

Anterior-posterior cervical instrumentation – the need and benefits in multilevel corpectomy and cervico-thoracic junction pathology

(Abstract ID: 210)

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Background:

The postoperative stability of the cervical spine is not only affected by the increasing number of decompressed levels, but it is also depending on the severity of the underlying disease - which plays a challenging role in the selection of the suitable surgical technique. Considering the stability the anterior-posterior (combined) instrumentation seems to be the best choice. However, in multimorbid elderly patients the combined approach could be disproportionately risky. Therefore, less debilitating experimental methods are investigated in the recent years - e. g. anterior-only instrumentation techniques and tools. Until market maturity of these novel strategies and the current lack of adequate replacement techniques it will be a balancing act between the extent of surgery for cervical spine stability and patient safety. We report on our experience in anterior-posterior cervical instrumentation in complex spine reconstruction and the postoperative results.

Materials and methods:

We retrospectively identified 38 patients aged between 38 and 85 years (64 ± 10 years, 20 female vs. 17 male) over a period of the last six years. The inclusion criteria were anterior-posterior instrumentation either including cervico-thoracic junction or multilevel (≥ 2) cervical corpectomy. Reasons for surgery were pathologic and traumatic fractures, advanced degeneration or purulent diseases of the cervical spine. All patients received postoperative computed tomography and follow-ups (8 ± 7 months, range 1 - 28 months).

Results:

Patients could be assigned into two groups, the larger group 1 (87 %, $n = 33$) received anterior-posterior cervical instrumentation in a one-stage approach, including 2 patients (5 %) who were initially planned for anterior or dorsal (unilateral) instrumentation - in which early instability of the instrumentation in terms of cage and screw dislocations during current hospital stay forced to immediate conversion to the combined approach.

Patients of the smaller group 2 (13 %, $n = 5$) had to be treated in a two-stage procedure. They all received unilateral instrumentation first - but instability like increasing malposition of the cervical spine,

loosening of screws, sintering of the cage or plate dislocation led to secondary combined instrumentation after a mean time of 11 months (range 1 - 28 months).

None of the group 1 patients showed secondary instrumentation failure after one-stage approach. Patients of the group 2 had to undergo secondary surgery due to complications of the unilateral instrumentation.

None of the patients died after the treatment. Within group 1 seven patients (21 %) developed complications like wound healing disturbances (6 %, n = 2), pleura effusion, urinary tract infection, Horner's syndrome, paralysis of the recurrent nerve and pneumonia (each 3 % / n= 1). Three patients (60 %) in group 2 showed wound healing disturbances (40 %, n = 2) and pneumonia (20 %).

Regarding the neurologic outcome none of the patients deteriorated, eight patients were unchanged (21 %) and thirty patients improved (79 %) in terms of sensorimotor function, pain level and / or spasticity.

Conclusion:

Considering the lower morbidity, and missing secondary failure of the instrumentation, anterior-posterior cervical instrumentation in multilevel corpectomy and cervico-thoracic junction pathology seems to be unrivaled - especially in regard of lacking rational replacement procedures.

Impact and outcome of complex dorso-ventral stabilization in elderly patients

(Abstract ID: 259)

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Background:

Surgical complex correction of pathological spine fractures because of osteoporosis, tumors or other reasons is a complex undertaking with suspected high morbidity. The elderly population is poorly studied and constitute a rapidly expanding surgical demographic. Although neurological deficits could be present, senior citizens are often surgically undertreated because of age and comorbidities. Previous studies aimed at elucidating appropriate risk factors for surgery have been limited by small cohort sizes only older than 65 years of age. The purpose of this retrospective study was to assess factors that modify the risk of surgery in elderly patients more than 75 years old.

Materials and methods:

A retrospective data analysis in elderly patients more than 75 years of age was performed, who underwent complex dorso-ventral spine surgery because of different indications, with and without neurological deficit. Analyzed risk factors included demographics, comorbid conditions, surgical factors, perioperative morbidity and mortality.

Results:

26 patients with a mean age of 79 years were included. Indications for surgery were pathological spine fractures causing instability because of osteoporosis or spinal metastasis and degenerative or infectious deformity in the cervical, thoracic or lumbar spine. All patients underwent ventral or lateral corpectomy with vertebral replacement and multilevel dorsal stabilization, partly with cement screw augmentation. There was no perioperative mortality, no new neurological deficit and all patients could be mobilized again with improved pain situation.

