Dynamic Reconstruction of the Spine

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Nonfusion Stabilization of the Degenerated Lumbar Spine with Cosmic

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The degeneration of the lumbar motion segment starts with a height loss of the disk caused by water loss of the nucleus pulposus. The facet joints lose their congruence, which may cause a concomitant spondylarthrosis. The fibers of the annulus fibrosus and the vertebral column ligaments lose tension so that a structural loosening occurs, complete with increased rotation instability. To compensate for the instability, hypertrophy of the yellow ligament as well as the facet joints occurs very frequently, which may lead to a reduction of the cross-sectional surface of the central as well as the lateral spinal canal. At the same time, the motion segment may lose its original position, and scoliosis, flat back, rotation, and rotation sliding may develop. Further along the course of degeneration, lateral and frontal spondylolisthesis up to and including syndesmophytes may form, which in turn may lead to spontaneous stiffening of the segment.

The complaints depend on the stage of the vertebral column degeneration. In the first phase, with a reduction of the height of the vertebral disk and loss of the congruence of the facet joints, chronically recurrent lumbalgies may occur that increase under load stress. When the stenosis of the spinal channel increases, additional symptoms may occur in one or both legs, with the indications of a claudicatio spinalis. If spontaneous ankylosis of the segment occurs before a symptomatic spinal channel stenosis occurs, the frequency and intensity of lumbalgies decrease.

Leg symptoms can be caused by the compression of the neural structures, which results from a narrow spinal channel or recessus or neuroforamen. As a rule, adequate decompression of the neural structures leads to good clinical success. The etiology of the lumbalgia is less clear; also, clinical success does not occur in the same measure as the fusion rate of a spondylodesis. What is certain is that the instability in the motion segment caused by the vertebral disk shrinkage is a trigger for the frequency of lumbalgies. Nonphysiological movements that have become possible due to the vertebral disk shrinkage lead to shifting of the nucleus pulposus or nucleus pulposus fragments within the vertebral disk, with the vertebral disk itself experiencing increased ingrowth of pain-conducting nerve ends as a result of the degeneration. This increased innervation of the degenerative vertebral disk is also responsible for the “memory pain” in the diskography.

The term instability used in this context has been better defined by Panjabi as a “clinical instability” that leads to a pathological movement capability and to pain, deformities, and neurological failures.

Operative treatment of the symptomatic lumbar vertebral column degeneration has thus far consisted of stabilizing, correcting, and adequately decompressing the diseased segment(s), always in connection with a spondylodesis. In recent years, the various forms of the spondylodesis [anterior and
posterior lumbar interbody fusion (ALIF and PLIF), total lumbar interbody fusion (TLIF), posterior lumbar fusion (PLF)] were discussed intensively because 360 degree fusions were believed to provide the greatest clinical success rate.

This theory was disproved in a prospective, randomized, double-blind study. The clinical results were independent of the selected fusion form. Complications naturally increased with increased surgical effort (360 degree fusion). In this study, pseudarthroses did not have any influence on the clinical result. A possible disadvantage of spondylodesis in the treatment of degenerative lumbar vertebral column diseases is the increased risk of accelerating degenerative processes in the neighboring segment. Following a spondylodesis, 16.5% symptomatic vertebral disk degenerations after 5 years were expected in the neighboring segment, and 36.1% after 10 years. Obviously there is a lower risk for spondylodeses without the use of pedicle screw systems. It must be questioned whether the risk for the adjacent segment increases with the rigidity of the spondylodesis, which would above all concern the currently favored 360 degree fusions that use a cage in combination with a pedicle screw system.

This does not appear to apply to spondylodeses that were performed for the correction of extended deformities. Thus, even after more than 20 years following a Harrington spondylodesis, low back pain was found in only 13% of cases.

Why Are Spondylodeses Performed in the Treatment of Degenerative Lumbar Vertebral Column Diseases?

Until recently, there were few alternatives to a standard spondylodesis. One important reason is that the surgery of the degenerative lumbar vertebral column is a relatively young chapter in spine surgery. The techniques of correction and fusion, so successful in scoliosis surgery, were transferred to this new area of spine surgery, increasing in usage since the early 1980s. An essential task of the spondylodesis consists of protecting the implants used against failure (dislocation, breakage).

When Is a Correction Necessary?

