan (BBB) scale was used to evaluate rat locomotor function following etanercept administration. Terminal deoxynucleotidyl transferase (TdT)-mediated dUTP-biotin nick end labeling (TUNEL)-positive cells were counted and the immunoreactivity to active caspase3 and caspase-8 was examined following etanercept administration.

**Results:** Immunoblot and double immunofluorescence staining revealed suppression of TNF-α, IL-6, IL-1β, TNFR1, and TNFR2 expression after administration of etanercept in the acute phase of spinal cord injury. LFB staining demonstrated potential myelination in the etanercept-treated group from 2 weeks after spinal cord injury, together with an increased BBB locomotor score. Double immunofluorescence staining showed a significant decrease in TUNEL-positive neurons and oligodendroglia from 12 hours to 1 week in the gray and white matters after etanercept administration. Immunoblot analysis demonstrated overexpression of activated caspase-3 and caspase-8 after spinal cord injury, which was markedly inhibited by etanercept.

**Discussion:** Our results indicated that etanercept reduces the development of inflammatory tissue damage of spinal cord injury, improves hindlimb locomotor function, and facilitates myelin regeneration. This positive effect of etanercept on spinal cord injury is probably attributable to the suppression of TNF-α, TNFR1, TNFR2, and activated caspase-3 and caspase-8 overexpressions, as well as the inhibition of neuronal and oligodendroglial apoptosis.

**POSTER PRESENTATIONS 48**

Distal embolic brain infarction due to recanalization of asymptomatic vertebral artery occlusion resulting from cervical spine injury. Case report.

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**Background:** Spinal injuries are frequently associated with vertebral artery occlusion (VAO). Many aspects of the management of VAO remain controversial, including the screening criteria, the diagnostic modality, and the optimal treatment for various lesions. We present a case of brain infarction due to recanalization of the occluded VA following open reduction of cervical spinal dislocation, and discuss the management of VAO.

**Methods:** A 41-year-old man presented with C4-5 distractive-flexion injury manifesting with quadriplegia below the C3 cord level (including phrenic nerve paralysis), anesthesia below the C3 level, and bowel bladder dysfunction. MR angiography and CT angiography showed left extracranial VA (V2) occlusion and patent contralateral VA. He was observed without antplatelet and/or anticoagulation therapy, and underwent surgery (open reduction and internal fusion of C4 and C5, and tracheostomy) 8 hours after the injury.

**Results:** After surgery, supraspinal symptoms such as left horizontal nystagmus and left homonymous hemianopsia led to cranial CT and MRI, which showed left-side cerebellar infarction in the posterior inferior cerebellar artery (PICA) territory and right-side posterior cerebral artery (PCA) infarction. MR angiography and CT angiography demonstrated patent bilateral VA (but hypoplastic right VA) and occluded right PCA (P2). He was treated with observation alone without any other ischemic complications.

**Discussion:** In this case, VA occlusion on the dominant side caused by cervical spinal dislocation led to cerebellar infarction in the PICA territory due to hemodynamic compromise or arterial dissection. Contralateral PCA infarction was caused by artery-to-artery embolization originated from recanalized VA. The management of asymptomatic VAO is controversial with several treatment options available, including observation alone, antplatelet therapy, anticoagulation therapy, or invasive intervention. Although there are some reports described that management with observation alone seems safe, we should pay serious attention to the VA injury caused by cervical spine trauma.

**Conclusion:** The optimum modality for the treatment of VA injury is as yet undetermined. Clearly, there is a need for further study in this regard.

**POSTER PRESENTATIONS 49**

The Effectiveness of Anterior Cervical Microdiscectomy and Fusion Techniques

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Background: Anterior cervical microdiscectomy (ACD) and fusion is commonly applied in the surgical treatment of cervical disc herniation. However, following discectomy and fusion procedures are still controversial. Therefore, a multicentric, retrospective study was designed.

Material and Method: Totally 23 patients were operated. Twelve patients were operated with applying ACD and cage fusion technique (Group I). Eleven patients were operated via ACD and bladed cage fusion technique (Group II). Preoperative and postoperative (postoperative first day and postoperative 3 rd and 12 th months) plain x-rays were obtained. The cervical disc heights of the operated level and adjacent segments were calculated. The segmental and cervical lordosis angles of the patients were also added to these measurements. Pain assessment was performed using visual analog pain scale. Mann-Whitney statistical analysis method was applied to compare the outcomes for both groups.

