Percutaneous Posterolateral Transforminal Endoscopic Discectomy: Clinical Outcome, Complications and Learning Curve Evaluation

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BACKGROUND:
Surgery for herniated lumbar disc is intended to provide relief of sciatic pain and disability. The advantages of minimally invasive techniques include smaller incisions, less pain, early ambulation and shorter hospitalization. The ongoing technological development combined with a better understanding of endoscopic anatomy has made posterolateral endoscopic discectomy an appealing surgical option for the management of herniated lumbar disc. Our goal was to retrospectively evaluate clinical outcome, complications rate and learning curve with the percutaneous posterolateral transforminal endoscopic discectomy technique.

METHODS:
Percutaneous posterolateral transforminal endoscopic discectomy was preformed from 2004 to 2008 in 150 patients. 124 patients were available for follow up. Demographic data, pain evaluation by visual analog scale and Oswestry Disability Index were recorded for each patient. Data regarding postoperative complications, neurological status, operation time and subjective patient satisfaction was obtained as well.

RESULTS:
A satisfactory clinical outcome as reflected in the VAS (mean 3.6) and ODI (mean 21%) scores is reported. 26 patients required additional surgery because of continuing symptoms. In The assessment of surgical learning curve, we found a statistically significant difference (p value 0.043) for fewer revision surgeries as the surgeons became more experienced. Thirty patients (24%) had at least one previous back surgery prior to the index endoscopic discectomy. Patients that had endoscopic discectomy as a primary surgery achieved significantly lower VAS (p value 0.04) and ODI (p value 0.004) scores in comparison to patients having transforminal endoscopic discectomy as a revision surgery. The combined Complication rate in this patient series was 1.6% including one case of post surgery hypoesthesia, and one case of deep wound infection, requiring surgical debridement.

CONCLUSIONS:
Based on our results and experience, the percutaneous posterolateral transforminal endoscopic discectomy technique has a satisfactory clinical outcome with a low total complication rate. We acknowledge the steep learning curve of this technique, which can be overcome with training and suitable patient selection.
Intertester Reliability of Spinal Range of Movement Using the SpineScan™ Measuring Device

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Background: Intertester reliability is important for longitudinal assessment of patients by different clinicians. Numerous spinal range of motion measuring devices have been previously tested for this purpose, including the cervical range of motion device (CROM™), a flexible ruler, the FASTRAK™, the potentiometer-based electrogoniometer, the OSI CA-6000 Spinal Motion Analyzer™ and the electronic digital goniometer EDI-320™. Although most of the above mentioned devices have proved to exhibit fair to good intratester and intertester reliability, a recent meta-analysis dealing specifically with the subject, concluded that further research is needed to establish a gold standard for normative values as well as to identify an instrument that is reliable for all motions.

Aim: The purpose of this study was to investigate the intertester reliability of a new, simple-to-use, hand-held spinal measuring device (SpineScan™).

Method: Three experienced manual therapists tested each other on two separate occasions using the SpineScan™. Active cervical, thoracic and lumbar flexion, extension, lateral flexion, and rotation movements were measured. Reliability was evaluated by the intraclass correlation coefficient [ICC].

Results: Intertester reliability was good. Coefficients ranged from .80 to .91 for session one and .74 to .89 for session two. Paired data t-tests showed that there were no significant differences between testers or sessions (p = .01). Moderate to high intraclass correlation coefficients (ICC = +.76 to +.98) were found between testers.

Conclusions: The results suggest that the SpineScan™ has acceptable intertester reliability and proved to be a simple-to-use instrument for measuring active spinal motion about the 3 Cartesian axes. Individuals can repeat the same patterns of motion in sequential trials on the same day with very little variation. This is an ongoing study with the aim of adding more testers and testing intratester reliability on normal subjects.
Spinal Cord Protection from Aortic Occlusion-Related Ischemia by Minocycline

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Introduction: Ischemic injury to the spinal cord and paraplegia are known complications in descending thoracic aorta surgery. Effective therapeutic methods to prevent such injury are still under investigation. As subsequent effects of spinal cord ischemia are similar to those observed following traumatic spinal injury, we examined the role of minocycline, a second-generation tetracycline, known to ameliorate secondary events of the injured brain, such as apoptosis and inflammation. We investigated the protective role of minocycline in attenuating the histopathological changes in the spinal cord following a period of aortic occlusion-related ischemia in the rabbit.