In contrast to the treatment of adolescent scoliosis, where the correction of the deformity is also the objective of the treatment, there are not very many indications for correction of the degenerative lumbar vertebral column that actually serve the direct objective of the operation with pain release and restoration of neurological functions.

Positional deformities in the sagittal and frontal planes that in total do not lead to a loss of the body vertical plumb line need not be corrected. This concerns most lateral deviations. Therefore, the correction of a degenerative lumbar scoliosis is only necessary in exceptional cases.

The reduction of the vertebral disk always leads to flattening of the lumbar vertebral column, which also does not need to be corrected as long as the patient assumes an upright, well-balanced posture. True and degenerative olisthoses at an adult age are not usually progressive. Stabilization and decompression without correction lead to the objective of the treatment. Therefore, it is not meaningful to transfer the principles of scoliosis surgery noncritically to the surgery of the degenerative lumbar vertebral column.

When Is a Fusion Necessary?

A fusion is required when corrections (mostly in the sagittal plane) are necessary to treat pain.

When Will It Be Possible to Do without a Fusion?

The precondition is a dynamic implant that does not require the protection of a spondylodesis. It must be possible to achieve the treatment objective (pain release, restoration of the neurological function) without correction. The stabilization does not need to include more than three segments.

The Cosmic Implant System

A posterior nonfusion implant system, which can do without protection by a spondylodesis, should not have any rigid characteristics. However, to be able to control instabilities effectively, the system must also feature stable characteristics. The Cosmic Posterior Dynamic System (Ulrich GmbH & Co. KG, Ulm, Germany) is a stable, nonrigid implant. Stability is assured by the 6.25 mm rod, and nonrigidity is assured by the hinged screw head. The screw features a hinged joint between the head and threaded part, which causes the load to be shared between the implant system and the anterior vertebral column (Fig. 42-1). Laboratory tests show that
Cosmic allows the same rotation stability as a healthy motion segment. In a cyclic loading test with 0.3–3.0 kN/Hz, we did not find an implant breakage or any debris after 10 million cycles. Because Cosmic is used like a stability endoprosthesis, the bone healing of the pedicle screws is of major importance here. For this reason, the threaded part of the screw is coated with bonit. Bonit (Dot GmbH, Rostock, Germany) is the second generation of bioactive calcium phosphate coatings on implants. In 1995, it was originally used for the first time in oral surgery for dental implants. In the area of vertebral column surgery, a study on the use of a first-generation bioactive calcium phosphate coating on Schanz screws found significantly improved fixation of the coated screws in comparison with uncoated screws. Thus the screw is introduced transpedicularly into the vertebral body, similar to an orthopedic endoprosthesis. To achieve a sufficient press-fit, the pedicle is widened by drilling to 3.2 mm maximum; but only along ~50% of the screw. The screw has a self-tapping thread so that the tapping instrument is needed only in cases of extremely hard spongiosa. To prevent early loosening of the screw, the screw must not be manipulated in any major way. Before being implanted, the rods must be pre bent such that they can be connected without any problems to the screw heads.

After the screw heads have been connected to the longitudinal rods, there remains only a micromobility in the hinges, which, without rod connections, are caudally and cranially mobile by ~20 degrees (Fig. 42–2).

Due to its good rotation stability, Cosmic is used not only for purely diskogenic pain conditions but is also combined with a conventional laminectomy or even a facetectomy. A transverse stabilizer is used for a monosegmental application in combination with a laminectomy. For two- or three-segmental applications, no transverse stabilizer is used.

The screws are implanted either by means of a conventional midline approach (point of entry lateral to the facet joint, angle ~15 degrees horizontal to the sagittal plane) or by means of the more laterally situated Wiltse access (a somewhat ventrally located point of entry close to the base of the transverse continuations, angle 20–25 degrees horizontal to the sagittal plane) (Fig. 42–3). A purely sagittal implantation direction is not recommended because this will lead to parallel positioning of the hinges and thus to increased mobility in the sagittal plane.

![Figure 42–2](image)

**Figure 42–2** Flexion-extension view, 1 year postoperatively.

Before the rod is implanted, the correct positioning of the patient will be checked by means of lordosis that is as physiological as possible. To avoid any early loosening, correction forces must not be applied to the screw.