Results: Satisfactory result was achieved in both groups. The pain scores for major complaint (arm pain) were decreased significantly in both groups. The improvement in neck pain scores was observed in both groups. There were no significant changes in disc height of operated levels and segmental and cervical lordosis angles between two groups in immediate, 3 rd month and 1-year postoperative periods.

Conclusions: ACD and PEEK cage fusion technique offers satisfactory outcome regardless of whether the cage is bladed or not.

Key Words: Anterior cervical microdiscectomy, cage, disc height, foramen height, fusion.

POSTER PRESENTATIONS 50

Relationship between self-pay ratio of medical expenses and quality of life in patients with cervical compressive myelopathy


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Purpose: In Japan, health-insurance systems cover all of the citizens and self-pay ratios of medical expense were set at 3 categories, 0%, 10% or 30%. The self-pay ratio in patients certificated of physically-disabled is 0%. There were few reports about quality of life in those patients free from anxiety of medical expenses. The purpose of this study was to clarify the impact of self-pay ratio of medical expenses to QOL in patients with cervical compressive myelopathy (CM) compared with lumbar spondylotic myelopathy (LCS).

Methods: Sixty-five patients with CM (32 male and 33 female, average 69.7 years old, 56 cervical spondylotic myelopathy and 9 ossification of posterior longitudinal ligament) and 81 patients with LCS (39 male and 42 female, average 73.2 years old) were enrolled in this study with agreement. All the patients filled out following questionnaires: SF-36 and 4 items of Preference-Based QOL; rating Scale, standard gamble, time trade-off and willingness to pay. As disease-specific questionnaires, the Japanese Orthopaedic Association cervical myelopathy evaluation questionnaire (JOACMEQ) and the Japanese Orthopaedic Association back pain evaluation questionnaire (JOABPEQ) were completed. We divided all the patients into two groups, group A: self-pay ratio 0% (19 patients with CM, 15 patients with LCS) and group B: self-pay ratio 10% or 30% (46 patients with CM, 66 patients with LCS).

Results: In the patients with CM, PCS of SF-36, motor function of upper extremities scores and lower extremities scores and bladder function scores of JOACMEQ were significantly lower in group A than in group B (Mann-Whitney U test, p<0.05). There were no significant differences in MCS of SF-36, cervical function and QOL scores of JOACMEQ and all 4 items of Preference-Based QOL between the two groups. In the patients with LCS, only lumbar function score of JOABPEQ was significantly lower in group A than in group B. No significant differences were found in other scores.

Conclusions: The patients of self-pay ratio 0% with cervical compressive myelopathy had worse physical function. However, the mental aspects of QOL of these patients were not lower comparing with 10% or 30% self-pay.

POSTER PRESENTATIONS 51

An Anatomical and Radiological Study for The C1 Lateral Mass Screw Fixation Technique

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Objective: The purpose of the current study is to determine the appropriate screw length and angle of application in C1 lateral mass screw fixation by means of the investigation of the anatomical variations between the right and left sides of C1 vertebrae and anatomical and radiological measurements.

Hypothesis: The hypothesis of this study is that there is no standard screw length for every individual.

Materials and Method: A total of 15 measurements, 11 of which was for length and 4 for angle, was performed on thirty dry stored C1 vertebrae (atlas. Furthermore, each of the measurement was made separately on both sides of C1 vertebrae. 5 parameters of length were measured using digital calipers on atlas vertebrae and 6 parameters were radiologically measured in the vertical and sagittal axes by means of 3D CT scanning.

Results: The measurement results of the current study have revealed there are statistically significant differences between the right and left sides of the C1 vertebrae in 8 of the 15 measured parameters (p≤0.05). The meticulous review of the related literature has pointed out that the 10th and 11th parameters, generated to determine the closest values of bicortical screw length, have not been measured in any other studies before. The closest values of bicortical screw length of the former parameter has been measured as average 17.80 mm on the right (interval value: 14.43 -21.36 mm) and average 18.72 mm on the left (interval value: 15.29 - 23.06 mm). The latter parameter has been found to be average 19.06 mm on the right (interval value: 13.11 - 22.36 mm) and average 19.26 mm (interval value: 16.46 - 22.11 mm) on the left. The differences between the interval values of the two measurement parameters range between 5.69 mm and 9.25 at minimum. The results of the study also suggest that there is no standard screw length for every individual. Therefore, surgeons to apply C1 lateral mass screw fixation must calculate the proper length of bicortical screw by examining the pre-op cervical CT scanning results.