Methods: With adherence to the Laboratory Animals Guide of Care, aortic occlusion was achieved in anesthetized NZ albino rabbits by using a 3F Fogerty catheter, introduced through femoral incision to the L2 level (one cm below left renal artery origin – fluoroscopic confirmation). Aortic flow occlusion was verified by disappearance of pulse oxymetry tracing and arterial pressure readings in the contralateral femoral artery. Increasing I.V. doses of minocycline (1, 2, 5, and 10mg/kg; n=10-12 animals in each study group) were given thirty minutes prior to aortic occlusion of 25 min. The modified motor Tarlov scoring (0=complete paraplegia to 3=normal movements, at days 0 to 2) was correlated to the histological injury in the different regions (L4 to L6) of the cord. A pathological grading (0- normal to 4- marked disruption) of the H&E stained specimens was determined according to rarefaction or vacuolar-like disruption of the neuropil of the gray matter ventral horns and the number of intact neuronal population. Statistical analysis was performed using Spearman Correlation, Kruskel-Wallis and Mann-Whitney tests.

Results: Spinal cord ischemia for 25 minutes resulted in high-grade paraplegia in the control group. Minocycline administration produced a dose-dependent, significant improvement in the post-ischemic neurological deficit (10mg/kg; p<0.001). The severity of histopathological damage paralleled the neurological deficit scores. A clear reduction in focal micro vacuolization of neurons and in rarefaction intensity or vacuolar-like disruption of the neuropil was observed with minocycline (p<0.003).

Discussion: Minocycline demonstrated dose-dependent neuroprotection against temporary ischemia to the spinal cord, with significant sparing of motor neurons. With the high safety profile of the drug, the functional recovery achieved with minocycline has the potential for
A Morphological Adaptation of the Thoracic and Lumbar Vertebrae to Lumbar Hyperlordosis in Young and Adult Females

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The lumbar shape in females is thought to be unique and compensating for lumbar hyperlordosis. Yet, the morphological adaptation of various vertebral parameters in the thoracic and lumbar spine to this unique posture in young and adult females is partially addressed in the literature. The current study aims to investigate the gender association with vertebral shape in the thoracic and lumbar spine as a possible adaptation to lumbar hyperlordosis in young and adult females. A 3-dimensional digitizer was used to measure the vertebral body sagittal wedging, relative spinous process thickness, and interfacet width at the T1-L5 level. Two hundreds and forty complete, non-pathological skeletons of adults (males and females, White Caucasians and African Americans, age range from 20 to 80 years), and 32 skeletons of young individuals (10 boys and 22 girls with an average age of 11.5 (+/-4.2) years) housed at the Hamman-Todd Human Osteological Collection (Cleveland Museum of Natural History, Cleveland, OH) were assessed. Statistical analysis included Pearson's \( r \) and ANOVA following the Kolmogorov-Smirnov test for normal distribution. The results have indicated that in children, all calculated parameters are not affected by gender. In the adult human skeletons three major results are indicated independent of age and ethnicity: a-VB sagittal wedging in females is significantly less kyphotic than males from T9 to L2 (T11 excluded) with a cumulative mean difference of 8.8\(^{0}\), b- females have significantly relatively thinner lumbar (L1-L5) spinous processes and c- relatively wider superior interfacet distance (T9-T10 and L1-L4) than males. To conclude, the combination of less kyphotic VB wedging in the lower thoracic and upper lumbar vertebrae, relatively greater interspinous space and larger interfacet width in the lumbar spine in females are key architectural elements in the lumbar hyperlordosis in females and may compensate for the bipedal obstetric load during pregnancy.
Miniature Robotic Spine Surgery – The First 100 Patients

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Introduction: Instrumentation has become an integral part in traumatic, infected, neoplastic and degenerative spinal conditions. Misplacement of implants may result in immediate catastrophic events, or may lead to inferior mechanical properties of the construct and may lead to late sequel such as adjacent level degeneration. Factors affecting misplacement include: surgeon's experience and anatomical factors. Fluoroscopy guided implantation may result in up-to 50% misplacement in the thoracic and 70% in the cervical spine. Robotic assisted spine surgery is aimed at increasing the accuracy of implantation, therefore to reduce immediate complications related to misplacement and late complications related to inferior mechanical properties. After performing 100 robotic assisted cases, and audit was done to identify the system's added value to the spine surgeon.