Conclusion:

Elderly patients, the expanding demographic part of our population, are not limited in surgical spine reconstruction, especially with no or mild preoperative comorbidity. There are clear benefits in pain improvement, mobilization in stand and gait and neurological outcome without increased morbidity or mortality.

Application of the Six Sigma principle for quality assessment in deep brain stimulation surgery

(Abstract ID: 332)

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Background:

The six sigma principle is a widespread management concept to identify weaknesses in complex processes and to achieve a workable zero-defect quality. The basis of the six sigma concept is a standardized process and patient-oriented approach by using the DMAIC-cycle (Define, Measure, Analyze, Improve and Control) to optimize processes and to eliminate errors or quality problems. Especially, the deep brain stimulation (DBS) with its essential precision and as a complex medical process seems to be suitable for such a quality analysis. For the first time, we adapted the six sigma concept for clinical quality measurement in DBS of the subthalamic nucleus in patients with Parkinson's disease.

Materials and methods:

First, we defined the main quality factors that have significant impact on patients outcome and set their acceptable boundaries according to current literature and clinical experience. These factors were a reduction in UPDRS III (>15%), reduction in levodopa equivalence doses (LED) (>35%), improvement of the UPDRS IV (more than 50%), the stimulation amplitude (<4.2V), lead deviation (<2mm), the operation time (<300min) and the occurrence of bleedings (none). Then, these quality indicators were measured in 10 surgeries. Out of this, the sigma values were calculated. Further, an average therapeutic sigma value (consisting of sigma values of UPDRS III, UPDRS IV, LED and stimulation amplitude) was calculated to rate the therapeutic success of the surgery since these values may influence each other. Then, the surgical process was optimized (3 tesla MRI instead of 1.5 tesla; non-varying team of two neurosurgeons, usage of microelectrode recordings, lead fixation on the cranium with StimLoc® lead anchoring device from Medtronic) and the measurement with the analysis was repeated. Thus, possible improvements due to the modified surgical process could be identified.

Results:

Originally, the sigma values for the reduction of the UPDRS III (median: 29%) and the LED (median: 28%) 1 year postoperatively were calculated with a sigma value of 3.09 and 1.32. The therapeutic yield could be calculated with 94.4% and 42.9%. The improvement in UPDRS IV was 62% with a sigma value of 2.08 and a therapeutic yield of 71.9%. Further, the stimulation amplitude (median: 3.05 V) 1 year postoperatively revealed a sigma value of 2.34 and a yield of 79.9%. Consequently, the average therapeutic sigma value was calculated with 4.81 and a therapeutic yield of 99.95%. The occurrence of bleedings revealed a sigma value of 6. Since only ten surgeries were included, the sigma value of the bleedings is artificial. Further, the sigma values of the operation time (median: 255 min) and the lead deviation (median: 1.44 mm) were 4.43 and 1.72. After optimizing the surgical process, the sigma values of the UPDRS III improvement (median: 45%) and LED (median: 57%) reduction could be increased up to 3.39 (therapeutic yield: 97.1%) and 2.48 (therapeutic yield: 83.7%). The sigma values of UPDRS IV improvement (median: 73%) and the stimulation amplitude (median: 2.5V) were calculated with 2.96 (therapeutic yield: 92.8%) and 4.01 (therapeutic yield: 99.4%). The average therapeutic sigma value increased to 5.81. The sigma value of the operation time (median: 220 min) and the lead deviation (median: 0.9mm) improved also to 4.1 (therapeutic yield: 99.5%) and 5.13 (therapeutic yield: 99.99%) after the application of the improvements.

Conclusion:

In summary, the six sigma concept is an easy-to-apply method to monitor directly the impact of perioperative changes for the patients' outcome. Further possible applications of this concept in neurosurgical procedures have to be proven.

