Degenerative conditions affecting the lumbar spine are variously described as lumbar spondylosis or degenerative disc disease (DDD), which we regard as one entity. Clinically symptomatic DDD presents with low back pain (LBP) and/or associated leg symptoms. MRI is frequently applied as a diagnostic tool in the search for the source of back or leg pain. There are several disc-related and bone-related abnormalities that can readily be observed on lumbar MRI, including reduced signal intensity, irregularities of the nucleus’s shape, reduced disc height, anular tears, high intensity zones, changes in disc contour (bulging, protrusion, extrusion, and sequestration), nerve root compromise, endplate irregularities, Modic type changes, central and foraminal stenosis, degeneration and asymmetry of Z-joints, anterolisthesis and retrolisthesis. Disc degeneration is a product of lifelong degradation with synchronized remodelling of the disc and neighbouring vertebrae, including simultaneous adaptation of the disc structures to changes in physical loading and healing from the occasional injury with scar tissue formation. There is no standard definition of disc degeneration; therefore, determinations of its presence and severity vary widely and are determined largely by the technology used to interrogate the disc, i.e. radiographs, CT, MRI. The prevalence of disc-related degenerative findings on MRI images of the lumbar spine varies a lot and is depending on the disc level and other factors like age, environmental and behavioural influences, familial aggregation and heritability. Boden et al. have shown that disc degeneration at an average of three levels can be seen in up to 90% of people over the age of 60 years. Little is known about the segmental distribution of DDD in one individual. As a rule, L4-L5 and L5-S1 had the highest prevalence of all disc findings. The clinical significance of such findings is debatable, because these abnormalities are also commonly found in asymptomatic individuals. Boos et al. demonstrated that disc extrusion and neural compromise are common in patients with back pain and sciatica, Jarvik et al stated that moderate or severe central stenosis, root compression, and disc extrusions are likely to be diagnostically and clinically relevant and Kjaer et al found that Modic changes were
consistently and strongly associated with LBP, but considered hypointense signal and reduced height as well as anular tears, high intensity zones, disc bulging, and anterolisthesis as clinically relevant\textsuperscript{1}.

The treatment of degenerative disc disease remains one of the most controversial topics in the spine literature. Most authors agree that the primary treatment of patients with DDD is nonsurgical. Surgery is indicated in those cases that are refractory to nonsurgical care. Spine surgery has always followed three main strategies: decompression, stabilization, and correction of scoliotic or kyphotic deformities. Depending on the clinical and radiological manifestation of the degenerative lumbar disc disease, these procedures frequently need to be combined. The authorized indications for decompression are symptomatic compression of neural structures due to disc herniation or due to severe narrowing of the size of the spinal or root canal.

Up to now, there is no agreement which indications are best treated with lumbar fusion, and there are different fusion methods available from which a surgeon can choose. Despite evidence of higher complication rates associated with fusion and the paucity of evidence demonstrating efficacy of the procedure for most degenerative spinal conditions, the number of lumbar fusions, performed for degenerative conditions, increased by 220 % from 1990 to 2001. Rates of lumbar fusions rose most rapidly among patients aged 60 and above.\textsuperscript{6} All fusion procedures (i.e. uninstrumented, instrumented, PLIF, TLIF, ALIF) have their specific disadvantages. They all generate a considerable amount of morbidity and rate of complications. Moreover does fusion eliminate motion of the functional spinal segment and may overload the adjacent segments generating the transition syndrome and a high frequency of re-interventions.\textsuperscript{8}

