SPINE „À LA CARTE“
Croatian Orthopaedic Society
Slovenian Orthopaedic Society
Zagreb, 17th October 2015
KRAŠ Auditorium ZAGREB

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INVITED LECTURER
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ABSTRACTS
Anatomically based examination of the spine

Vide Bilić
Zagreb, Croatia

ABSTRACT

The vertebral column, or spine, is the central supporting structure of the trunk and back. Concave curves of the cervical and lumbar spine and convex curves of the thoracic and sacroccygeal spine help to distribute upper body weight and cushion the concussive impact of walking or running. Physical examination always begins by observing the patient’s posture and evaluation of the spinal curvatures. Palpation of the bony and soft tissues of the neck and lumbar spine is divided into two clinical zones: the anterior and the posterior aspect. Palpation of the bony and soft tissues of the thoracic and sacral spine is possible only from posterior. Tenderness over spinous processes suggests fracture or dislocation, underlying infection or arthritis. Tenderness and spasm of the paravertebral muscles occur in degenerative and inflammatory processes, prolonged contraction from abnormal posture or anxiety. The neck is the most mobile portion of the spine. Flexion and extension occurs primarily between the skull and C1 (the atlas), rotation at C1-C2 (the axis), and lateral bending at C2-C7. Thoracic spine is relatively rigid. Since there is no restraining ribs in the lumbar spine, more flexion and extension can take place than in the thoracic spine. In comparison to the joints of the extremities, there is relatively little motion in the individual facet joints of the lumbar spine. Major motion primarily involves motion in the hip. The neurologic examination of the cervical spine has been devided into two phases: muscle testing of the intrinsic muscles of the cervical spine and neurologic examination of the entire upper extremity by neurologic level. The neurologic examination of the lumbar spine includes an examination of the entire lower extremity (motor, sensory and reflex testing). ASIA classification system is widely accepted as standard for classification of spinal cord injury.

LITERATURE

3. www.asia-spinalinjury.org
Radiological evaluation of spine

Matej Mustapić
Zagreb, Croatia

ABSTRACT

Nowadays, there are different radiological modalities which are available for spinal pathology imaging. The orthopedic and trauma surgeons’ area of interest mostly comprises spinal deformities, degenerative changes and spinal injuries. Radiography is usually initial method for spinal imaging. It is able to reveal deformities and congenital bony abnormalities, and, with lower sensitivity, to depict traumatic changes. Computed tomography (CT) enables better visualization of spinal fractures and dislocations using multiplanar and 3D imaging compared with radiography. Magnetic resonance imaging (MRI) is the only radiological method for imaging bone marrow edema and with high contrast resolution it is a method of choice for depicting both bone and soft-tissue changes making it valuable in diagnostic imaging of traumatic lesions of vertebrae and paravertebral soft-tissue as well as pathology within spinal canal.

INTRODUCTION

The main orthopedic and trauma surgeons’ requests for spinal imaging are related to the spinal deformities, degenerative changes and injuries. The different imaging modalities are available but which one is the most appropriate for imaging specific pathological entity depends on the clinical diagnosis. Radiography and CT are radiological modalities based on ionasing radiation that limits their application. They primarily depict calcified bone matrix making them especially valuable for imaging of the spinal fractures and dislocations, showing the number and the position of bony fragments. MRI is the most sophisticated radiological modality without ionising radiation making it suitable for frequent imaging but there are some limitation regarding implanted electronic devices, ferromagnetic prosthesis, etc. The capability of visualization of the bone marrow edema makes MRI valuable in diagnostic imaging of stress reactions and fractures, overuse and soft-tissue injuries.

CURRENT CONCEPTS

Scoliosis is defined as a lateral deviation of the spine from the normally straight appearance in the coronal plane. The abnormality always includes deviations in the sagittal profile of the spine as well as the axial rotation which is important because it is the origin of concomitant deformities of the chest. Clinically, scoliosis can be either structural or functional depending on the possibility of correction by bending. The most cases (80%) of structural scoliosis are idiopathic and the rest of them have underlying cause such as congenital anomaly, developmental syndrome, neuromuscular disorder or tumour. So, the imaging plays important role in excluding/determining underlying aetiology and in monitoring the changes of the deformity during growth. Radiography is still not just the first examination required for the initial diagnosis and evaluation of the degree of curve, measured by the Cobb angle, but the mainstay of scoliosis management, and pre- and post-operative assessment. At the time of the initial presentation, plain films of the entire thoracic and lumbar spine should be taken. They have to be taken in the frontal and lateral plane with the patient standing erect, utilizing a long film cassette. The radiographs should include enough of the pelvis to show the iliac crests in their full lateral extent in order to visualize the developing apophysis. Underlying osteogenic anomalies can also be identified.
Pre-operatively, passive lateral “bending” radiographs in the frontal plane of the thoracic (including C7) and lumbar spine (including S1) together are also obtained with the patient bending maximally to the left and then to the right. This enables the surgeon to measure the degree of correction that can be achieved and also helps to determine the extent of the fusion. Post-operatively patients must be followed up at least until the bone has matured to ensure that the fixation is secure, to exclude the development of pseudoarthrosis, and to exclude recurrence of the deformity. MRI is more sensitive and specific in the assessment of intraspinal anomalies and has important role in the pre-operative planning of scoliosis. Failure to detect abnormalities of the neuraxis prior to treatment of scoliosis, particularly with instrumentation that lengthens the spine, can have serious neurological consequences with neurological deficits, paraplegia or quadriplegia. In all cases of “atypical scoliosis” - neurological deficit, headache, male gender, juvenile onset, left thoracic curve, unusually rapid curve progression and associated deformity of the lower extremity, MRI should be performed.

Degenerative spinal disease is one of the most common disorders, affecting adults at every age, which means it is an important medical and social problem. It involves the whole disco-vertebral unit (functional spinal unit), usually at multiple levels, as well as facet joints. Disco-vertebral unit consists of the intervertebral disc, adjacent parts of the vertebral bodies, facet joints, ligamenta flava and longitudinal ligaments at a given level. Degenerative changes of intervertebral disc with subsequent herniation is the most severe type of degenerative spinal disease. Radiographs of the spine are still useful as an initial study, enabling detection of major abnormalities, e.g. narrowing of the disc space, osteophytes, subchondral sclerotization, scoliosis, spondylolisthesis and other congenital spine anomalies.

MRI is the imaging method of choice, and should be used in all patients with long-term pain, radicular symptoms or neurological deficits. MRI allows a complex assessment of degenerative changes in all the structures of the disco-vertebral unit – both the bony and soft tissue structures. During the time MRI replaced CT in spinal imaging primarily due to better contrast resolution, capability to depict soft-tissue changes and bone marrow edema. CT still has an important role in imaging bony abnormalities, especially bony spinal canal stenosis and it is a supplementary method to MRI.