Easy minimally invasive retractor system for the extreme lateral, transthoracal approach – Technical Note

(Abstract ID: 347)

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Background:

Anterior approaches to the thoracic spine enable corpectomy for different pathologies and vertebral replacement. However, this approach has previously required a thoracotomy incision, which is associated with significant perioperative morbidity, pain, and the potential for compromised ventilation and subsequent respiratory sequelae. The extreme lateral approach to the anterior spine has been used to treat degenerative disorders of the lower thoracic and lumbar spine, and reduces the potential complications compared with the anterior transpleural approach. We describe the first use of a new fixed, easily used retractor system for transthoracal corpectomy via a minimally invasive extreme lateral approach.

Materials and methods:

We used this new retractor system for different indications, such as pathological fractures because of osteoporosis or vertebral metastasis and spondylitis/spondylodiscitis with consecutive vertebral instability. The procedure was combined with dorsal stabilization, partly combined with cement screw augmentation.

Results:

12 patients were treated by extreme lateral transthoracal corpectomy and vertebral replacement. This new way of retractor system was easily and X-ray guided fixed into the adjacent vertebral levels via a small thoracotomy incision (4-7cm) depending on corpectomy levels. It could be used from spinal vertebra TH4 to L1 from both sides without significant compromised ventilation, severe thoracic pain and with decreased morbidity.

Conclusion:

This new fixed retractor system for transthoracal, extreme lateral approach to the spine is feasible and safe for degenerative discectomy or corpectomy combined with vertebral replacement by any cages. Further, even young residents less experienced in transthoracal approaches are able to perform this surgery without long lasting learn curves.

Picture:



Sperrer-System

Surgical impact and benefit of spondylodesis in elderly patients

(Abstract ID: 363)

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Background:

The elderly population is poorly studied and constitutes a rapidly expanding surgical demographic. Although neurological deficits could be present, senior citizens are often surgically undertreated because of age and comorbidities. Hence the question arises, if elderly patients do really profit from aggressive surgical treatment.

Materials and methods:

We performed a retrospective, single center, data base analysis. Data were extracted out of clinical data base. Search term was "spondylodesis". Only patients older than 68 years were included. Clinical outcome was extracted out of Patients' file and the Oswestry Disability Index was calculated retrospectively. Surgical technical outcome represented screw placement, spine alignment and cage placement.

Results:

Data of 109 patients treated between 2011 and 2015 were analyzed. In the group, 61 patients were between 68-75 years old and 41 Patients were between 75 and 87 years old at time of surgery. Gender was distributed equally. 83% of the patients had a cardiac history recorded. Indication of surgery was spondylodiscitis in 12, spondylosisthesis in 40 and fracture in 24 patients. In 53 patients 1 to 3 segments, in 24 patients 4 segments and in 24 cases 5 segments and more were operated. Preoperatively, the patients suffered from pain in 90.8%, sensory deficit in 35.8% and motor deficit in 33.9%, as well as symptoms of spinal claudication in 52.3% of cases. Surgical adverse events were in 9.2% wound infections, in 19.3% screw dislocations, deep vein thrombosis in 0.9% and pulmonary artery embolism in 8.3% of the patients. Clinical neurological outcome was good in 27.5%, worse in 6.4% , improved in 22.9% and the same as without surgery in 15.6% of all patients. The patients with preoperative Oswestry Disability Index between 80 to 100% could be reduced by surgery completely. Surgical technical outcome was without displacement or needed revision surgery in 82.6% of patients

Conclusion:

The Oswestry Disability Index was reduced due to surgery in 30 patients. There were no severe adverse events. 55 Patients (50.4%) showed an improvement in clinical outcome. Surgical technical outcome was good in the majority of patients. Spondylodesis in elderly patients is feasible and most of the patients seem to benefit from spinal surgery

Painless Motor Radiculopathy of the Cervical Spine – Clinical and Radiological Characteristics with Long-term Outcome after Operative Decompression

(Abstract ID: 400)

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Background:

Cervical radiculopathy due to foraminal stenosis is commonly leading to radiating pain, sensory and/or motor deficits. However, radiculopathy with predominant motor deficit and mostly accompanied muscular atrophy without pain can be a rare clinical manifestation of cervical nerve root compression, often under- or misdiagnosed, e.g. as motoneuron-disease. Aim of the study was a comprehensive characterization of affected patients including an evaluation of long-term outcome and quality of life after surgical decompression.