Keywords: Atlas, Lateral mass screw fixation, Spinal stabilization, Anatomy.

POSTER PRESENTATIONS 52

Correlation between the length of C6 spinous process and neck symptoms in the general population

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Introduction: It was reported that preservation of attachment of nuchal ligament in the C7 spinous process was effective for reducing neck symptoms after cervical laminoplasty. However, we have often experienced that the nuchal ligament is also rigidly attached to the C6
spinosus process in some cases. It is thought that the nuchal ligament attached to the C6 spinous process by the case with a long C6 spinous process. The purpose of this study was to investigate the correlation between the length of C6 spinous process and neck symptoms in the general population.

**Methods:** Lateral cervical roentgenographs of 758 healthy volunteers who participated in a health promotion project were analyzed, including 493 women and 265 men with ages ranging from 21 to 86 years. The lengths of C6 and C7 spinous processes were measured by lateral roentgenograph, and C6/C7 process lengths ratios were calculated. Neck symptoms were assessed by the presence or absence of neck or shoulder stiffness using the visual analogue scale (VAS).

**Results:** The average C6/C7 spinous process length ratio was 0.76 (range 0.40–0.99) with males averaging 0.75 and females 0.77 with no significant difference between genders. The average VAS was 27.5mm (male average 24.3mm, female average 29.4mm). There was no correlation between C6/C7 ratio and VAS in males but, in females with C6/C7 ratios greater than 0.9 had significantly lower VAS (P=0.005).

**Conclusion:** These data suggest that females with greater C6/C7 ratios experience less severe neck symptoms.

**POSTER PRESENTATIONS 53**

**The supplementation of brain-derived neurotrophic factor by retrograde gene in vivo delivery promote the survival of neurons and oligodendroglia after cervical spinal cord injury**

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**Objectives:** Deficiency of endogenous neurotrophic factors is a serious problem for injured spinal cord tissue, therefore, exogenous administration of neurotrophic factors has been proposed as one potential treatment. Direct routes for administration of neuroprotective genes have difficulties and serious concerns regarding the possible spread of resultant traumatic spinal cord injury (SCI). In contrast, targeted retrograde gene delivery through the peripheral nervous system or by muscle injection of adeno-virus vectors seems a less invasive method. The present study was designed to investigate the effects of retrograde adenosine-mediated brain-derived neurotrophic factor (AdV-BDNF) gene delivery after cervical SCI.

**Methods:** Adult Sprague-Dawley rats entered and an established weight-compression technique (50 g static load for 5 minutes) was used to produce SCI at C5 segment level. Each of AdV-BDNF or AdV-mediated beta-galactosidase (LacZ) was injected via bilateral sternomastoid muscle injection of adenovirus vectors seems a less invasive method. The purpose of this study was to investigate the correlation between the length of C6 spinous process and neck symptoms in the general population.

**Results:** The average C6/C7 spinous process length ratio was 0.76 (range 0.40–0.99) with males averaging 0.75 and females 0.77 with no significant difference between genders. The average VAS was 27.5mm (male average 24.3mm, female average 29.4mm). There was no correlation between C6/C7 ratio and VAS in males but, in females with C6/C7 ratios greater than 0.9 had significantly lower VAS (P=0.005).

**Conclusion:** These data suggest that females with greater C6/C7 ratios experience less severe neck symptoms.

**POSTER PRESENTATIONS 54**

**Results of US FDA-IDE clinical trial validate early European experience with Mobi-C® artificial cervical disc**

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**Background:** Total disc replacement (TDR) has been successfully used for the treatment of symptomatic cervical degenerative disc disease (DDD) for a number of years in Europe. The current standard of care in US is anterior cervical discectomy and fusion (ACDF). Recently, FDA-regulated Investigational Device Exemption (IDE) studies have been conducted to evaluate the clinical effectiveness of TDR when compared to ACDF. These IDE studies provide an opportunity to validate the success of TDR in Europe.

**Purpose:** Investigate the clinical success at 24 months post-op of TDR compared to ACDF. Study Design A prospective, randomized, multicenter, concurrently controlled FDA IDE clinical study conducted at 24 sites in the US.