Patients and methods: Robotic guidance was used in 100 patients undergoing spinal surgery. Average patient age was 60, 54% females, 36% males. The cohort included patients with degenerative disorders (85%), vertebral compression fractures (14%) and other conditions (1%). Pedicle screws were the most frequent implant, followed by vertebral augmentation needles. Data included surgical time, robotic usage time, planned versus executed trajectories, accuracy and analysis of failures.

Results: Robotic guidance required 15% in average of the total procedure (33/213 min). A total of 348 trajectories were planned (1-8per case), 87.5% were executed. Mean implantation took 8.7 minutes (3.5-64). In 3 cases technical failures prevented robotic guidance. In 2 cases registration could not be achieved and in 2 cases the platform was not secure in a stable position, leading to deviation from plan. Omitting technical failures, the system's accuracy exceeded 96%. Seventeen complications occurred in 15 patients, with 5 deep wound infections, 2 superficial wound infections and 5 dural nicks.

Discussion: Robotic guidance can be expected to result in excellent results if cases are meticulously pre-planned, the robotic platform is firmly connected to the patient, good quality fluoroscopy images are acquired and gentle surgical technique is applied. Obstacles to perfect results are rare occasions of skiving and surgeon's failure in understanding the 3-D anatomy from the 2-D CT leading to planning errors. The clear advantages of the system are: The need to meticulously pre-plan, resulting in immediate upgrade of the surgical procedure. Less radiation exposure to the OR staff. And the ability to perform MISS safely. Future studies should concentrate on issues such as cost effectiveness, reduction of complications (neurological? Infections? Other?) and the relation between implant position and adjacent level degeneration. New robotic application may expand the indications for its use.
Lumbar Facet and Interfacet Shape Variation during Growth in Children from the General Population: A Three Years Follow-up MRI Study

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Study Design. A descriptive MRI study on the growth of the lumbar zygoapophyseal facets and interfacet area in children from the general population.

Objective. To characterize lumbar facet and interfacet shape variation during growth.

Summary of Background Data. The growth of the lumbar facet and interfacet area in children from the general population has rarely been discussed in the literature. This is an important caveat considering the important role these structures play in the development of spinal anomalies.

Materials and Methods. All lumbar (L1-S1) facet and interfacet widths and transverse orientations were measured twice by the same investigator (YM) from T2-weighted MRIs of 100 healthy children (51 boys and 49 girls) from the general population at the mean age of 12-13 years (t₀) and following three years at the mean age of 15-16 years (t₁) using the iQVIEW system. Statistical analysis included t-tests and Pearson's r following the Kolmogorov-Smirnov test for normal distribution.

Results. The superior facet width is correlated with individual's height only in boys at t₀ (0.56 ≤ r ≤ 0.66). No significant asymmetry in lumbar facet width and orientation is seen in children independent of gender both at t₀ and t₁. Lumbar facets have widened significantly only in boys from t₀ to t₁ (up to 30.8%). Girls at t₁, manifest greater superior interfacet width relatively to the superior vertebral body width than boys at L2-L4. No significant difference is indicated in facet orientation of the two sexes at t₀ and t₁. In boys only, the superior facet rotates significantly from t₀ to t₁ (up to -10° in the interfacet angle) towards a more sagittal orientation.

Conclusions: The lumbar facet joints in boys continue to develop after the age of 12, whereas facets in girls seem to have reached maturity at that age. Moreover, lumbar facet asymmetry when noted in children can be considered as a deviation from the normal state. Further research should look into what the consequences might be.