**Indications for Dynamic Stabilization with Cosmic**

**Symptomatic Lumbar Stenosis (Claudicatio Spinalis)**

Stand-alone decompression of the spinal channel carries the risk of a recurrence of spinal narrowed because the instability that led to the hypertrophy of the yellow ligament and the facet joints is not taken into consideration. In addition, lumbalgies and deformities may increase as an expression of the increased clinical instability. For this reason, we always carry out an additional stabilization with Cosmic (Fig. 42–4A–C).

**Chronically Recurring Lumbalgia in the Case of Diskogenic Pain and Facet Syndrome**

Degenerated disk disease is present if, in the magnetic resource tomography (MRT), vertebral disk dehydration with height loss and positive Modic signs is detected. If there are further changed vertebral disks (black disk), we carry out an additional diskography. A positive memory pain confirms the suspicion of symptomatic vertebral disk degeneration. In the case of a facet syndrome, we carry out a diagnostic local anesthesia under x-ray control, using 2 mL local anesthetic, respectively. If the pain subsides for some hours, the suspected diagnosis is confirmed. In such cases we carry out the Cosmic stabilization using a paraspinous transmuscular approach according to Wiltse (Fig. 42–5A–C).

**Recurrent Disk Herniation**

In the case of a second recurrence of a disk herniation we carry out a stabilization with Cosmic in addition to the nerve root decompression.
In Combination with a Spondylodesis

Cosmic can also be used if, in addition to the nonfusion stabilization, there is an indication of a spondylodesis in one or two segments. For example, if there is a spondylothesis with a clear shift in the function x-rays and, in addition, in a further segment a symptomatic vertebral disk degeneration. In addition to the Cosmic stabilization in situ, a posterolateral fusion is set up within the area of the spondylothesis. A laminectomy or facetectomy is performed if there is an indication for this purpose (Fig. 42–6).

Extension of an Existing Spondylodesis in the Case of a Painful Adjacent Level Degeneration

Typically, in the case of a rigid 360 degree spondylodesis with cage and pedicle screw rod or pedicle screw plate fixation, there is the risk of developing a painful connection instability. In these cases, we remove the pedicle screw rod or plate system and stabilize the adjacent segment with Cosmic together with a decompression, if indicated. We fill up the existing pedicle drilling holes with bone chips and use a 7 mm revision screw for this purpose (Fig. 42–7).
spondylolisthesis vera, there is a rule: no significant shift in the lateral function x-rays. If this is the case, Cosmic is used in combination with a posterolateral fusion in situ. In cases of greater instability, as typically found in younger adults or youths, we carry out a posterior partial repositioning with Cosmic in combination with a posterolateral and interbody spondylodesis.

**Stabilizations Extending beyond Three Segments**

In the case of the degenerative lumbar vertebral column, extended instrumentations should in principle be avoided. If this is impossible, Cosmic may be used beyond three segments only in combination with a posterolateral spondylodesis. If, for example, there is a degenerative kyphoscoliosis with a loss of balance in the sagittal plane, where there is a necessity to correct the kyphotic part, longer extended instrumentations are required as a rule. Here, in the correction area, Cosmic can be used with a posterolateral spondylodesis, and in the further cranial segments in the nonfusion technology.

**Contraindications**

Cosmic should only be used for a maximum of three segments. If corrections are necessary, to influence the complaints of the patient (as already stated, in almost all cases of a degenerative deformity this is not indicated), a spondylodesis must be provided in addition to the Cosmic instrumentation. Such a case exists, for example, for a postfusion kyphosis where a correction such as a closing wedge–osteotomy is necessary to treat the pain. In adulthood, in the case of a

**Surgical Technique**

Under general anesthesia, the patient is positioned in the knee-chest position with the hip joints flexed to 90 degrees to avoid any pressure on the abdomen. The lordosis is radiologically controlled and can be increased by lifting the leg section of the operating table. For pure stabilizations, two skin cuts are made paraspinally, each one in position located 4 cm laterally to the processus spinalis vertebrae. The fascia thoracolumbaris is split, and the finger is used to prepare the muscular system between the multifidus and longissimus, until the transverse processes can be felt. The screw implantation is effected under lateral imager control (C-arm). In the case of a monosegmental stabilization, only closed screws are used (Fig. 42A-C); two- or three-segmental stabilizations use closed screws at the caudal end of the instrumentation.