**Patient Sample:** 575 skeletally matured patients with 1 or 2 level symptomatic DDD (between C3-C7) of a least 6 weeks duration. Outcome Measures: Clinical success was defined as: functional improvement, no study failure due to subsequent surgeries, and no major complications.

**Methods:** Patients were diagnosed using usual criteria and randomized to receive TDR treatment with Mobi-C or ACDF with allograft and anterior plating (2:1 ratio). TDR treatment group included 164 patients at one level and 225 patients at two levels while ACDF treatment group included 81 patients and 105 patients respectively.

**Results:** At the 24 month follow-up visit the success rate of TDR was 75.6% compared to 65.3% for ACDF at one level and 70.6% for TDR compared to a 36.4% for ACDF at two levels. These success rates demonstrate statistical non-inferiority at one level (p<0.05) and superiority at two levels for TDR compared to ACDF (p<0.05). To compare success rates of IDE study to the European study, IDE success rates were recalculated using same success criteria. These success rates are: 76.1% for the IDE study vs. 69% for the European study (onelvel) and 73.3% vs. 66% (twolvels).

**Conclusions:** The IDE study demonstrates that TDR with Mobi-C is viable alternative to ACDF for patients symptomatic cervical DDD at a single level and a potentially superior treatment at two levels. These results also validate the European Mobi-C study.

**POSTER PRESENTATIONS 55**

**Hybrid Surgical Technique Combining Fusion And Disc Arthroplasty For The Treatment Of Multilevel Cervical Degenerative Disc Disease**

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**Summary:** The aim of this study is to report clinical and radiological results of hybrid technique in patients with multilevel symptomatic...
cervical degenerative disc disease. Hybrid surgical strategy for multilevel degeneration is safe and effective in patients with varying degrees of degeneration in each symptomatic level.

**Introduction:** Hybrid solutions such as fusion + disc arthroplasty may be an option for patients with more advanced multilevel degeneration of cervical spine. The aim of this study is to report clinical and radiological results of hybrid technique in patients with multilevel symptomatic cervical degenerative disc disease.

**Materials and Methods:** Clinical and radiographic outcome of 10 patients having symptomatic multilevel cervical degenerative disc disease treated by using hybrid technique and with minimum 2 years follow-up were analyzed retrospectively. Clinical analysis included pain, function and complications. Radiological parameters analyzed included sagittal alignment, presence of heterotopic ossification, adjacent segment disease, fusion rate and mobility of the arthroplasty level.

**Results:** The average age of patients was 37 (range; 26 to 45) years and male/female ratio was 4/6. The mean follow-up was 15.3 (range; 12 to 24) months. 2 patients had single level corpectomies, while 5 patients had single level and 3 had two level discectomies. Nine of the patients had single level arthroplasty while 1 had 2 levels. Total number of implanted prosthesis was 11 and of cages were 13. Mean operation time was 266 minutes, the average blood loss was 236 ml and the average hospitalization period was 6.4 days. Clinical follow-up outcome questionnaires demonstrated significant improvement. Five patients having preoperative incomplete neurological deficit in the form of radicular motor weakness improved completely. Radiological examination showed that preoperative segmental and global lordosis values of 2.5 and 16.2 degrees have improved to 7.8 and 25.5 degrees immediately after surgery and maintained until last follow-up with 3% loss. None of the patients had heterotopic ossification and degeneration adjacent to the arthroplasty level.

**Conclusion:** Hybrid surgical strategy for multilevel degeneration is safe and effective in patients with varying degrees of degeneration in each symptomatic level.

**POSTER PRESENTATIONS 56**

**Posterior-Anterior-Posterior Surgery For Cervical Spondylotic Myelopathy Associated Severe With Kyphosis**

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**Introduction:** Correction of rigid cervical kyphotic deformity associated with spondylotic myelopathy may be necessary to relieve the cord compression and to restore the cervical alignment. The aim of this paper is to report the efficacy and safety of staged posterior-anterior-posterior approach for the management of this entity.

**Materials and Methods:** The clinical and radiographic data of 15 patients who had posterior-anterior-posterior surgery for cervical spondylotic myelopathy associated with rigid kyphosis were retrospectively reviewed. The surgical technique included at first stage, temporary posterior instrumentation and decompression was done. The rods were not locked to allow correction. Then anterior decompression and correction and fusion was done. Unlocking the posterior lower anchor points enabled manipulation and correction of kyphosis via the anterior cage and plate. Reexposure of the posterior incision was done at the third stage and posterior rods bend to physiologic contours were placed and fixed.