The imaging assessment of trauma patients has undergone dramatic changes over the past several years. Specifically, when spine injury is suspected, there has been a shift from radiography to CT, which provides faster and more accurate evaluation of the spine. Multidetector CT (MDCT) provides a faster and more comprehensive display of spinal anatomy than does radiography, and, more important, it has shown a much higher sensitivity than radiography for fracture detection. All patients with pain, a neurologic deficit, a distracting injury, altered mental status, obtundation or who fulfill a high probability of fracture according to mechanistic criteria should undergo CT imaging. Several studies involving patients suspected of having multisystem injuries showed more than twice as high sensitivity for CT compared with radiography, in this high-risk population. Injury patterns in elderly patients differ from those in younger patients because of a combination of altered biomechanics resulting from degenerative changes and osteopenia. In elderly patients, as compared with patients younger than 65 years, spinal fractures are more likely to be caused by low-energy mechanisms such as a fall from standing height, and these injuries are more often missed. The four major patterns of injury are flexion, extension, rotational, and shearing. Each major mechanism may frequently be associated with other forces, making the injury pattern more complex. Currently, the commonly accepted classification system for predicting stability of the spine is the one described by Denis in 1983 - namely, the three-column system. Denis divided the spine into three columns: the anterior column, the middle column, and the posterior column. In evaluating stability of the spine, four basic guidelines need to be assessed: the anterior vertebral alignment, the posterior vertebral alignment, the spinolaminar line, and the spinous process line. In addition, there should be normal spacing of the
facet joints, interspinous distances, and disk spaces. The facets should be parallel to each other, and the facet joint intervals should be relatively uniform. Disk spaces should also be symmetric, and there should not be widening or narrowing anteriorly or posteriorly. The interspinous or interlaminar distances should also demonstrate little variation. Vertebral body heights and their anteroposterior length, along with all osseous and soft tissues, should be assessed. Under certain clinical conditions, MRI can add vital information and influence clinical and surgical care. Specifically when there is clinical evidence of progressive neurologic deficits, MRI is indicated regardless of the CT findings. An incomplete neurologic deficit could also be an indication to perform MRI. Patients with severe pain may also require further MRI evaluation. MRI can, for example, help determine the presence of a traumatic disk herniation or an expanding extramedullary hematoma, both of which may escape detection on CT images. In a younger population, especially young athletes, overuse injuries of the spine are common. Stress reactions and stress fractures usually occur at pars interarticularis vertebrae. In the early stage, MRI is the best modality to show bone marrow edema of the involved vertebrae and edema of surrounding soft-tissue. Unrecognized condition can lead to spondylolysis and subsequent spondylolisthesis. In that stage, CT is a method of choice to depict bony abnormalities of the lamina and pars interarticularis, and the degree of spondylolisthesis. The stability of involved vertebral unit can be evaluated using functional radiographs.

CONCLUSION

The accurate diagnosis and appropriate spinal imaging algorithm depend primarily on the clinical diagnosis. In order to avoid unnecessary exposure to ionizing radiation it is very important to have enough clinical information and clear clinician’s request before imaging. All imaging modalities have their strengths and weaknesses, different sensitivity and specificity for different spinal pathology. So, the choice of the best imaging modality depends on the suspected pathology. Also, all imaging modalities are complementary and sometimes it is necessary to use two or three different methods in order to obtain full diagnosis.

LITERATURE

Chronic Low Back Pain / Lumbar Degenerative Cascade

Mislav Čimić

Zagreb, Croatia

ABSTRACT

Low back pain (LBP) is a worldwide phenomenon. According to some studies, up to 80% of the population will experience LBP at least once in their lifetime. Most individuals do not seek medical care, and are not disabled by their pain, once it is managed by nonoperative measures. However, around 10% of patients go on to develop chronic pain. Despite the high prevalence of this disorder, the etiology remains controversial. The main diagnostic challenge lies in identification of the pain generator. The main components of the vertebral column are the intervertebral discs, synovial facet joints, ligaments, and the bony elements. All of these elements can exhibit normal aging changes and different degenerative or regenerative alterations. Kirkaldy-Willis introduced the term “the three joint complex” to highlight the importance of a normal interaction of the three joints in a segment: the intervertebral disc and the two facet joints. Any alterations in one of these components will result in a disturbance of their interplay, finally leading to back pain, deformity and neurological compromise. The intervertebral disc has a central role in this context. Factors that might influence the progress of degenerative changes of the discs can be divided into three main groups: nutritional effects, genetic predisposition and mechanical load. Degenerative disc disease can be an important factor in the development of other abnormalities such as osteoarthritis of the facet joints or degeneration of the yellow ligament. The degeneration cascade is divided up into three stages. The first is dysfunction, the second is instability, and the third phase is stabilization. To understand the physiopathology of lumbar pain, it is necessary to know the innervation of the lumbar spine, and to distinguish the two types of pain pattern in the lumbar spine: irradiated pain and referred pain. Only a thorough knowledge of the etiology of lumbar degenerative process, will be able to provide quality treatment for our patients.

INTRODUCTION

Low back pain (LBP) is a worldwide phenomenon. In the USA, back pain is the most common cause of activity limitation in people younger than 45 years, the second most frequent reason for visits to the family doctor, and the third most common cause of surgical procedures. It is estimated that 75% to 80% of the adult population will experience LBP at least once in their lifetime. Most of these individuals do not seek medical care and are not disabled by their pain; instead, they recover spontaneously after a short period of time. However, around 10% of these patients go on to develop chronic persistent or recurrent pain. Definition of chronic low back pain is lumbar, sacral, or lumbosacral spinal pain that is continuous for 12 weeks or essentially continuous due to low-level pain punctuated by exacerbations of pain, each of which is characterized as acute.

A thorough history and physical examination are important to evaluate all possible factors contributing to the patient’s pain. The goal of medical evaluation is to efficiently identify the rare, serious causes (neoplasia, infection, inflammatory arthritis, and fracture) of LBP and to identify patients who may be at risk of delayed recovery associated with poor outcome. The “flag system” is a useful tool to distinguish between non specific LBP and LBP due to neural compression and serious spinal pathologies.
Red flags for back pain:

- Saddle anaesthesia or paraesthesia
- Sudden and unexpected bladder or bowel dysfunction/incontinence
- Unexpected laxity of the anal sphincter
- Severe or progressive lower limb neurological deficit
- Major trauma such as a road accident or fall from a height
- History of cancer
- Constitutional symptoms fever or chills
- Unexplained weight loss
- Immunocompromised patients
- Night pain that disturbs sleep
- Loss of tendon reflexes
- Up-going plantar reflex

In patients without radicular symptoms or any red flags (e.g., inflammatory arthritis, infection, fracture, cancer, and cauda equina syndrome), a focused physical examination is usually sufficient. In patients suspected of having a systemic or visceral cause of LBP, the physical examination must be expanded to include all organ systems.

The spine is a multi-segmented column, which provides stability and mobility to the body, and gives protection to the nerve roots and the spinal cord. The smallest anatomical unit of the spine which exhibits the basic functional characteristics of the entire spine is called the “motion segment” or “functional spine unit”. Each motion segment consists of two adjacent vertebrae, separated dorsally by facet joints and anteriorly by the intervertebral disc. The vertebrae are further connected by spinal ligaments, joint capsules and segmental muscles. The normal spinal function largely depends on the integrity of these components and their coordinated interplay. Kirkaldy-Willis introduced the term “the three joint complex” to highlight the importance of a normal interaction of the three joints in a segment: the intervertebral disc and the two facet joints. Any alterations in one of these components will result in a disturbance of their interplay, finally leading to back pain, deformity and neurological compromise. The degeneration cascade is divided up into three stages. The first is that of dysfunction, whereby the annulus fibrosus is fissured and can no longer contain the nucleus pulposus. This leads, first to the so-called disc disruption syndrome and, if the nucleus exceeds the contour of the annulus, to disc herniations. The second stage, is that of instability. At this stage, the mobility of the mobile segment increases pathologically. The third phase is that of stabilization and is characterized by stenosis, which may or may not be associated to instability. The intervertebral disc has a central role in this context, and disc disease can be an important factor in the development of other abnormalities such as osteoarthritis of the facet joints or degeneration of the yellow ligament.

Once other causes of back pain have been excluded and magnetic resonance imaging (MRI) scan confirms the presence of degenerated intervertebral discs, pain can be attributed to DDD. It has been shown that the intervertebral disc is capable of acting as a pain generator, and degenerative discs are believed to be involved in the pathogenesis of low back pain. Degeneration of the intervertebral discs is common among patients with disc-related pain, and it has been suggested that degeneration of the disc is a prerequisite for disc herniation. The L4–5 and L5–S1 levels are most frequently affected and usually show degenerative changes earlier than upper lumbar segments. This correlates with the higher incidence of pain in these distributions.