These disadvantages lead to alternative procedures and techniques for stabilization without fusion: the non-fusion systems. Mobile stabilization systems have to neutralize noxious forces and restore normal function of the spinal segments on one hand, and protect the adjacent segments on the other. Implants for a mobile connection have been proposed for intervertebral (disc arthroplasty), for transpedicular and for interspinous application. DYNESYS is a pedicle system providing mobile stabilization controlling motion in any plane. (Picture 1) It is designed for the treatment of degenerative conditions of the lumbar spine that present with unstable motion segments.\textsuperscript{9} It aims at the restoration of stability in unstable conditions of degenerative origin as presented by some forms of degenerative disc disease as well as unstable forms of lumbar stenosis, be this dynamic or permanent. Thus, indications are conditions of instability with local lumbar pain as well as radicular pain and/or deficit.
DYNESYS is also designed to stop further progression of minor deformity frequently combined with spinal stenosis as are degenerative spondylolisthesis, early degenerative scoliosis, and the combination of the two. Dynamic neutralization has limitations. DYNESYS is not indicated in cases with severe advanced degenerative disc disease, where most of the disc tissue is missing and also in cases with gross instability, where this pedicle system is too weak (i.e. spondylolisthesis greater grade II). Most of the non-fusion systems are used in mono- or bisegmental pathologies.

Multisegmental disc disease is very often encountered in symptomatic back patients. Often the stage of the degenerative process is different in between the motion segments. We often see one motion segment with an advanced degeneration (disc collapse) neighboring one or more segments with just a mild discopathy (black disc/ anular tear (HIZ)) in the same patient. To detect the source of pain we advocate in such cases to perform a discography of the degenerated (MRI signs) discs. Patients with positive pain response to the discography in multiple segments are most difficult to treat. Long fusions have a bad reputation and the modern non-fusion techniques are not designed to address all multilevel disease.

But the real problem is, that spine surgery up to now always was an either/or solution, that means the surgeon decided to perform either a fusion or to apply a non-fusion technique to solve one patient’s problem. But why not address the pathology segment by segment? This means an advanced degeneration of an intervertebral disc as well as a gross instability of a motion segment should be treated by a fusion but a painful discopathy with still acceptable disc height and dysstability can be treated with a motion sparing non-fusion technology. DYNESYS as a pedicular system can be used for both tasks, that means fusion and non-fusion. Shortly after the introduction of the DYNESYS system we started to combine DYNESYS with a PLIF procedure in one segment and to use the system for neutralization in the adjacent segment/-s in the same patient. We termed this operation as the “hybrid stabilization”. To fuse a segment, DYNESYS acts as a posterior tension band, therefore the modular spacers are cut about 1-2 mm shorter as the measured distance between the two adjacent screw heads on each side and the system is fixed under maximal compression. Any intervertebral implant/cage to achieve a posterior or transforaminal lumbar interbody fusion (PLIF/TLIF) can be combined with DYNESYS. Since two years I personally prefer to use the OptiMesh implant as an intervertebral fusion device. OptiMesh is a three-dimensional mesh container designed to retain and reinforce granular grafting materials. (Picture 2) The tool set includes several key components for creating and filling cavities. The first instrument is an expanding reamer that allows the surgeon to create a cylindrical, elliptical, or spherical cavity.
within a hard tissue structure in a cavity that is larger (up to 2.5 times larger) than the entrance hole through which the tool is placed. The second key component is the specially designed Injection Tube(s). These tubes are long metal cylinders with thin rigid walls, having a highly polished internal wall surface. These tubes are filled with small allogeneic bone graft chips. The third key component is the injection tube loading tool.

The advantage of OptiMesh over other intervertebral implants (i.e. cages) that are applied in PLIF procedures are:

- Small and only unilateral entrance portal, either translaminar or transforaminal.
- Biological graft tissue (small bone allograft chips).
- Conforms to any intervertebral space, even big defects, for example after impression fractures of vertebral body endplates.
- Good primary stability due to big contact surface with vertebral endplates.

OptiMesh is CE Mark Certified in Europe for use in orthopaedic procedures, including those in the spine. OptiMesh 1500S, designed for interbody fusion, is currently the subject of a multi-center IDE study in USA. To date OptiMesh has been successfully implanted in an estimated 200 European spinal surgeries.

The hybrid stabilization technique with DYNESYS in combination with PLIF is subject of an ongoing prospective non-randomized study. We have evaluated pre- and post-operative pain and function in a consecutive series of 32 patients (15m/17f), with a mean age of 50.3 years (26-76) at surgery. One female patient was excluded from analysis due to cancer disease. Main indication was DDD, frequently combined with failed low back surgery syndrome or stenosis. All operations were performed by the author between May 1997 and November 2002; the mean follow-up-time was 39 months (24-90). 16 patient received a two level stabilization that means one level with fusion, one level with neutralization. 14 patients had a 3 level stabilization and another one a 5 level stabilization. 16 patients had one ore more previous spine operations.