![Figure 42-6](image)

Unstable spondylolisthesis vera, stenosis L5–S1, degenerative disk disease L4–L5, Cosmic L4–S1, laminectomy L5, posterior fusion L5–S1.

![Figure 42-7](image)

Cosmic L3–L5, laminectomy L3, preexisting fusion L4–L5.
and, in all other respects, open screws (Fig. 42–9). In the sacrum we recommend a bicortical screw implantation if the screw length is 50 mm or shorter.

In the case of a monosegmental instrumentation, a straight rod is implanted, and in the case of two- and three-segmental instrumentations, the rod will first be bent in accordance with the profile. With open screws, the rod is fixed by a clamp to the screw base; the cap is then put on. The rod and screw base feature a thread for guaranteeing a high degree of rotation stability between the rod and screw (Fig. 42–10). Fixation is then effected by a small grub screw that is tightened by a force of 6 Nm. Lateral decompressions can also be performed from this access point. If a laminectomy is necessary, we carry out a midline incision from which either (1) the muscular system is then prepared beyond the joint continuations to carry out screw implantation and decompression from the same access point, or (2) the screws are first set using the technique already described, followed by the economical preparation of the spinal muscular system from the processus spinalis vertebrae and the vertebral laminae to a medial position relative to the facet joints to make the decompression. The advantage of this latter procedure is that damage to the spinal muscles is reduced and there is less blood loss. In the case of pure stabilizations, the patient will be mobilized on the first postoperative day. In the case of a

Figure 42–8  (A) Paraspinal approach L5–S1. (B) Single-level stabilization, anteroposterior and (C) lateral view at 2-year follow-up.

Figure 42–9  Three-level stabilization at 2-year follow-up.
conventional midline approach with decompression, such mobilisation will be effected on the second day. The redon drainage is removed on the first day. For infection prophylaxis, a dose of cephalosporin is given before the skin incision. The thrombosis prophylaxis is performed with a low molecular heparin for 2 weeks postoperatively. External support will not be used.

Results

From January 2002 to June 2005, 203 patients were operated in Feldkirch (Austria). For 96 patients there is a 12-month follow-up course available, and for 38 patients of these 96 there is a 24-month follow-up course available. Preoperatively, there is conventional x-ray imaging for all patients, anteroposterior (AP) and lateral, in a standing position, and additionally, and where this was not possible (agoraphobia) a computed tomographic (CT) scan. The complaints are documented by a 10-part analog pain scale from 0 to 10 (0 = no pain, 10 = unbearable pain) and by the Oswestry Disability Index (ODI) score.

Three months, 12 months, and 24 months postoperatively conventional x-rays will be performed again, AP and lateral, in a standing position, and the clinical results documented by the pain scale and the Oswestry score. The x-ray images are studied for implant fractures, screw loosening, or screw dislocations. A screw loosening is defined as a loosening seam around the screw without any dislocation having occurred.

Of these 96 patients, 51 were female (53%) and 45 were male (47%). The age distribution was:

- 30–40 years 3 patients
- 41–50 years 8 patients
- 51–60 years 30 patients
- 61–70 years 19 patients
- 71–80 years 31 patients
- 81–90 years 5 patients

Four additional patients could not be examined for their 2-year check-up because they had died (three patients, the death having no connection to the operation) or had moved (one patient).

Fifty-one patients were stabilized in one segment, 35 patients in two segments, and 10 patients in three segments. In total, 494 screws, 192 longitudinal rods, and 23 transverse stabilizers were implanted.

The clinical results were compared with those from 75 patients with a follow-up of at least 24 months that, for the same indications, had been treated with the Segmental Spinal Correction System (SSCS: Ulrich GmbH & Co. KG, Ulm, Germany), which also contains a jointed head pedicle screw but without coating, and with a conventional posterolateral fusion. The SSCS has been used since 1989.

In both groups, the indications were comparable: symptomatic lumbar stenosis, painful olisthesis, painful osteochondroses, painful spondylarthroses, recurring vertebral disk prolapses, and diskoegenic pain.

The average age in the nonfusion group was 67.2 years, and in the fusion group 55.9 years. The reason for the increased age of the nonfusion group is that, during the first year, we predominantly used the nonfusion technique for the treatment of older patients to keep the surgery trauma as low as possible. With increasing experience we then used the nonfusion technique in the case of middle-aged adult patients.