Although the etiology of disc degeneration is far from being understood, there is consensus that not a single factor can be held responsible for the complex phenomenon of disc degeneration. A multitude of exogenous and endogenous factors, each contributing individually, might influence the progress of degenerative changes of the discs. These factors can be divided into three main groups: nutritional effects, genetic predisposition and mechanical load. Insufficient nutritional supply of the disc cells is thought to be a major problem contributing to disc degeneration. Since the intervertebral disc is the largest avascular tissue in the human body, its cells have to maintain a huge extracellular matrix with a “fragile” supply of nutrients that is easily disturbed.
The supply of the nucleus pulposus cells is almost completely dependent on the capillary network in the vertebral bodies. The nutrients need to diffuse, from the capillaries, through the endplate and the disc matrix, to the cells in the nucleus of the disc. With the originally cartilaginous endplates becoming calcified when degeneration progresses, the supply of disc cells with nutrients will become even more restricted. This will consequently lead to: limited nutrient supply, and accumulation of waste products. The timeframe for these alterations (early or late) appears to be predetermined by genetic predisposition. Genetic predisposition has been confirmed by recent findings of associations between disc degeneration and polymorphisms in various classes of genes. Disc degeneration may be explained primarily by genetic influences and environmental factors have only modest effects. However, it is important to keep in mind that despite the dominating role of genetic predisposition, injuries can occur when normal forces are applied to abnormally weak tissues, or when abnormally high forces are applied to normal tissues.

Possibility of correction by bending. The most cases (80%) of structural scoliosis are idiopathic and the rest of them have underlying cause such as congenital anomaly, developmental syndrome, neuromuscular disorder or tumour. So, the imaging plays important role in excluding/determining underlying aetiology and in monitoring the changes of the deformity during growth. Radiography is still not just the first examination required for the initial diagnosis and evaluation of the degree of curve, measured by the Cobb angle, but the mainstay of scoliosis management, and pre- and post-operative assessment. At the time of the initial presentation, plain films of the entire thoracic and lumbar spine should be taken. They have to be taken in the frontal and lateral plane with the patient standing erect, utilizing a long film cassette. The radiographs should include enough of the pelvis to show the iliac crests in their full lateral extent in order to visualize the developing apophysis. Underlying osteogenic anomalies can also be identified.

CURRENT CONCEPTS
Traditionally, the stepwise approach to treatment of lumbar degenerative disease starts with local anaesthetic and steroid injection followed by spinal fusion. Fusion aims to alleviate pain by preventing movement between affected spinal segments; this commonly involves open surgery, which requires large soft tissue dissection and there is a possibility of blood loss and prolonged recovery time. Established minimally invasive spine surgery techniques (MISS) aim to reduce all of these complications. However, the main problem of fusion is the disruption of the biomechanics of the rest of the spine; leading to adjacent level disease. Theoretically, this can be avoided by performing motion-preserving surgeries such as total disc replacement, facet arthroplasty, and non fusion stabilisation. Over the decades since the degenerative cascade was first presented, we have come to appreciate that spinal degeneration is the end-result of interplay between subtle alterations in mechanical and biochemical properties of the intervertebral disc and facet joint complex.

FUTURE TREATMENTS
As we gain further insight into the degenerative cascade, the treatment of symptomatic spinal degeneration may eventually involve a combination of less-ablative reconstructive procedures and biological manipulations. With better understanding of degenerative pathophysiology we must move away from the general term “degenerative disc disease” (DDD) and move toward the determination of etiology-specific conditions and the development of etiology-specific preventative or therapeutic strategies. In the future our vision must be the optimization of treatment outcomes for specific conditions of the lumbar disc and the implementation of degeneration prevention strategies through genetic or tissue engineering or other biologic modality.

CONCLUSION
Only a thorough knowledge of the etiology of lumbar degenerative process, will be able to provide quality treatment for our patients.
Spinal stenosis: classification and treatment

Nikša Hero
Ankaran, Slovenia

ABSTRACT

Lumbar spinal stenosis is one of the most common illnesses of the spine which often needs surgical treatment. Causes of spinal stenosis are degenerative changes in small joints (arthrosis) and degenerative changes in intervertebral discs (protrusions, herniations), sometimes as a result of deformation of spine (kyphosis, scoliosis) or as a result of spinal trauma. There are various classifications of Lumbar spinal stenosis (LSS) assessed on MRI by measuring dural sac cross-sectional area (DSCA). A new method, morphological grading A–D, has recently been introduced as an alternative method. The comparison of different methods for assessing LSS on MRI will be presented as well the study of their reliability and intercorrelation. Different kinds of operative treatment are used in Valdoltra Hospital: central and foraminal decompression, decompression with spondylodesis. In the future most of the cases will be treated by minimally invasive surgery.

INTRODUCTION

Lumbar spinal stenosis is the most common cause for walking disabilities known as neurological claudication in mid age and older generations. Diagnosis is performed by MRI which is by far the most common used imaging modality for evaluation of the lumbar spinal canal. Dural sac cross-sectional surface area (DSCA) is the most frequently used radiological measurement method. Therapy is mostly surgical. There are different kinds of operative treatment: central and foraminal decompression, decompression with spondylodesis (different approaches and instrumentations).

CURRENT CONCEPTS

Nowadays most of operations are performed by foraminal/central decompression. In our hospital in majority of cases we combine decompression with spondylodesis. There is a trend to do decompression (with or without spondylodesis) by minimally invasive surgery. Some colleagues are already performing decompression endoscopically.

FUTURE TREATMENTS

Most of the cases will be treated by minimally invasive surgery.

CONCLUSION

With minimally invasive surgery performed by experienced surgeons we expect to have better results with shorter hospitalization and fewer complications. In the classification of LSS a new classification is expected which will take in consideration three dimensional aspects of LSS.

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ABSTRACT

Total Disc Replacement (TDR) was developed as an alternative to disappointing results with spinal fusions in Degenerative Disc Disease (DDD) treatment.

In clinical point of view it is well known that fusion offers approximately 50% of excellent results, 38% of slightly better results and 12% worsening due to instrumentation. In radiological view, 97% of solid fusions can be achieved. There is no correlation between different fusion techniques. Fusion without instrumentation gives equally good results. Adjacent Disc Degeneration presence was a matter of debate for long time.

Hypothesis in preserving motion and preventing hypothetic (ADD) resulted in great enthusiasm. It was supposed that TDR will gradually replace fusions, indications were not clear, up to 5 lumbar discs were implanted in one surgery. Insufficient learning curve in operative technique and implant construction led to disappointment concerning the end results and the number of complications.

On the contrary, TDR in cervical region did very well. It is now the treatment of choice in cervical DDD, long term studies support cervical TDR superiority comparing to cervical fusion.

In lumbar spine, situation is different. Significantly more demanding surgery, exposure to greater weight bearing forces, complications and difficult revisions, debates about adjacent disc disease reality, led to general pessimistic opinions. Despite the fact that some important studies (FDA report) and studies in sport medicine supported the TDR surgery, the method was almost abandoned, implants were disappearing from the market and enthusiasm was redirected to minimally invasive disc and facet joints denervation.

Currently, presence of the ADD is accepted in number of studies. It is accepted that incidence of ADD is present in 30% of cases after 5-7 year in fusion follow up. Recognizing the importance of sagittal balance of the spine in spinal fusions increase. Instead of complicated lordosis segmental calculation before fusions, ability of TDR to choose the optimal lordosis by self-positioning, make a significant advantage in biomechanics of DDD. New constructs, moving towards monoblock shock absorbers and using new materials offer better survival.

Surgical technique refinements are moving from strictly anterior approach, to less risky and easier anterolateral approach. Dacron sheets left between the implant and the great vessels make revisions much easier and safer. Presence of facet joint replacement implants on the market make the TDR more promising in future.

Main current indications are: young individuals without osteoporosis, discogenic pain with or without herniation, facet joints in relatively good condition, painless in motion, no congenital canal abnormalities.

In the moment, artificial disc implants are growing again in the market. The near future will show whether this revival will be long lasting, or some new techniques will take the leadership in DDD treatment.
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Minimally invasive treatment of chronic back pain is based on a specific diagnosis.

The term "non-specific low back pain" can be accepted only if we speak about acute low back pain, because low back pain is a self-limited disease. Up to 80% will improve in the first two weeks, and 90% by three months. The vast majority of acute back pain cases will not have a physical or diagnostic explanation.

In the case of chronic back pain, the introduction of the term "non-specific back pain" is in my view a disaster. It is not a diagnosis; it is just a statement that a diagnosis has not been made. In patients with chronic back pain, we need to find a pain generator. If we do that, we can effectively treat these patients with minimally invasive procedures and without surgery.