Materials and methods:

The medical records of 788 patients undergoing decompression due to degenerative radiculopathy/myelopathy of the cervical spine between 2005 and 2015 in our centre were analyzed. Among those, 31 patients (3.9%, m/f=4.2/1) with altogether 67 symptomatic foraminal stenoses presented with painless compressive cervical motor radiculopathy. Of these 31 patients, long-term evaluation was available in 23 patients with 49 symptomatic stenoses. Clinical characteristics, imaging findings, and operative records were retrospectively analyzed. Outcome parameters included short- and long-term status concerning MRC grade of paresis and a questionnaire evaluation of neurological outcome and general performance.

Results:

Preoperative symptoms (mean duration 13.3±10.2 mos) included - besides a defining painless paresis (median MRC grade 3/5) in all patients - a clinically visible muscular atrophy (78.3%) and concomitant sensory changes (39.1%). Mean age at first operation was 59.9±10.6 yrs, mean follow-up was 4.8±5.3 yrs. 82.6% of the patients had a positive smoking history and 17.4% had diabetes. Preoperative imaging revealed a predominant nerve root compression from anterior at the neuroforaminal entrance, mostly due to uncarthrosis, in 98.0% of the symptomatic stenoses. Most stenoses were located at level C4-5 (32.7%) and C5-6 (30.6%). At index surgery, 30 stenoses in 11 patients were decompressed via Anterior Cervical Discectomy and Fusion (ACDF) and 19 stenoses in 12 patients via Posterior Cervical Foraminotomy (PCF). Mean number of decompressed levels was 1.8±0.6. 2/11 patients with ACDF and 3/12 with PCF needed 2nd surgery for 5 new (adjacent/distant level) and 3 recurrent (index level) stenoses during follow-up. Overall mean time between index and second surgery was 5.9±8.2 yrs. Long-term follow-up evaluation revealed a stable or improved status according to MRC paresis grade in 87.0% of the patients and according to Odom's Criteria in 91.3%, independent from the surgical procedure chosen. The severity of paresis was significantly improved compared to the preoperative status (p=0.046) with a median MRC grade of 4/5 at the end of follow-up. Long-term general performance was excellent with 86.9% having a WHO/ECOG Performance Status score ≤1, 100% a Karnofsky Index ≥=80, and 87.0% a Barthel Index of 100%. The median Patient Satisfaction Index of 1 indicated an altogether high subjective contentment regarding surgical treatment.

Conclusion:

Painless cervical radiculopathy with paresis/atrophy occurs predominantly in male patients with focal compression of the anterior nerve root and disturbance of microperfusion (diabetes, smoking). Differentiation from neurological disorders (e.g. motoneuron-disease) and indication for surgical decompression can provide improvement of motor function and a favourable long-term outcome.

The influence of oral anticoagulant therapy on clinical outcome and management in very elderly spine patients (>80 years) after lumbar decompression-surgery

(Abstract ID: 530)

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Background:

Increasing incidence of aged 80 or older patients with degenerative spine disease, rising comorbidities and oral anticoagulants (OAK) are the result of an increasing demographic aging of general population. We therefore evaluate the risk and management of OAK-therapy in aged 80 or older patients after lumbar decompression surgery in regard to clinical outcome and complications.

Materials and methods:

All patients of our institution aged 80 or older in the period from 1/2013 to 12/2015 with lumbar decompression surgery by hemi-laminectomy were reviewed retrospectively by chart analysis. Demographic data as well as sort of OAK, results of coagulation tests, co-morbidities, neurostatus, intra-/postoperative complications, surgery-time and -procedure, postoperative care unit (PACU)- and hospital-stay overall and the outcome of patients were assessed. Two groups - patients with OAK (group 1) and patients without OAK (group 2) - were formed.

Results:

In total 58 patients (m: 24, f: 34) with mean age of 82.6 (range 80-87 years) could identified.

In group 1 (m: 13, f: 18; mean age 82.5 years) 87% of patients received single- (platelet inhibition or vitamin K antagonist) and 13% dual-OAK therapy (platelet inhibition plus vitamin K antagonist) paused 7 days (min. 5, max. 10) before hospital admission. In 5 (16%) coagulation tests (Quick/INR value, PFA100, Born-test) abnormalities were found. Mean number of co-morbidities was 4 (min. 1, max. 11). Decompression surgery was performed in 42% of level-1-, 52% level-2- and 6% level-3-stenoses. Complications intraoperatively were a dural leak (n=5). Postoperatively re-surgery was performed in case of persistent dural leak (n=1), hematoma (n=1) and exacerbated wound infection with patient's death (n=1). 13 patients were observed for 1 day at PACU. After mean hospital stay of 10 days 90% (28) patients could in good outcome discharged at home.