In the nonfusion group, the visual analog scale (VAS) scores were 5.7 preoperatively and 2.9 postoperatively, and in the fusion group the pains were 5.8 preoperatively and 3.4.

The ODI in the nonfusion group was 25.4 points or 50.8% preoperatively and 17.0 points or 34% postoperatively. In the fusion group, the Oswestry activity score was 23.7 points or 47.4% preoperatively and 14.7 points or 29.4% postoperatively.

The hospital stay in the nonfusion group was 7.4 days (6–18 days), and in the fusion group 16.9 days (9–36 days).

The surgery time (skin to skin) in the nonfusion group was 118.8 minutes (62–200 minutes), and in the fusion group 172.4 minutes (120–215 minutes). Perioperatively, a total of 0.60 U of eryconcentrate were transfused (0–4 U), and, in the fusion group, 2.96 U of eryconcentrate (0–6 U) were transfused on average.

In the nonfusion group, revisions were performed in the case of four patients (4.2% of 96 patients) and, in the fusion group, revisions were performed in the case of six patients (8.0% of 75 patients). The revisions were caused by wound infections (one case in the nonfusion group as well as three cases in the fusion group), twice by symptomatic loosening of a screw in the nonfusion group, once by a screw break-off in the nonfusion group, and a total of three times due to a pseudarthrosis in connection with an implant fracture or implant loosening in the fusion group.

In the nonfusion group, a total of two broken screws were found in two patients, and in five patients a total of 10 screws with loosening edges (2.4% of 494 implanated screws) were found. In total, seven patients were affected: of these, three patients developed symptoms causing a revision to be performed.

In the case of the revision, the loosened or broken screws were removed, the pedicle bore holes were filled with bone.
chips (similar to matchsticks) from the spinous process, and 7 mm Cosmic revision screws were implanted. So far, there have been no new occurrences of renewed loosening or screw fractures in these patients. In one case, a rod fracture occurred without any symptoms. There was no record of any screw dislocations or the fracture of a transverse stabilizer. All implant failures observed so far occurred within the first year.

In June 2005 a multicenter study was started in cooperation with six international spine centers. So far, 215 patients have been documented: and for 100 of these 215, there is a 3-month follow-up available, and for 58 there is a 12-month follow-up. After 3 months no implant failures were found by this study, and after 12 months a screw fracture was found that led to a revision, as well as six loosening seams around the screws that, however, remained without symptoms and so far did not cause any revision. A screw dislocation was not observed.

**Discussion**

Degenerative diseases of the lumbar vertebral column represent their own nosological entity. So far they have been treated primarily in accordance with the principles of deformities surgery and traumatology.

To achieve correction of existing deformities that is as complete as possible, rigid implants have been used that provide three-dimensional correction if at all possible. The experience that the fusion of individual segments of the degenerative lumbar vertebral column may cause painful connection instabilities—and this applies obviously in particular to the rigid 360 degree fusions—increasingly casts doubt over the use of such techniques for the treatment of degenerative diseases.21-33 The postoperative sagittal profile of the lumbar spine did not have any influence on the development of adjacent instabilities.34

In addition, there is the problem that, in the case of older patients, the quality of the bone frequently does not allow any corrections, including secure fixation of rigid implants. Some patients at an advanced age also show additional secondary diseases that cause increased perioperative complications with more invasive operations on the vertebral column.

Fusion as the gold standard for the treatment of chronic pain within the area of the degenerative lumbar vertebral column must also be questioned because a 100% spondylodesis is not the equivalent of a 100% clinical success rate.35,36

The significance of patient selection is justifiably regarded as a decisive criterion for achieving a good clinical result.37 For this reason it is not surprising that there is a search for different alternative operative techniques that prevent any fusion.38 But what may be surprising is that it took so long to question fusion as the gold standard. However, for some time already, there have been individual efforts to develop alternative solutions in relation to the fusion concept. The Graf band is possibly the first pedicle screw-supported nonfusion system for the treatment of painful degenerative instabilities on the lumbar vertebral column. Biomechanically, it increases the use of dorsal tension chords and reduces painful movements in the facet joints and also in the disk. There are some reports of excellent clinical success.39-43