Different anatomical structures can be responsible for low back pain. In about 40% of patients, pain arise from intervertebral discs. Zygapophyseal joints are responsible for 15-40% of low back pain (≈15% in younger patients and ≈40% in patients over the age of 60). Sacroiliac joint can be a pain generator in about 15% of patients, but can be up to 40% in patients with lumbosacral fusion.

After a careful history and thorough clinical examination, imaging should be performed. A diagnosis of chronic back pain should never be made in the absence of a magnetic resonance imaging (MRI) scan. MRI scan is relatively cheap, non-invasive, and should be regarded as part of the clinical assessment in today’s world. There are no reliable clinical signs to suggest for discogenic, zygapophyseal joint or sacroiliac joint pain. Therefore, these anatomical structures must be confirmed as a pain generators by minimally invasive diagnostic procedures, mainly diagnostic blocks.

The zygapophyseal or facet joints are innervated by the medial branches of the lumbar dorsal rami. Complete or almost complete relief of pain after medial branch block with a local anesthetic, suggest patients with facet joints back pain, and those patients can be successfully treated with another minimally invasive procedure: radiofrequency neurotomy.

The only way to prove the sacroiliac joint as a source of low back pain is intra-articular injection of local anesthetic into the joint. If the diagnostic block is positive, which means 80% or more reduction in pain, such patients can be successfully treated with intra-articular steroid injections or radiofrequency neurotomy of the sacroiliac joint, depending on whether the changes in the joint are predominantly inflammatory or degenerative.

Lumbar disc stimulation or lumbar provocation discography is a diagnostic test to determine if a particular intervertebral disc is the source of a patients pain. Internal disc disruption is a very common and the most extensively studied cause of low back pain. Patients with discogenic low back pain can be treated with minimally invasive intradiscal procedures (IDET, biacuplasty) or with major surgery.
Nonsurgical treatment of scoliosis and kyphosis

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The goals of nonsurgical treatment of idiopathic scoliosis may be divided into two groups: morphological and functional. The first aspect influences aesthetics while both aspects determine patients' quality of life, psychological well-being, and disability. The basic objectives of comprehensive conservative treatment of Idiopathic Scoliosis are: 1. to stop curve progression at puberty (or possibly even reduce it), 2. to prevent or treat respiratory dysfunction, 3. to prevent or treat spinal pain syndromes, 4. to improve aesthetics via postural correction.

The main goal of nonsurgical treatment of scoliosis and kyphosis in children and adolescents is to stop the progression of deformation, less often reduce the size of deformation. The conventional nonsurgical treatment includes periodic observation, bracing, casting and physical therapy.

Observation is generally for patients whose curves of scoliosis are less than 20° and kyphosis whose curve are less 50° who are still growing, or for curves of scoliosis less than 45° in patients who have completed their growth. Scoliosis surgeons often wish to observe the scoliosis every few years after patients complete their growth to make sure it does not progress into adulthood.

Bracing is recommended for patients with curves of scoliosis that measure between 20° and 45° during their growth phase. Bracing is recommended for patients with curves of kyphosis that measure more than 50° during their growth phase. The goal is to prevent the curve from getting bigger. There are several types of braces available but all of them work in the same fashion. All braces are worn under the clothes and cannot be seen by others. Bracing is most effective when it is worn more than 20-22 hours per day. When bracing treatment is started, radiographs are usually performed with the brace on to ensure that the brace is effective in achieving some correction of the curve. Brace treatment has been shown to change the natural history of adolescent idiopathic scoliosis and reduce the incidence of surgery. However, the mechanism of action by which braces prevent curve progression, is not well understood. A recent prospective cohort study by Weinstein and coauthors published 2013 in The New England Journal of Medicine has shown that bracing in patients with adolescent idiopathic scoliosis is effective in reducing progression and preventing surgery. In addition, combining bracing with exercises has been shown to increase treatment efficacy. Design principles for many braces are contradictory and based on dated concepts, proposed and tested decades ago when the three-dimensional nature of AIS was rarely considered or incorporated into the brace design. The proper biomechanical principles for orthotic correction should apply derotational forces that correct in the coronal and axial plane in addition to producing normal spinal alignment in the sagittal plane. The brace as a mean of spinal deformity conservative treatment should be based on the following general principles: 1. Prevention of asymmetric compressive forces related to passive posture. 2. Reduction of the secondary muscle imbalance. 3. Prevention of the lordosing reactive forces (passive posture, repeated forward bending movements). 4. Prevention of asymmetric torsional forces from gait. 5. Production of dynamic detorsional forces involving breathing mechanics.

Casting is effective method in treatment of progressive infantile idiopathic scoliosis and some cases of juvenile idiopathic scoliosis and kyphosis.

The core of physical therapy of scoliosis and kyphosis are exercises. No exercises...
for scoliosis and kyphosis have proved to reduce or prevent curvature. However, exercise is highly recommended for both idiopathic scoliosis and kyphosis to keep back muscles strong and flexible. The most famous exercise system for scoliosis is the Schroth Method with exercises in a three dimensional approach to elongate the trunk and correct imbalances of the spine. The goal is to develop the inner muscles of the rib cage in order to change the shape of the upper trunk and to correct any spinal abnormalities. The physical therapist will instruct the patient in specific exercises to straighten, centralize and de-rotate the spine with corrective breathing technique. Exercise based therapies, alone or in combination with orthopedic approaches, are a logical approach to improve and maintain flexibility and function in patients at risk for pain, pulmonary dysfunction, and progression. Data from the Schroth clinic in Bad Sobernheim, Germany reveal improved pulmonary function and reduced pain in response to an intensive scoliosis in-patient rehabilitation (SIR) regime.

Non-surgical treatment of scoliosis and kyphosis is a team effort that requires the participation of orthopedic surgeons, specialists of rehabilitation medicine, physiotherapists, psychologists and prosthetic profession.

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Surgical options for 3D correction of scoliosis

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Scoliosis is a 3D deformity and a major task of surgery is a 3D curve correction. Two principal concepts exist.

Posterior surgery apply hooks, straps or transpedicular screws. By means of 3D forces (distraction, compression, lateral traction, direct derotation, curved rod rotation, in situ rod contouring) the spinal elements are forcefully pulled in the desired position. Posterior facet fusions are performed in order to achieve permanent deformity correction.

In anterior surgery screws are placed in vertebral bodies, 1 cm away from spinal cord. After spine mobilization, correction is performed using smaller forces. Fusion is achieved by intercorporal contact.

According to White and Panjabi major resistance to scoliosis correction are discs (50%) and rib cage (145%).

In posterior surgery, correction is achieved by means of huge forces that overcome resistant structures. Hooks, sublaminar wires and straps are currently rarely used, because transpedicular screws offer better stability and derotation possibility. However screws bring significantly greater risks of surgery, concerning great forces are applied to screws placed close to spinal cord and to anterior great vessels (aorta, v.cava). In order to reduce risks, expensive new equipment are growing on the market (neuromonitoring, navigation). As well, in rigid curves treatment, posterior solutions are gibectomy, spinal wedge resections and corrective osteotomies. That means opening of the spinal canal, bilateral vessels ligation (spinal cord ischaemia risk?). Increased neurological risk and intraoperative bleeding should be taken in consideration. The average correction is up to 68% (L.Lenke). Correction in spinal osteotomies depend on the extent of resections. Industry trends currently are: „everything can be performed from behind with help of expensive aditional equipment”. Despite that, it is obvious that optimal lumbar profile in adult scoliosis is not possible to obtain without anterior lumbar cages. It becomes clear that one should distinguish „what is possible to be done” from „what do we meet in everyday clinical practice”.

Anterior surgery eliminates resistant factors by means of subtotal anterior discectomy without spinal canal opening and by rib osteotomies at the apex of the rib hump, thus transforming the rigid deformity to a flexible one. After curve mobilisation is achieved, the spine is put in corrected position, by means of significantly smaller forces. Correction is performed in 4 steps: 1. Compression forces, 2. Direct derotation, 3. Cantileaver frontal correction, 4. Rod rotation for terminal correction. An average frontal correction is 76-85%, apical derotation 70-90%, adjacent segments to instrumentation 26% and 8% respectively. Anterior surgery is currently not popular because of a trend to avoid anterior approach whenever possible.