**Results:** Average follow-up was 45 months (range; 24 to 96). Mean age of the patients (8 male, 7 female) at the time of operation was 66 (range; 31 to 81) years. Mean preoperative local kyphosis angle was 12 degrees and was corrected to 10 degrees at the extension lateral x-ray. Mean preoperative global kyphosis was +9.2 degrees (range; +4 to 29 degrees) and was corrected to -13.3 (range; 8 to 24) degrees of lordosis. An average of 3 corpectomies and 2 laminectomies was done. The mean operation time was 420 minutes and the average blood loss was 423 ml. Average hospitalization period was 12 days. There was no pseudoarthrosis at the final follow-up and loss of correction was an average of 1.5 degrees. There was a significant improvement both in myelopathy and neck pain. Four patients developed bilateral C5 root palsy postoperatively and resolved within 3 months. Other complications included 2 wound dehiscences requiring an additional operative procedure and 1 superficial wound dehiscence treated conservatively.

**Conclusion:** Posterior-anterior-posterior surgery for spondylotic myelopathy associated with rigid kyphosis restored the sagittal alignment and provided a successfull neurological and clinical outcome.

**Significance:** Restoration of kyphosis might have helped to the improvement of neurological status and neck pain.

**POSTER PRESENTATIONS 57**

**Clinical Application C2 Translaminar Screw Fixation**

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**Objective:** Various techniques have been described for C1-C2 fixation. Screw fixation has been shown to be more rigid than wire fixation procedures and is associated with a high rate fixation. C1 lateral masses and the C2 pedicles (Harms technigue) and transarticular technique are the most popular choices for upper cervical spine fixation. Both techniques involve screw fixation in to the C2 pars/pedicle, which can result in a significant risk to the vertebral artery. (VA). For these reasons, a technique using crossing screws placed directly on to the cancellous bone of the laminar of C2 was devised in 2004, Wright first described the combination of C2 translaminar screws (TLS) and C1 lateral mass screws for atlanto axial fixation which was simple to handle and had lesser risk of VA injury. In this study, we used crossing C2 laminar screws to effect C2 fixation in 4 patients. The axis was successfully stabilized using this technique.

**Material and Method:** C1 lateral mass (C1LMS) and C2 translaminar screw (C2TLS) fixation was applied to four patients who were referred to our clinic because of C1-C2 dislocation after servical trauma. The oldest patient was 46 years old and the youngest was 24. Three of them were male and one was female. Type 2 Odontoid fracture was observed in all of the patients which was suitable to posterior approach. One-sided translaminar fixation was applied to one patient. The duration of the operation was about one hour. There weren’t bleeding and major vascular injury in none of the cases. There were no complications observed postoperatively. Postoperative reduction was achieved.

**Conclusion:** The use of C2 translaminar screws is an alternative method of fixation in C2, C1 lateral mass and C2 translaminar screw fixation provide a powerful means of reducing C1-C2 subluxations and maintaining alignment, achieving indirect decompression of the spinal cord. Our results demonstrate that the technique of C1LMS and C2TLS fixation is safe and efficient for achieving posterior C1-C2 fusion.

**POSTER PRESENTATIONS 58**

**Cervicothoracic diastematomyelia in an elderly with normal neurology (Report of a case and review of the literature).**

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**Objective:** Diastematomyelia, an uncommon dysraphic state usually seen in children, is a rarity in adults and a medical curiosity in the
elderly. Among 36 adults with diastematomyelia reported in the past, only one elderly have been published so far. Cervicothoracic and cervical region are the least common site for the spinal cord splitting, so it is not a surprise to find only 11 adults with diastematomyelia of this area, but none in an elderly. Abnormal neurology is a cardinal guiding feature of diastematomyelia pointing to the diagnosis and it is a rare event to encounter a subject with split cord malformation remaining neurologically free. In comprehensive review of the literature, among 14 neurologically asymptomatic patients with SCM only one, were found in geriatric age group. In none of these 14 cases the cleft was located above T2. Herein, a unique sets of circumstances will be discussed.