What remains disadvantageous is surely the missing rotational stability and the risk of early failure of the cable. The Dynesys Dynamic Stabilization System (Zimmer Spine, Inc., Warsaw, IN) represents a further development of the Graf system. The band is provided with a plastic sleeve, and the band is tensioned against this sleeve. This causes increased stability but also an increased load on the interface between the vertebral bone and screw, which may cause loosening.44 In relation to the rotational forces, the Dynesys system does not show any stability comparable to that of an intact vertebral column.45

The clinical reports that have been published on the Dynesys system are mostly positive.46,47 In combination with decompressions, these two systems, Dynesys and the Graf, are used somewhat more rarely because even partial removal of the facet increases the rotational instability.48

Other nonfusion techniques not based on pedicle screws stabilize the motion segment by spreading the processus spinalis vertebrae, thereby expanding the spinal channel. The indications are limited to light spinal narrowing and facet syndrome. Interspinous spreaders can be implanted minimally invasively. At this time, major clinical studies are not yet available.

In contrast to the aforementioned posterior nonfusion systems, Cosmic is used for symptomatic spinal stenosis, in combination with decompressions, as well as in the case of purely diskoigenic or facet joint–related pain. The hinged screw provides a sufficient degree of dynamization and load sharing between the implant and the vertebral column and prevents any rotation and translation instability. The rotation stability corresponds to that shown by an intact lumbar vertebral column.19

Because nonfusion implants act like stability prostheses and must last permanently without the protection of a fusion, the Cosmic screw was additionally coated with Bonit to ensure better anchoring in the vertebral bone.49 The clinical results found so far, when compared with conventional fusions, are equally good. The perioperative trauma was much lower. The careful transmuscular (between the musculus multifidus and musculus longissimus) access to the pedicles may further decrease the operative trauma.

Even when using Cosmic, careful selection of patients by the precondition for clinical success.

The radiological complex implant-related complications are in the lower range of those specified in the literature with regard to rigid implants in combination with a fusion. Here, between 2.5 and 15% screw fractures are specified.49,50

Radiological loosening seams, as documented in the present study, are not really considered in the literature, unless screw dislocations are noted. In fusion surgery as well as in nonfusion surgery, the meaning of implant–related complications cannot always be equated with a clinical failure. In those cases where a patient again develops pain after experiencing a temporary relief from complaints and where an implant–related complication can be radiologically detected, the revision is recommended in all cases. In principle, when using a nonfusion implant system, there is the option to carry out a conventional fusion in addition to the replacement of implants. The three patients revised in the present...
study due to symptomatic implant problems again received
Cosmic revision screws without fusion.

So far, the results found with the Cosmic system are very
encouraging. However, additional long-term observations
are necessary. For this reason we started an international
multicenter study in June 2004, which is Internet based.

◆ Conclusion

Posterior nonfusion stabilizations represent an alternative
to spondylodesis in the treatment of painful degenerative
diseases of the lumbar spine.

Cosmic is a dynamic nonfusion pedicle screw–rod system
for the stabilization of the lumbar vertebral column. The
hinged pedicle screw provides for the load being shared
between the implant and the vertebral column and allows a
high stability in relation to the rotational forces.

This report covers the clinical and radiological results of
96 patients with a follow-up of 12 to 24 months. The clinical
results were compared with those from 75 patients who
had been treated with hinged screws and a conventional
posterovertical fusion. In both groups, the indications were
comparable: symptomatic spinal stenosis, diskogenic pain,
facet syndrome, and postdiskectomy syndrome. In both
groups, the Oswestry score and the VAS showed a good
improvement of the symptoms without any significant
differences.

The perioperative morbidity in the nonfusion group was
significantly lower. In the nonfusion group, with 494 screws
implanted, two broken screws were found in two patients.
in the case of five patients, 10 screws with radiological loosening
were found. From these seven patients, three again de
dveloped symptoms that led to a revision. In the fusion group,
three pseudarthroses with screw fracture were found that
were also revised. All implant-related revisions occurred
within the first year.

The early- and medium-term results found so far with the
Cosmic system are very encouraging. Additional long-term
observations are necessary.