In early onset scoliosis derotation is even a greater problem. All instrumentations available do not produce satisfactory results. Problems are: 1. spontaneous fusions due to periosteum detachment, 2. poor sagittal correction and derotation.

Therefore EOS is still a „bad disease”.

Anterior instrumentation offers 1. A short segment early fusion. A five segment instrumentation can produce excellent 3D correction and control of the entire thoracic curve without wearing a brace.

2. An instrumentation with „sliding screws” anteriorly. Excellent 3D correction, no spontaneous fusions due to periosteum detachment, the spine is allowed to grow until maturity. No braces necessary. No repetitive surgeries until puberty.

Both concepts need further improvements. The future will tell us in which way to go.

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Spondylolisthesis treatment options

ABSTRACT
Optimal treatment for spondylolisthesis is still incompletely understood. It initially consists of conservative measures like avoiding pain-related positions, activity modification, stabilization exercises and analgesics. Surgical intervention is indicated for patients with persistent pain, progressive spondylolisthesis or neurologic symptoms, who fail conservative treatment. The choice of operative procedure is still a matter of much controversy today and it depends on the type of the spondylolisthesis, degree of slippage, patient’s activity level, nature of his symptoms, and expected progression of the slip. Although fusion with instrumentation is most widely used today, decompression alone or fusion without instrumentation might also be sound options in selected cases. Less invasive approaches offer promise for the future.

KEY WORDS
spinal fusion, decompression, minimally invasive, interbody fusion

INTRODUCTION
The clinical syndrome of spondylolisthesis was first described in 1782 by the Belgian obstetrician Herbiniaux. He reported a bony prominence anterior to the sacrum that created an impediment to vaginal delivery in a cohort of his patients (1). The condition is termed spondylolisthesis, from the Greek roots, spondylos, meaning „vertebrae”, and olisthesis, meaning „to slip” (2). The classic measurement of the slip degree has been that of another obstetrician Myerding, who in 1932 described four degrees of slip (3). A complete dislocation of L5 on S1 was called a spondyloptosis, from the Greek word ptosis, meaning „falling off or falling down”, to indicate a vertebra that is completely dislocated (Figure 1).

As understanding of spondylolisthesis progressed, classification of common clinical subtypes emerged (Figure 2). The most widely used classification system nowadays was described in 1976, by Wiltse, who separated spondylolistheses into five main groups (4). The reason for this was to separate the tangential movement in the

Figure 1. Myerding classification of vertebral body slip.
low-grade slips from the angular tangential slip that occurred in the higher levels of slip. This more complete classification has served to point out that the low-grade slips behave like degenerative disc disease, and the high grade slips require treatment similar to the spinal deformity cases (5). In a true type I, dysplastic spondylolisthesis, the slip occurs secondary to a congenital defect of the superior sacral facet or the inferior L5 facet or both with gradual but imminent progression. Type II, known as isthmic spondylolisthesis, involves a defect in the isthmus or pars interarticularis. This type is further divided into 3 subtypes based on the nature and aetiology of the lesion: type IIA refers to spondylosis or the stress fracture, type IIB represents an elongated but intact pars, and type IIC an acute traumatic fracture of the pars region. Type III is termed degenerative spondylolisthesis because it develops as a result of facet arthritis and remodelling. As the disease progresses, the articular processes may become more horizontally shaped, creating the potential for rotational deformity as well. Patients with this type usually present with symptoms of spinal stenosis. Type IV refers to a post-traumatic gradual disruption of posterior elements other than the pars. Type V involves the destruction of the posterior elements in the setting of a pathologic process, such as malignancy or Paget disease (6).

Spondylolisthesis secondary to aggressive surgical intervention that destabilizes a spinal segment is not included in the Wiltse classification. It occurs most commonly in spinal stenosis decompression without concomitant fusion, when too much of a facet joint is removed, which allows for a later slip. It is called iatrogenic spondylolisthesis. It is likely that many of these patients had a subtle, unrecognized slip at the time of surgery that simply became worse later. A variant of the latter is termed spondylolisthesis acquisita, and it occurs when a vertebral body above a lumbar fusion slips anterior. This is simply a degenerative spondylolisthesis that occurs because of motion transfer to the segment above. An increase in facet joint and disc forces may result in their subsequent degeneration (5).

**CURRENT CONCEPTS**

Optimal treatment is still incompletely understood and dependent on the type of the spondylolisthesis, degree of slippage, patient’s activity level and expected progression. Surgical intervention is indicated for patients with persistent pain, progressive spondylolisthesis or neurologic symptoms, who fail conservative treatment. However, the choice of operative procedure is still a matter of much controversy today. One reason for considering decompression without fusion in select patient populations is that it is less invasive than fusion and reduces the morbidity and mortality associated with spinal fusion in elderly patients (7). Advanced degenerative spondylolisthesis with narrow or obliterated disc space, no instability on functional x-rays and insignificant back pain might be safely approached by doing careful decompression alone (the same procedure might prove catastrophic in an unstable type 1 or type 2 slip). Particular attention should always be given to maintaining the integrity of the facet joint; otherwise, postoperative progression of the slip with symptom recurrence is highly possible.

Incontrovertible evidence supporting fusion over decompression alone is nevertheless sparse, although fusion is widely used as a treatment of choice by spinal surgeons worldwide. The idea that arthrodesis minimizes bone regrowth after surgery
compared to laminectomy has been supported in 1993 (8). The proportion of satisfactory results was also significantly higher in patients who had noninstrumented posterolateral spinal fusion. The authors speculated that arthrodesis stabilizes the spine, resulting in less bone regrowth with less recurrent stenosis and produces superior long-term results. However, one problem associated with absence of instrumentation is inability to restore normal lumbar lordosis, which is particularly important in multilevel disease. A consequent flatback deformity with its debilitating symptoms is a highly unwanted result for a practising surgeon (9).

An important issue with the use of pedicle screws is its potential ability to prevent further slippage and to enable segmental lordosis. Although there is strong evidence that the use of adjunct instrumentation produces a higher fusion rate than noninstrumented fusion, it is hard to demonstrate clinically superior outcomes (10). There is also concern that the rigidity produced by a solid posterior instrumented fusion may cause significant stresses at the adjacent levels below or above the fusion with the potential for adjacent segment failure. Direct intraoperative injury to the superior facet and concomitant osteoporosis appear to be important issues as well.

The use of concomitant anterior column support in addition to posterior fusion has been recommended in the management of some types of spondylolisthesis, especially in isthmic defects. Such interbody fusion can be readily achieved from many directions, by a PLIF (posterior route), TLIF (transforaminal route), ALIF (anterior route), XLIF (lateral route), OLIF (oblique route). Purported advantages of interbody fusion compared with posterior instrumented fusion without anterior support include greater likelihood of fusion, better indirect foraminal decompression, better reduction of the spondylolisthesis, and better lordosis (11). In order to achieve these goals, attention to the appropriate position and size of the interbody device as well as strict compression on pre-bent rods are paramount (12). The addition of an interbody cage significantly increases the construct stiffness and decreases hardware strain. Consequently, increased motion at the adjacent levels further predisposes these segments to early degeneration and failure (Figure 3).

Figure 3. Posterior lumbar interbody fusion of a degenerative spondylolisthesis at L3-L4 level 25 years after anterior fixation of a two-level spondylolisthesis (L4-L5 and L5-S1).
FUTURE TREATMENTS

During a traditional laminectomy, the spinous process is removed and posterior tension band disrupted. However, a thorough decompression can be readily achieved without need for removal of spinous process. The spinal canal can be safely approached through a unilateral portal via a hemilaminectomy technique even in patients with degenerative spondylolisthesis (13). Increased complication rates during the initial series of patients, anatomic variation limiting the procedure above L3 level as well as occasional difficulty reaching the ipsilateral recess have to be taken into account (14).