**Method:** This 72 years old female was admitted to our clinic because of neck discomfort in the last two weeks. Her neurological exam was quite normal, Cervical x-ray disclosed blocked vertebras and some degenerative changes AP view showed increased interpedicular distance and a bony spur through C5 to T2. the patient was sent for MRI which surprisingly showed split cord malformation extending from C5 to T3. Subsequent CT confirmed presence of bony diastematomyelia.

**Result:** The patient’s neck pain was ameliorated with medication. Later, this anomaly was discussed for the patient and neck exercises was instructed and she was pursued for regular seasonal follow up

**Conclusion:** The number of the reported adults with cervical and cervicothoracic diastematomyelia is too small to formulate a definitive treatment protocol. However while, surgery is strongly considered if progressive neurological deficits are detected., management of asymptomatic subjects remain controversial for the lack of natural history applicable to this age group. with concern about the clinical consequences of trauma of the cord, prophylactic surgery of diastematomyelia in neurologically free adults is advocated by most of the authors. On the other hand, the minority group of the surgeons, advocate observation rather than surgery. These authors propose monitoring of neural function in all asymptomatic patients with SCM of all locations. Nonetheless although we are proponent of the former group and propose surgery for such adults but we are not in favor of prophylactic surgery in an asymptomatic patient in her eighth decade of life.

**POSTER PRESENTATIONS 59**

**Coexisting a cervical spondylosis and Intermedullary arachnoid cyst causing sever quadripareis**

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**Objective:** Intermedullary arachnoid cyst are very rare and has been reported only in seven rare occasions. Coexistence of an intermedullary arachnoid cyst distal to cervical spondylosis has been not reported before. On the other hand, syringolmyelia can develop distal to all lesions that partially obstruct cerebrospinal fluid flow such as tumors, cysts and congenital anomalies. Although syringolmyelia secondary to intradural arachnoid cyst has been seen in a few occasions, but its development distal to an Intermedullary arachnoid cyst is not reported before. So Here in we present a case with sets of three unique conditions

**Method:** This 62 years old woman was admitted because of progressive weakness of her extremities more prominent on the lower limbs making her unable to walk without a cane. She had urinary incontinence too. Neurological examination revealed spastic quadripareis. Her MJOA score was, Cervical X-Ray showed multilevel cervical spondylosis. Cervical MRI showed multilevel marked spondylosis from C3 to C7. Further, from C7 to T3 there was a a large Intermedullary cystic mass. The Cyst content had density similar to CSF both in T1 and T2 images . From the end of this cystic mass, syringolmyelia was started which was terminated at T10.

**Result:** The patient underwent long cervicothoracic laminectomy. Decompression of the cervical region was accomplished with further foraminotomy of the appropriate cervical roots the. Subsequently, dura was incised from C7 to T3 exposing the cord which was budged mostly on the left. Now, through a Left DREZ myelotomy, a transparent cystic mass with a very thin capsule was seen. the cyst wall was excised partial and with clear CSF like fluid removal, normal pulsation of the cord reappeared. After Dural closure, a screw - rod construct was utilized from C22 to T3. Post operative the patient recovered very soon and within a month she had MJOA score of 13. She was seen regularly Post OP MRI a year later, showed normal looking cervical and upper thoracic cord with complete disappearance of coexisting syringolmyelia

**Conclusion:** Coexistence of cervical spondylosis and an Intermedullary arachnoid cyst seems to be a coincidence, while syringolmyelia is the consequence of partial obstruction of CSF pathway by the arachnoid cyst. Single stage surgery for cervical spondylosis and the associated Intermedullary should have been done. Because of long cervicothoracic laminectomy stabilization was logic. However the syrinx below an obstructive pathology does not need intervention and usually is resolved with time.

**POSTER PRESENTATIONS 60**

**Craniovertebral Intermedullary lipoma in an elderly Report of a case necessitating occipito-cervical instrumentaion**

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**Objective:** Intermedullary lipomas not associated with dysraphism are rare and those locating at craniovertebral region are extremely rare. Majority of lipomas of this region occur in children and young adults and becoming symptomatic till the elderly is a medical curiosity.

**Method:** This 72 year old man was admitted because of sever neck pain for six months and inability to walk for two months. His neck pain was aggravated with neck movements. Neurological exam revealed quadripareis with MJOA score of 8. MRI surprisingly showed a hyperintense cervicomedullary tumor both in T1 and T2 images. Reconstructed CT revealed a large hypodense lesion with patchy calcification at the periphery, The lateral masses and pedicles of C2 and C3 were extremely attenuated.