Early postoperative complications occurred in 4 patients (one wound revision due to seroma, 2 urinary tract infections and one deep vein thrombosis). Leg pain and back pain improved significantly. Average Oswestry DI improved from 52% to 29%, with improvement in 29 patients. 19 patients (61%) showed an improvement of ODI of more than 15%. Detailed results disclosed clear radiological signs of a pseudarthrosis in one patient without clinical symptoms. In two patients radiolucent lines around screws were observed. So far no further operations have been necessary in this group of patients. Fig. 1 and 2 show two clinical examples of a hybrid stabilization with DYNESYS.
Segmental treatment of degenerative lumbar conditions with Dynesys in combination with a fusion procedure is technically feasible and yields a significant improvement in clinical outcome. Comparing with reported results in the literature the combination of a dynamic stabilization with a fusion procedure proves to be a good alternative to multisegmental lumbar fusion. Our findings compare favourably with reported results and are so far even better in respect to reoperation rates.\textsuperscript{11} Patient selection is the key determinant in successful outcome of these procedures.

Hybrid stabilization is a relatively new concept in spinal stabilization procedures. The combination of a rigid stabilization technique with a non fusion technique in the same patient is not restricted to the posterior dynamic stabilization devices. Combinations of anterior stabilization procedures, i.e. ALIF and total (or partial) disc replacement or even anterior and posterior stabilization techniques of either kind are possible. Most recently R. Bertagnoli et al. have presented different possibilities of hybrid constructs in the lumbar spine.\textsuperscript{12} Clinical datas of hybrid stabilizations are so far missing in the literature. Therefore the unrestricted use of hybrid stabilization can not be advocated today. Spine surgeons who perform these complex operations have to be experienced in fusion and non-fusion technologies and know exactly the limitations of these methods. Patient data have to be collected on a scientific base. Single – or multicenter studies should be performed to explore the clinical value of the hybrid stabilizations.

\begin{center}
\textbf{Picture 1:}
DYNESYS (Dynamic Neutralization System for Spine)
\end{center}
The DYNESYS system is composed of titanium alloy (Protasul 100) pedicle screws, polyethyleneterephthalate (Sulene-PET) cords, and polycarbonaturethane (Sulene-PCU) spacers.
OptiMesh: Surgical steps

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<tr>
<td>1) Reaming of cavity with expanding reamer</td>
<td>2) Introduction of OptiMesh implant</td>
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<td>3) Filling of OptiMesh with Bone graft through filling tubes</td>
<td>4) OptiMesh implant/graft in place</td>
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References:


Case 1 Legend
44 year old female, long lasting low back pain and radicular pain S1 due to recurrent disc herniation at L5/S1, and discopathy at L4/L5.
LWS 1CT: left sided recurrent disc herniation at L5/S1 with root compression S1
LWS 1 Discography lat: positiv memory pain on discography at L4/L5. Anular tear.
LWS 1 postop ap and lat: 1 year follow up. Hybrid stabilization with PLIF at L5/S1 with interbody titanium mesh grafts, DYNESY L4-S1, additional translaminar screw fixation at L5/S1right side.
Case II Legend
51 year old female with low back pain not responding to conservative treatment. Erosive spondylosis L3/L4, dysstability L4/L5 and L2/L3 (positive memory pain on discography) LWS 2 Inclination, Reclination: Dysstability at level L2/L3, L4/L5, end plate reactions at L4/L5 (sclerosis) LWS 2 MRI I & II: Multisegmental discopathy with Modic I reaction at L3/L4, discopathy at L2/L3, L4/L5 LWS 2 postop ap & lat: Hybrid stabilization with PLIF at L3/L4 with OptiMesh, DYNESYS stabilization L2-L5, postero-lat bone graft L3-L4