Minimally invasive posterior spinal fusion with instrumentation has been used safely and effectively to treat instability associated with spondylolisthesis. Obesity, advanced spondylolisthesis (grade 3 and 4) and previous instrumentation that requires an open approach for extension or removal are all relative contraindications (15). Avoiding extensive soft tissue injury in mini-open transforaminal lumbar interbody fusion resulted in measurable clinical benefits like decrease of blood loss, less pain and faster rehabilitation postoperatively (16). However, advanced technical support, the need for superb lighting down the working corridor and steep learning curve have to be taken into consideration.

Although screw-based dynamic systems have been suggested to provide similar outcomes to fusion in degenerative spondylolisthesis, they have largely fallen out of favour. Their positive effect has been relatively short-lived compared to arthrodesis (17). Interspinous process distraction devices refer to another appealing but rather unsuccessful dynamic concept. The device prevents lordosis at the affected segment and improves symptoms of neurogenic claudication. On the other hand, it triggers erosions of the neighbouring spinous processes with additional symptoms of debilitating back pain necessitating further operative intervention (18).

CONCLUSION

Currently there does not appear to be a clear consensus as to the optimal way to treat all patients with symptomatic spondylolisthesis. Although fusion is an appropriate option in most, decompression alone might still be eligible in some selected cases. Surgical treatment, however, has to be tailored individually depending on patient’s expectations, work and leisure time activities, type of slippage, chance of progression, and nature of symptoms.

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Surgical site infections

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ABSTRACT

Surgical-site infection (SSI) in the spine is a serious postoperative complication. Risk factors such as posterior surgical approach, extent of the operation, operation time, arthrodesis, use of spinal instrumentation, age, obesity, diabetes, tobacco use, operating-room environment and estimated blood loss are well established in the literature. Our study on 869 patients revealed 29 deep SSIs with most significant risk factors being Staged surgery (p = 0.005) Odds Ratio 6.057 (95% CI 1.437 - 25.540), Preop. Hospital stay > 4 days (p = 0.044) Odds Ratio 6.012 (95% CI 1.179 - 30.658), Politrauma (p = 0.012), presence of paraplegia (p = 0.023) The reported infection rates range from 0.7% to 11.9%, depending on the diagnosis and complexity of the procedure (Discectomy <1%, Posterior fusion (-implant) 1-4%, Posterior fusion (+implant) 2-13% (6%), Neuromuscular scoliosis 25%, PVCR 11.1%, Other osteotomies 4.1%). The most frequent causative organism for SSIs following spine surgery is Staphylococcus aureus. MRSA being reported as high as 40% in UK. Antibiotic prophylaxis and precautions against risk factors are important to prevent infections after spinal surgery with instrumentation. Besides operative factors, patient characteristics could also account for increased infection rates. These infections after instrumented spinal fusion are particularly difficult to manage due to the implanted, and possibly infected, instrumentation. Because the medical, economic and social costs of SSI after spinal instrumentation are enormous, any significant reduction in risks will be beneficial.

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The new AOSpine thoracolumbar spine injury classification

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ABSTRACT

In 2013 Vaccaro et al published the AOSpine Thoracolumbar Spine Injury Classification System,[1] which was designed to incorporate critical elements of both the Magerl classification system and the Thoracolumbar Injury Classification System (TLICS).

The AOSpine Thoracolumbar Spine Injury Classification System separates fractures into three major types: Type A—Compression injuries; Type B—Tension band injuries and Type C—Translational injuries. Type A and B injuries are further subdivided into five and three subtypes respectively. Next the neurologic status of the patient is evaluated and classified: N0—Neurologically intact patient; N1—Resolved transient neurological symptoms; N2—Persistent radicular symptoms; N3—Incomplete spinal cord injury or cauda equina injury; N4—Complete spinal cord injury, and NX—Neurologic exam is unobtainable. Lastly the patient is evaluated for patient specific modifiers. M1 is assigned to compression type injuries in which the status of the posterior ligamentous complex is unclear, and M2 is assigned to any patient in whom patient specific morbidities affect the treatment algorithm such as ankylosing spondylitis, polytrauma, etc.

REFERENCE

Cervical Spine Injuries

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ABSTRACT

Cervical spine injuries include a wide spectre of pathological states from benign sprains to fatal upper cervical spine fractures and dislocations. Due to different biomechanical properties, cervical spine is divided into two distinct parts, upper including occipital condyles and first two cervical vertebrae, and lower representing remaining five cervical vertebrae and first two thoracic vertebrae. Different patterns of motion, and differences in morphology resulted in different methods of fixation.

Cervical spine is least inherently stable part of the spine, and potential injury to its neural content could cause very severe incompetence. Unlike to the other parts of the spine in which most injuries could be treated conservatively, cervical spine injuries demand surgical stabilisation as a way to secure healing. In cases of spinal cord injuries, this is the only way to minimize the damage. Achieving stability in all three spinal columns is mandatory. We always trade function for stability, our first consideration being to achieve stability with minimum loss of function.

After the great leap forward, development of new methods is stagnant at present. Enthusiasm about transpedicullar fixation has lessened after few catastrophic complications. Anterior locked plate fixation, combined with autologous bone transplants, and posterior lateral mass fixation in C3-C6, with possible pedicullar fixation in C2 and C7 is a rule. Reconstruction of upper segment is still a challenge reserved for experienced and well-equipped teams. In terms of neural injury, few concepts are under investigation, with stem cell transplantation as a most promising treatment.

Although the basic principles are well made down, cervical spine still presents a diagnostic and therapeutic challenge. Due to its anatomic properties, it has to be fixed as soon as possible, demanding availability of competent team at any time. This should be achieved by teams of capable and well-equipped spine surgeons posted at strategic points throughout the country.
Fractures of the thoracolumbar spine

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ABSTRACT
Fracture of the thoracolumbar spine are the most common spinal injuries but the vast majority of these do not involve neurologic deficit. Conscious patient can explain mechanism of injury and any history of transient paralysis or sensory disturbance. Patients under suspicion of thoracolumbar injury should be immobilized on a full-length backboard. Native spinal radiographs thereafter MSCT is mandatory in all patients with a recognized thoracolumbar fracture. MRI is recommended if patient has neurologic deficit that is unexplained by bony injury or suspicion of posterior ligamentous complex. At the present time there is no universally accepted fracture classification but last AO Spine Classification can help surgeon to decision about nonsurgical or surgical treatment. Nonsurgical treatment is indicated in the vast majority of patients. Treatment is based on analgetics, short bed rest and orthosis. Surgical treatment offer immediate stability, better restoration of anatomical alignment, decompression of the neural elements and reduce of pain. Absolute indication for surgery will be progressive neurologic deficit with compression, a significant ligamentous injury, and dislocation. Posterior approach is best choice for predominant posterior complex injury or rotational injuries. For isolated vertebral body burst fractures best options is anterior approach. Burst fractures are often associated with distraction or rotational injury where best treatment is combined anterior posterior approach. In patients with neurologic deficit and spinal canal compromise early decompression should be a part of fixation procedure. In compressive vertebral fractures percutaneous procedure with vertebral body augmentation and percutaneous fixation can be use. Day after operation patients start with physical therapy and lift up procedure. Orthosis does not provide additional mechanical stability but is reminder for patient to limit their activity. Surgical follow up can be finished between 6 to 24 months. Extraction of posterior implant isn't obligate, but if patient fill uncomfortable with them, can be recommended.

INTRODUCTION
Fracture of the thoracolumbar spine are the most common spinal injuries. The vast majority of these do not involve neurologic deficit. Motor vehicle accidents are by far the most common cause of spinal column injuries. Second reason is fall from height. Men are more likely to sustain injury than are women. In elderly patients fall in same level and lifting of heavy object can cause compressive vertebral fractures. Attention should be made to obtain a history from patients. Conscious patient can explain mechanism of injury and any history of transient paralysis or sensory disturbance. Past medical history is important for treatment plan. The initial physical examination should include overall assessment according to ATLF (advanced trauma life support) protocol. Deformity related to spine, areas of tenderness as well as gap between spinous processes should be noted. Open wounds may indicate open fracture. A detailed neurologic examination should include motor, sensory, reflex and rectal examinations. Because of anatomic arrangement possible neurologic deficits can be complete and incomplete cord injury, mixed cord and root injury, and isolated root injury. Very important is to document level and score of neurologic injury. Before arrival patients should be immobilized on
a full-length backboard. In patients with neurologic deficits pharmacologic treatment should be start within 3 hours of injury.