In group 2 (m: 11, f: 16; mean age 82.7 years) mean number of co-morbidities was 3 (min. 0, max. 6). In 52% 1 level-, 41% 2 level- and 7% 3 level-decompression surgeries were performed. 2 cases of dural leak appeared intraoperatively and 1 case of postoperative ISG-syndrome occurred. The mean hospital stay was 8.9 days. 26 patients reported about improvement after surgery and 85% (23) could directly discharged at home.

Conclusion:

The vast majority of patients aged 80 or older with and without OAK and high number of comorbidities can profit from lumbar decompression surgery. However for the adequate hospital treatment a clear surgical indication together with consideration of OAK therapy and co-morbidities remains important to avoid unnecessary complications and longer hospital stays.

Early complications, morbidity and mortality in Octo- and Nonagenarians undergoing posterior intraoperative spinal navigation based C1/2 fusion for acute traumatic odontoid type II fractures

(Abstract ID: 588)

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Background:

Odontoid type II fractures are the most common cervical spine injury in the elderly. Recent studies confirm that external stabilization is associated with high mortality and complication rates. The decision for surgical treatment is still controversial, particularly with regard to elevated perioperative risk owed to frequent comorbidities and poor bone quality. Modern navigation may help to improve perioperative safety and efficacy and thereby reduce complication rate. The aim of this study was to assess short-term mortality as well as mid-term clinical and radiological outcome in elderly.

Materials and methods:

35 patients with an acute traumatic odontoid type II fracture who underwent posterior atlanto-axial instrumentation with a modified Goel-Harms technique at our institution between January 2007 and December 2015 were retrospectively analysed and prospectively examined clinically and radiologically. Comorbidities were stratified using the age-adjusted Charlson Comorbidity Index (AACCI). Mortality, length of ICU and hospital stay were determined. The neurological and radiological outcome, blood loss, the necessity of blood transfusion as well as medical and surgical complications were evaluated. Quality of life was measured using the EQ-5D and SF-36 questionnaires at final follow-up (FU).

Results:

Average age was 86.5 y (range 80 - 96 y). Mean AACCI was 7.1 which is classified as severe. In-hospital mortality was non-existent and no patient showed new permanent neurological deficits after surgery. Average length of hospital stay was 13.8 d and 2 d for ICU. Blood transfusion was necessary in one patient. Three patients developed cardio-pulmonary complications postoperatively (two pneumonia, one heart attack). One wound infection occurred. 25 patients were available for final FU with a mean FU of 22 months (range 6 - 72 months). The quality of life measured by EQ-5D showed a good outcome (0.7 0.1). All SF-36 domains were reduced in comparison with the German population. Solid bony fusion could be achieved in all patients.

Conclusion:

Our current study confirms that modification of the C1/C2 posterior fusion technique by using intraoperative CT-navigation is a safe and effective procedure in the elderly with few complications and preservation of favorable postoperative quality of life. Implant-related complications such as screw loosening or migration could be avoided under navigation guidance. The overall complication rate was 11%. Surgery in the very old should be considered as first choice treatment.

Analysis of outcome and complications in early vs. late cranioplasty procedure after decompressive hemicraniectomy in patients suffering from traumatic brain injury

(Abstract ID: 646)

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Background:

Cranioplasty (CP) as well established skull integrity restoring procedure is often performed after decompressive hemicraniectomy (DHC) in patients suffering from refractory ICP elevation caused by traumatic brain injury (TBI). However timing of CP and associated postoperative complications (e.g. infections or hydrocephalus) are still controversial discussed as well as the kind of usage of cranioplastic material.

Materials and methods:

A retrospective chart analysis was performed of all patients at our institution admitted with TBI that underwent DHC and subsequent CP in the period from 01/2009 to 12/2015. Demographic data, initial clinical diagnosis, timing of CP (early \leq 3 months vs. late \geq 3 months), type of cranioplastic material, CP related complications and the outcome of patients were analyzed.