**Result:** The patient underwent high cervical laminectomy and limited suboccipital craniectomy. After dural opening a yellow subpal lipoma was demonstrated and this was removed as much as possible. After dural closure, regarding the extreme thinning of the lateral massed, the pedicles, sever cervical lordosis and the patient’s neck pain in motion, occiptocervical instrumentation was decided. The patient had an uneventful course and recovered gradually to a degree that three months after surgery, he became able to walk with a cane independently.

**Conclusion:** Craniovertebral intermedullary lipomas are rare and only 10 cases had been reported in the past. On the other hand,. intermedullary lipomas of all regions usually present themselves in childhood and only in very rare occasions, they might remain silent till middle age. Clinical presentation of an intermedullary lipoma in the old age is an exception. Partial removal in majority of the reported cases had been followed by acceptable recovery as was seen in our patient. In the case of long standing intermedullary lipomas necessitating instrumentation, the screw purchase are quite demanding with regard to the deformed pedicles and lateral masse sand should be done extreme caution even at the hands of experts.
POSTER PRESENTATIONS 61

Large Traumatic extradural cervicothoracic arachnoid cyst as a late consequence of traumatic cervical root avulsion

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Objective: Extradural arachnoid cyst are rare and mostly occur as the result of a congenital dural defect. However it can develop after trauma in very rare occasions. Dural tear during trauma might allow the arachnoid to herniate through and enlarge. Gradual enlargement of the arachnoid pouch result in an extradural cyst which will ultimately result in cord compression. Development of an extradural arachnoid cyst after traumatic root avulsion is a very rare and is reported only in one rare occasion in pre CTand MRI era.

Method: this 32 years old male was admitted because of progressive weakness of his lower extremity making him unable to walk in the last month. His past history showed a motorcycle accident resulting in his left upper extremity paralysis immediately after the accident diagnosed to be due to root avulsion. His neurological exam showed spastic paraparesis in addition to flaccid paralysis of the distal part of his left upper extremity. MRI and MR myelogram showed root avulsion at three lower cervical segments on the left, a hypertense CSF like cystic mass s extending from C6 down to T5 was noted with apparent cord compression. T1 images showed hypointemnse mass in similar site. Compatible with CSF containing mass. Diagnosis of arachnoid cyst was made. Metrizamide myelography revealed compression of a cord with an extradural mass. Diagnosis of extradural arachnoid cyst of the cervicothoracic region was made.

Result: The patient underwent laminotomy from C5 to T4 and an extradural mass with transparent capsule containing CSF was demonstrated. The cyst was incised. Three dural defects were found on the left lower cervical region compatible with the site of root avulsion. The cyst was concluded to arise from the upper most defect. How ever all three defects were repaired and the cyst wall was removed. with subsequent laminoplasty. The patient recovered rapidly and was able to walk independently on the days of discharge.

Conclusion: Although extradural arachnoid cyst are mostly congenital in origin in very rare occasion it might develop after closed spinal traumas as well. It has been observed after traumas of different etiologies among them only once after cervical root avulsion. We should conclude that a dural tear with subsequent development of an extradural arachnoid cyst and cord compression should be considered the first possible cause of paraparesis in the patients with cervical root avulsions.

POSTER PRESENTATIONS 62

Management of late and neglected cervical flexion distraction injuries Report of 14 cases

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Objective: Flexion distraction cervical spine traumas result in discoligamentous injury Simple dislocation with mild kyphosis, unilateral locked facet and ultimately bilateral locked facet are the consequences of such traumas. These injuries might be left unrecognized or may be treated non surgically with collar or halo vest. Those injuries being referred or diagnosed more than three weeks after initial injury, are considered late… Optimal method for management of late injuries has not been established yet. Herein, 14 such cases are presented trying to highlight our treatment protocol.