Native spinal radiographs should be obtained in all patients with a suspicion on spinal injury. MSCT is mandatory in all patients with a recognized thoracolumbar fracture. MRI is recommended if patient has neurologic deficit that is unexplained by bony injury. Also MRI can help to recognize injury of posterior ligamentous complex. According to radiological findings surgeon have to classified thoracolumbar fracture. At present time there is no universally accepted classification but some of them are widely in use. AO/ASIF (Magerl) Classification is based on three type of injury: type „A“ – anterior column injury, type „B“ – posterior or anterior distraction injury, and type „C“ – fracture dislocation with rotary component. A nice paper from Vaccaro et all, in year 2005, simplify decision for surgery according to three major variables: fracture pattern, integrity of posterior ligamentous complex and neurologic status. A last AO Spine Classification again use three variables: first is morphology based on Magerl Classification, second is type of neurologic injury and third are modifiers. All classifications system should help surgeon to recognize degree of instability and potential for neurologic deterioration and make easy decision for nonsurgical or surgical treatment. If, despite classification, surgeon stay in doubt about treatment his first choice have to be conservative treatment. But in case with increasing pain or deformity in days after, they should recommend surgery.

**CURRENT CONCEPTS**

Nonsurgical treatment is indicated in the vast majority of patients. Treatment is based on analgetics, short bed rest and orthosis. Upper thoracic spine naturally immobilized with rib cage, but thoracolumbar junction fractures may benefit from a brace. Severe compression fractures will be treated with hyperextension cast. Patient with complete neurologic injury and stable spine may be treated nonsurgical.

Surgical treatment offer immediate stability, better restoration of anatomical alignment, decompression of the neural elements and reduce of pain. Absolute indication for surgery will be progressive neurologic deficit with compression, a significant ligamentous injury, and dislocation. For other type of injury previous noted classifications will be help for decision about treatment. Posterior approach was historically first choice for thoracolumbar trauma. After improvement of internal fixations, today is transpedicular fixation best choice. They give immediate stability and in same approach surgeon can make appropriate neural element decompression. Posterior approach is best choice for predominant posterior complex injury or rotational injuries. Some of problem for this treatment will be small pedicle size and thoracic kyphosis at upper thoracic spine. For isolated vertebral body burst fractures best options is anterior approach. They can be done with thoracotomy or thoracoscopy for fractures from T4 to L1, and with lumbotomy for fractures from L2 to L4 but final approach depend about individual patient body anatomy. Great challenge is L5 burst fractures. Burst fractures are often associated with distraction or rotational injury where best treatment is combined anterior posterior approach. Timing of surgery depends about severe of neurologic injury and patient ability to tolerate surgery. In compressive vertebral fractures percutaneous procedure can be use. Compressive fracture with preserved posterior wall can be treated with vertebral body augmentation like vertebroplasty, kyphoplasty or stentoplasty. In case with posterior wall injury percutaneous pedicular fixation will be combine with vertebral body augmentation.

In postoperative management surgeon first have to mean and treat possible complication like pneumonia, DVT or urinary tract infection. Strong painkillers will be great help in first few days. After decreased spinal pain patients start with physical therapy and lift up procedure. Orthosis does not provide additional mechanical stability but is reminder for patient to limit their activity. Patient with severe spinal cord injury have to continue physical therapy in rehabilitation center. Standard timing for patient control x-rays are 6 and 12 weeks and 6 and 12 months. Surgical cure can be finished between 6 to 24 months.
FUTURE TREATMENTS

Percutaneous transpedicular fixation allow early fixation with short procedure and minimal surgical trauma. Anterior column support can be made later with mini open approach. This kind of approach can reduce surgical trauma and allow early and safe patient mobilization.

CONCLUSION

Fracture of the thoracolumbar spine are the most common spinal injuries but the vast majority of these do not involve neurologic deficit. At the present time there is no universally accepted fracture classification but last AO Spine Classification can help surgeon to decision about nonsurgical or surgical treatment. Nonsurgical treatment is indicated in the vast majority of patients. Surgical treatment is indicated only when nonsurgical treatment will not produce an acceptably aligned and stable spine. Posterior approach is best choice for predominant posterior complex injury or rotational injuries. For isolated vertebral body burst fractures best options is anterior approach. Burst fractures are often associated with distraction or rotational injury where best treatment is combined anterior posterior approach. In patients with neurologic deficit and spinal canal compromise early decompression should be a part of fixation procedure. In compressive vertebral fractures vertebral body augmentation and percutaneous fixation can be use.

REFERENCES


Surgical techniques to correct posttraumatic kyphosis

Klaus John Schnake

Fürth, Germany

ABSTRACT

Posttraumatic kyphosis is a painful angulation of the spine. Every spinal trauma incorporates the risk of developing such a deformity. As long as the compensatory mechanisms are sufficient and instability is absent, a conservative treatment is possible. When all compensatory mechanisms are exhausted or when instability is present, only surgical treatment can ensure a good, lasting result. The typical complaints of the patients are intolerable pain, a reduction of their quality of life or neurological / urological symptoms as well as a progressive deformity.

The basis of every surgical intervention is the precise evaluation of the deformity as well as the present compensatory mechanisms. Only extensive radiological diagnostics enable a differentiated planning of the correctional surgery. Depending upon the kind and localization of the deformity, different osteotomy techniques are possible. The most common procedure is the PSO. The type of the planned surgery has to be adapted to the comorbidities and the expectations of the patient. Corrective spinal surgeries are high-risk surgeries and are regularly accompanied with complications. This type of interventions should be in the hand of experienced spinal surgeons in a good setting to diagnose and treat the possible complications. When a stable fixation and a good correction of the sagittal balance can be reached the results are good in the most cases.
Mini battle: Is anterior surgery needed?

Haluk Berk
Izmir, Turkey

ABSTRACT

Development of spinal instrument has impacted the surgical correction of scoliosis. With the introduction of Harrington instrumentation in 1960s, and subsequently Luque and Cotrel–Dubousset instrumentation, posterior approaches have been commonly used for the treatment of scoliosis. However correction in severe curves frequently necessitated combined anterior and posterior approaches and instrumentation to achieve a “satisfactory” result. Anterior procedures in severe curves were reported to have a negative impact on respiratory functions and increase the morbidity.

Boucher in the 1950s has introduced pedicle screws and later popularized by Roy-Camillle in the 1960s, are a penetrating type of anchor that makes use of the pedicle, that can be used as a cantilever point. This strong anchor resists all directions of force and offers improved three-dimensional correction of deformity and rigid fixation. Segmental pedicle screw fixation, dispersing the stress by allowing multiple anchors per spinal level and thus, distributing the stress on each implant, provides more powerful correction forces. Since the Suk et al first applied thoracic pedicle screws for the scoliosis treatment in late 1980s, the application is gradually increased among spine surgeons and it is shown that an additional anterior release may be unnecessary even in severe scoliosis.

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Hwan-Tak Hee, Zhi-Rong Yu, and Hee-Kit Wong. Comparison of Segmental Pedicle Screw Instrumentation Versus Anterior Instrumentation in Adolescent Idiopathic Thoracolumbar and Lumbar Scoliosis

Jianxiong Shen, Guixing Qiu, Yipeng Wang, Zhihai Zhang, Yu Zhao. Comparison of 1-Stage Versus 2-Stage Anterior and Posterior Spinal Fusion for Severe and Rigid Idiopathic

Scoliosis–A Randomized Prospective Study. SPINE Volume 31, Number 22, pp 2525–2528


SPINE Volume 32, Number 14, pp 1533–1542

Tomasz Kotwicki, Jean Dubousset, Jean-Paul Padovani Correction of flexible thoracic scoliosis below 65 degrees—A radiological comparison of anterior versus posterior segmental instrumentation applied to similar curves. Eur Spine J (2006) 15: 972–981
Tissue engineering in treatment of lumbar degenerative disc disease

Karlo Houra

Zabok, Croatia

INTRODUCTION

Disc anatomy is expected to play a pivotal role in the low back pain, yet abnormal disc morphology has been described as a normal component of an asymptomatic population.