Results:

In total 41 patients after DHC caused by TBI (32 male, 9 female, mean age 50 ± 17 years) could be identified.

26 patients (m: 20, f: 6; mean age 53 years) received an early CP procedure (mean 47 ± 26 days). In all early cases autologous material (patient's bone flap) was used. The mean defect size was 103 ± 23 cm² and mean time of CP procedure was 91 ± 43 minutes. Simultaneous shunt implantations were performed in 4 cases. In 5 cases a postoperative hematoma/hygroma with revision surgery and 2 cases of bone osteolysis occurred. In one case treatment for acute posttraumatic epilepsy was necessary. After mean hospital stay of 20 ± 14 days the patients were discharged.

In 15 patients (m: 12, f: 3; mean age 46 years) late CP procedures (mean 343 ± 478 days) were performed. In 5 of 15 late CP procedures synthetic materials were used (33%). The mean defect size was 92 ± 33 cm² and mean time of CP procedure was 96 ± 42 minutes. During late CP procedure in 1 case a lumbar drainage application and simultaneous shunt implantation were performed. Postoperatively 3 wound healing disorders (2 infections, 1 wound fistula) and 1 hematoma occurred. The mean hospital stay for late CP procedure was 10 ± 7 days.

Conclusion:

Early and late CP procedures can be safely performed in nearly same surgery time after DHC in patients suffering from TBI. In the early CP group there was a trend towards more complications (hematoma/hygroma and bone osteolysis with revision surgery) compared to late CP patients. A second hospital stay has to be considered in cases of late CP.

Vector-LIF: minimal invasive, preoperatively simulated, intraoperative navigation guided lumbar decompression and spinal stabilization via a single port approach - Prototyping of a template for realignment

(Abstract ID: 939)

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Background:

In order to develop a single port procedure for lumbar stabilization, a technical requirement arises to create an another kind of internal fixation. Vector-LIF, first described in 2011 (DE102011119646A1), is a construct consisting of dorsoventral pedical screws ipsilaterally, a translaminar screw below and a horizontal converging upper laminar screw contralaterally. The load-bearing directions (vectors) of MIS Vector-LIF are completely different compared to common coaxial pedicle screw implantation. The dorsal converging construct is combining the heads of dorsoventral pedicle screws with laminar pedicle screws following cortical bone structures within a small approach.

Materials and methods:

After informed consent, six patients were operated using the Vector-LIF because of different pathologies. Preoperative simulation software was used to determine the optimal height of the device regarding the sagittal balance. Vector-LIF uses conventional microscopical decompression through the standard dorsal midline approach from one side with undercutting. Reaching the contralateral recess, the contralateral facet joint has to be opened using a high speed drill to achieve a good release. Vector-LIF preserves the anatomical structures of the facet joints for segment`s conduct stability and fast ossification of the facet joints. Vector-LIF uses dorsally converging dorsoventral pedical screws ipsilaterally. Contralaterally it consists of a translaminar vector for the screw below and a horizontal dorsally-converging vector for the upper screw intending to reach the lamina pedicle complex.

Results:

Numeric rating scale data were collected preoperatively as well as 6 months after surgery. A CT scan was obtained on the first postoperative day to evaluate instrumentation. A second CT scan was performed 6 months after surgery to exclude instrumentation failure and to survey fusion. For determining the optimal height of the cage, a biokinematic analysis of the lumbar spine was done based on a preoperative x-rays. In all cases the software suggested height of the cage was used. Postoperative CT-scans showed a correct placement of the implants. Pre- and postoperative clinical status was documented using the International Spine Registry - Spine Tango. Mean surgery time was 129 minutes, average blood loss 200ml. All six patients showed considerable postoperative improvement in clinical scores (VAS, ODI, SF-36). After documented bony fusion in the CT scan, the fixation system was removed in three cases in a small surgical procedure.

Conclusion:

The challenge was to connect the four screws with one rod. Another disadvantage of this procedure is the fact that the cage has to be implanted first and then the reposition is done with the help of the rod, because after implanted rod it is not possible to get access to the disc-space. So it is not a useful procedure in high grade listhesis. In order to develop this promising procedure, we are prototyping a template for the punctual connection and for reposition first. MIS-VLIF is feasible with an emphasis on minimizing tissue trauma.