References

joint osteoarthrosis and disc degeneration of the lumbar spine: an MRI
study. Eur Spine J 1999;8:396–401
facet joint osteoarthrosis on the segmental flexibility of the lumbar
F. Motion in lumbar functional spine units during side bending and axial
rotation moments depending on the degree of degeneration. Spine
2000;25:2009–2027
4. Tanaka N, An HS, Lim TH, Fujikura A, Jeon DH, Haughton VM. The rela-
tionship between disc degeneration and flexibility of the lumbar spine.
Spine J 2001;1:47–56
5. Rauschning W. Pathoanatomy of lumbar disc degeneration and stenosis.
Acta Orthop Scand Suppl. 1993;251:1–12
Kinesiol 2003;13:371–379
for chronic low back pain; comparison of three surgical techniques used
in a prospective randomized study: a report from the Swedish Lumbar
9. Gitselli G, Wang JT, Bharia NN, Huw WK, Dawson EG. Adjacent segmen-
t degeneration in the lumbar spine. J Bone Joint Surg Am 2004;86-A:
1497–1503
10. Park P, Garton HJ, Galav MC, Hoff JT, McGilverady IE. Adjacent segment
disease after lumbar or lumbosacral fusion: review of the literature.
Spine 2004;29:1938–1944
11. Choia E, Goto K, Totohiki K, Tajima N. Analysis of the effect of lumbar
spine fusion on the superior adjacent intervertebral disk in the pres-
ence of disk degeneration, using the three-dimensional finite element
lumbar interbody fusion with the variable screw placement system: 10-
year results of a Food and Drug Administration clinical trial. Spine
2004;29:681–689
13. Rahm MD, Hall BB. Adjacent-segment degeneration after lumbar fusion
with instrumentation: a retrospective study. J Spinal Disord 1996;9:
392–400
14. Helenius I, Remes V, Yrjonen T, et al. Comparison of long-term func-
tional and radiologic outcomes after Harrington instrumentation and
spondylodesis in adolescent idiopathic scoliosis: a review of 78 patients.
Spine 2002;27:176–180
sharing posterior fixation device and its equivalent conventional device in
a calf spine model. Spine 1999;24:2206–2213
16. Ettenger CJ, Test report No. 27010119, 30.95. Rosenheim, Germany; Endolab
Mechanical Engineering, 2002;1–7
17. Lacefield WR. Current status of ceramic coating for dental implants.
Implant Dent 1998;7:315–318
2002;84:387–391
19. Guyer RD, Ohrnreiss DD. Lumbar discography: position statement from
the North American Spine Society Diagnostic and Therapeutic Committee.
Spine 1995;20:2048–2059
20. Wilke LS, Bateam JK, Hutchinson RH, Nelson WE. The paraspinous
Am 1968;50:919–926
21. Aeta Y, Kumano K, Hirabayashi S. Postfusion instability at the adjacent
segments after rigid pedicle screw fixation for degenerative lumbar
22. Esses SI, Doherty BJ, Crawford MD, Dreyzin V. Kinematic evaluation of
23. Kumar MN, Jacquet F, Hall H. Long-term follow-up of functional out-
comes and radiographic changes at adjacent levels following lumbar
spine fusion for degenerative disc disease. Eur Spine J 2001;10:303–313
24. Gillet P. The fate of the adjacent motion segments after lumbar fusion. J
Spinal Disord Tech 2003;16:338–345
25. Etrebar S, Cahill DW. Risk factors for adjacent-segment failure following
lumbar fusion with rigid instrumentation for degenerative instability.
after lumbar fusion: a review of clinical, biomechanical, and radiologic
27. Chou WY, Hsu CI, Chang WN, Wong CY. Adjacent-segment degeneration
after lumbar spinal posterior fusion with instrumentation in elderly
28. Booth KC, Bridwell KH, Eisenberg BA, Baldus CA, Lenke LG. Minimum
five-year results of degenerative spondylolisthesis treated with decompres-
sion and instrumented posterior fusion. Spine 1999;24:1721–1727
29. Aeberinsson P, Johansson K, Stromqvist B. The spondylolytic vertebra and
its adjacent segment: mobility measured before and after posteriora
struction on adjacent motion segment: comparison of aligned/klyphotic
posterolateral fusion with aligned posterior lumbar interbody fusion. J Neurosurg 2003;99:221–228


37. Fritzell P. Fusion as treatment for chronic low back pain: existing evidence, the scientific frontier and research strategies. Eur Spine J 2005;14:519–520