CURRENT CONCEPTS

The most apparent cellular and biochemical changes attributable to disc degeneration include a decrease in cell density that is accompanied by a reduction in synthesis of cartilage-specific extracellular matrix components such as Type II collagen and aggrecan. Biological restoration through tissue engineering i.e. the use of autologous disc chondrocyte transplantation or mesenchymal stem and progenitor cells offers a potential to achieve functional integration of disc metabolism and mechanics. Transplanted chondrocytes produce proteoglycan and collagen extracellular matrix components restoring disc structure and function. Transplanted cells can also act by releasing soluble trophic factors, which stimulate resident disc cells to produce disc matrix. Mesenchymal stem cells and mesenchymal progenitor cells secrete anti-inflammatory cytokines and growth factors. These factors enhance nucleus pulposus cell synthesis of new matrix and suppress catabolic events triggered by mechanically mediated disc injury. Pain reduction is likely due to the potent immune-modulatory and anti-inflammatory properties that the transplanted cells possess.

FUTURE TREATMENTS

Once the safety and efficacy of tissue engineering therapies are established, optimization of the therapeutic intervention will need to be performed. Questions like what is the ideal cell dose to administer or what is the ideal cell carrier need to be answered.

CONCLUSION

Numerous animal and some clinical studies have demonstrated success using cellbased therapies to treat disc disease but these successes are in the early stages of translation into everyday practice. These cell-based biological therapies are, for the first time, attempting not only to provide improvements in symptoms, but also attempt to restore biological structure and function of the disc. Tissue engineering therapies may not be the "miracle cure" but is likely to become part of the armamentarium that physicians can utilise in treating patients with low back pain.

REFERENCES

1. Oehme D, Goldschlager T, Ghosh P, Rosenfeld JV, Jenkin G. Cell-Based Therapies Used to Treat Lumbar Degenerative Disc Disease: A Systematic Review of Animal Studies and Human Clinical Trials. Stem Cells Int. 2015


CV
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Field of work

Primary
Spinal deformities and diseases

Secondary
Pediatric surgery, CP, neuro orthopaedics

Scientific Work

Paper 1

Paper 2

Paper 3

Paper 4

Paper 5

Paper 6
El O, Baydar M, Berk H, Peker O, Koşay C, Demiral Y. Interobserver reliability of the Turkish version of the expanded and revised gross motor function classification system. Disabil Rehabil. 2012; 34:1030-3

Memberships

Membership 1
Eurospine: The Spine Society of Europe, Switzerland (2002-2004; 2006-member at large at the ExCom and Chair education Committee 2006-2007, Secretary 2009-2012, President elect 2013, President 2014)

Membership 2
Scoliosis Research Society, USA programme committee member 2010-2013

Membership 3
AO Spine Switzerland

Membership 4
Turkish Society of Orthopaedics and Traumatology, Ankara

Membership 5
Turkish Spine Society (Served as general secretary, member at large)

Membership 6
Paediatric Orthopaedic Society (1998-2000 member at large at ExCom), Izmir
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## Scientific Work

<table>
<thead>
<tr>
<th>Paper</th>
<th>Title</th>
<th>Details</th>
</tr>
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</table>
# Mislav Čimić

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## Field of work

<table>
<thead>
<tr>
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## Scientific Work

### Paper 1

### Paper 2

### Paper 3

### Paper 4

### Paper 5

### Paper 6

### Paper 7

### Paper 8

## Memberships

- Membership 1: Croatian Orthopaedic Society
- Membership 2: Croatian Orthopaedic and Traumatology Society
TOMISLAV ĐAPIĆ

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Field of work
Primary  Pediatric orthopaedic surgery, ultrasound of locomotor system
Secondary  Deformity of spine

Scientific Work


Memberships
Membership 1  1988 Croatian Orthopaedic Society
Membership 2  1996 Croatian Pediatric Orthopaedic Surgery Society
Membership 3  2000 Europian Pediatric Orthopaedic Society
<table>
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<tr>
<td><strong>Membership 1</strong></td>
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</table>
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Field of work
Primary
Spinal surgery

Secondary
Minimally invasive interventions

Scientific Work

Paper 1

Paper 2

Paper 3

Paper 4

Paper 5

Memberships

Membership 1
Croatian Neurosurgical Society

Membership 2
Croatian Society of Vertebrology
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<tr>
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<tr>
<td>Institution</td>
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<td></td>
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<td>Occupation or</td>
<td>Chief of Department for Spine Surgery</td>
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</table>

**Field of work**

- **Primary**
  Operative treatment of spine injuries, including pathological fractures and conditions associated with spine infections.

- **Secondary**
  Investigation in effects of early surgical treatment of injuries with neurological involvement.

**Memberships**

1. Croatian Medical Association, Surgical Section
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Field of work
Primary Orthopaedic surgery
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Scientific Work

Memberships
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Membership 2 1989 Yugoslav Spine Deformity Society, President
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Membership 4 1986 European Spine Deformity Society
Membership 5 1998 Spine Society of Europe
Membership 6 1989 Croatian Pediatric Orthopaedic Society
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Scientific Work:


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Membership 2: European Society of Radiology

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Field of work
Primary  Spine surgery, Minimally invasive spinal procedures
Secondary  Quality of patients management

Scientific Work


Memberships

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Membership 3  Croatian Orthopedic and Traumatology Association
Membership 4  Croatian Society for Neuroscience
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Field of work

Primary
Degenerative spine diseases

Secondary
Pathological vertebral fractures

Scientific Work

Paper 1
REČNIK, Gregor, KRALJ-IGLIČ, Veronika, IGLIČ, Aleš, ANTOLIČ, Vane, KRAMBERGER, Slavko, RIGLER, Igor, POMPE, Borut, VENGUST, Rok. The role of obesity, biomechanical constitution of the pelvis and contact joint stress in progression of hip osteoarthritis. Osteoarthritis and cartilage, ISSN 1063-4584, 2009, letn. 17, št. 7, str. 879-882.

Paper 2

Paper 3

Paper 4

Paper 5

Memberships

Membership 1
Slovenian Medical Association, Orthopaedics Section

Membership 2
Slovenian Medical Association, Section of Vertebrology

Membership 3
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## Field of work

<table>
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<tr>
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<td>Membership</td>
<td>2014, Chair Elect for AOSpine International Community Development</td>
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<tr>
<td>Membership</td>
<td>2013, Vice Chair of the Spine Section of the German Orthopedic and Trauma Society (DGOU)</td>
</tr>
<tr>
<td>Membership</td>
<td>2013, Member of the Scientific Commission of the German Spine Society (DWG)</td>
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<tr>
<td>Membership</td>
<td>2013, German Society of Orthopedics and Orthopedic Surgery (DGOOC)</td>
</tr>
<tr>
<td>Membership</td>
<td>2011, AOSpine European Board Member (Community Development)</td>
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<tr>
<td>Membership</td>
<td>2011, Executive officer “Junges Forum” (young surgeons) of the DWG</td>
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<td>Membership</td>
<td>2011, Head of the osteoporotic spinal fracture study group (DGOU spine section)</td>
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<td>Membership</td>
<td>2011, Member of AOTrauma</td>
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<tr>
<td>Membership</td>
<td>2009, Member of the Education Commission of the German Spine Society (DWG)</td>
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<tr>
<td>Membership</td>
<td>2009, Member of the German Orthopedic and Trauma Society (DGOU)</td>
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<td>Membership</td>
<td>2007, Member of the Spine section (AG Wirbelsäule) of the DGU</td>
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<td>Membership</td>
<td>2005, Member of EuroSpine, Spine Society of Europe</td>
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<td>Membership</td>
<td>2004, Member of AOSpine</td>
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<td>2004, Member of the German Spine Society (Deutsche Wirbelsäulengesellschaft-DWG)</td>
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<tr>
<td>Membership</td>
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