Method: 15 patients with old cervical flexion distraction injury are presented. The time between injury and management averaged 40 days ranging from 40 days to 14 months. Surprisingly, except one with mild quadriaparesis the remaining had normal neurology. In all Traction was employed with increasing weights up to 2/3 body weight under closed observation. In three cases in whom reduction was achieved stabilization was preformed through two stage first anterior graft plate followed by posterior instrumentation. Among those in whom reduction was not effective in 5 cases unlocking and reduction could be achieved only through posterior approach with lateral mass or pedicle screw. In 3 cases despite of facet resection, reduction could not be achieved and alignment only can be reached with corpectomy of the lower vertebral followed with graft or expandable cage and plate. In two patient with gross calcification of ALL first anterior disc removal and release supplemented with graft and plate was done first followed with posterior stabilization. In one patient with marked kyphosis first posterior osteotomy and screw placement was done followed by anterior corpectomy and insertion of expandable cage and subsequently the r rod assembled into the previously inserted multiaxial screws.

Result: In 11 patients very good anatomical reduction and sagittal alignment was achieved. But in the 3 cases intervention result in acceptable reduction with mild kyphosis. Surgery in the latter group were all carried out in pre lateral mass/screw rod era.

Conclusion: Management of old cervical flexion distraction injuries either missed or mismanaged is a challenging issue. With respect to this 14 cases which is the largest one to date, we could reach to an algorithm which starts with skull traction. Surgery varies from single stage posterior, two stage anterior-posterior or reverse and three stage operation in angular kyphosis being discussed in detail stressing on, the efficacy of pedicle screws which has revolutionized the management of both early and late cervical discoligamentous dislocations.

POSTER PRESENTATIONS 63

Sporadic Cervical Spinal Hemangioblastoma

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Objective: To describe a cervical spinal hemangioblastoma

Presentation: An 18-year-old female patient admitted with a one year history of neck and right upper extremity pain and numbness in both hands for the last three weeks. Motor examination was notable for right wrist flexion strenght deficit (%60) and hypoesthesia in C5 dermatome. Magnetic resonance imaging scans revealed intradural-intramedullary homogeneous enhancing solitary lesion 2x2x2 cm in size at the level of C7 (Figure 1-2).

Methods: The patient underwent surgery. Following C7 total laminectomy, dura was opened and the mass was resected gross totally. Pathological examination revealed hemangioblastoma. Von Hippel Lindau (VHL) disease is an autosomal-dominant disorder frequently associated with hemangioblastomas of the spinal cord. Central nervous system manifestations of VHL disease include retinal angiomatosis, and supratentorial, cerebellar, brainstem, and spinal cord hemangioblastomas. Hemangioblastomas of the spinal cord may occur sporadically or in association with VHL disease. Our case is not associated with VHL disease.

Conclusion: Although benign tumors, spinal hemangioblastomas have a high recurrence rate and may present permanent neurological deficits. The best management of spinal hemangioblastomas is timely total removal.
En bloc cervical laminoplasty with preserving posterior structure
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Introduction: Many complications such as neck pain and deformity can develop with cervical laminoplasty technique in cases of multi-level compression due to cervical spondylosis and posterior longitudinal ligament ossification. In order to minimize these complications, en bloc open-door cervical laminoplasty technique with preserving posterior structures is performed. The results of these techniques is reported.

Material and Method: Between 2002 and 2010, one hundred twenty six cases with cervical spondylotic myelopathy underwent en bloc cervical laminoplasty by preserving posterior structures. Muscles attached to C2 and C7, spinous process, supraspinous and intraspinous ligaments, ligamentum flavum and facet capsules were preserved. Laminas were stabilized by titanium mini-plates and screws. Follow-up period was ranging from 3 months to 24 months (mean; 15 months). There was 105 male and 21 female (F:M=1:5) between 33 and 85 years old (mean; 60.3 years). Clinical (VAS and JOA) and radiological findings (cervical lordosis, myelomalacic changes) were evaluated before surgery and at last follow-up.

Results: Most common level of compression was C5-6 (78.5%), followed by C4-5 (76.1%). Preoperative VAS was found as 1.8, while 1.4 at last follow up. Preoperative JOA was found as 12.7, while 14.1 at last follow up. Transient C5 paralysis occurred in 5 patients (3.9%). Decrease of lordosis was found in 8 patients (6.34%). Neither instability or kyphosis was detected. In T2-weighted MR assessments, myelomalacic changes were almost completely disappeared in 32 cases (25.3%). When results were compared to literature obtained with expansive laminoplasty, it was seen that patient’s satisfaction was high with fewer complications.

Conclusion: En bloc open-door laminoplasty technique by preserving posterior spinous process and ligamentous structures markedly reduces complications of laminoplasty.