Low back pain is described as a deep pain surrounding the waist in a “belt style,” frequently seen in the midline, but which may spread to the hips and upper thighs. In recent years, degenerative disc disease has been observed as the most important result of low back pain. Tearing of the disc capsule, including nerve root irritation from the chemical substances that are expelled (chemical nociception) are major issues. This includes mechanical nociception, tearing of the facet joint capsule and the interspinous or supraspinous ligaments, as well as segmental instability, reflecting the most important aspects of the disease\(^1,2\).

Pathology occurring in the degenerated dynamic segment creates pain, although suppressing motion of the segment relieves related pain. Given these variables, surgical fusion has become the “gold standard” in disc degeneration and segmental instability. Later clinical trials showed that fusion surgeries failed to satisfy (mean ODI: 18.3) the expected outcome and caused a considerable number of complications. From a radiological perspective, fusion rates often increased to 95%, although clinical results were not that successful (approximately 70%). This indicated that solid bone fusion was not correlated with clinical success. However, in dynamic stabilization, relief of pain in the stabilized segment is aimed at limiting motion.

**Graf Artificial Ligament**

Henry Graf first used dynamic stabilization in 1980 and found\(^3\) that the use of the posterior dynamic stabilization technique, instead of fusion, improved chronic instability. Graf also developed an artificial posterior ligament system, aiming to relieve pain by limiting the motion of lumbar facet joints under compression forces. However, because the rear colon is stabilized during compression, canal and foraminal stenosis may develop following annular grinding. Researchers have attempted to develop new dynamic systems, following the long-term problems of Graf’s system\(^4\).

**Dynesys Stabilization System**

The Dynesys stabilization system was developed to compensate for the deficiencies of Graf’s system\(^5,6\). Biomechanical data showed that posterior stress band procedures decreased the resistance in the anterior annulus; annular protrusion and foraminal stenosis risk were minimized with an additional separator placed on the posterior stress band in this system. Range of motion (ROM) significantly decreased in the segment in which separators were placed, but it has been shown that it had no effect on axial rotation. Many studies found that it had a positive role in degenerative disc disease, although others concluded that it did not have any advantages to fusion\(^7,8\).

Strempel\(^9\) developed the first dynamic screw in 1999, by placing a hinge between the head and body of the transpedicular screw (Cosmic, Ulrich AG, Germany). This screw was initially used to facilitate fusion, but was also used for cases other than fusion;
patient complaints stopped, although pseudoarthrosis rates increased in these cases.

Biomechanically dynamic and rigid systems offer similar stabilization force. Hinged screws, coated with calcium phosphate, provide limited flexion and extension opportunity to the frontal colon during stabilization. They also distribute axial overload to the posterior colon with the help of a rigid rod. Posterior transpedicular dynamic stabilization systems protect segmental vertebral motion while maintaining a posterior stress band.

When dynamic screws and rigid rods are used in combination to stabilize multiple segments, the system loses its dynamic properties and becomes rigid. Therefore, dynamic screws should be used with dynamic rods when the stabilization of two or more segments is needed.

Dynamic stabilization systems, compared to standard rigid systems, offer sufficient stabilization with greater ROM but with less stress protection properties. These systems have been developed to increase the success of spinal surgery and to prevent fusion complications that occur with rigid instrumentation (3-55%), such as pseudoarthrosis, adjacent segment disease developing due to stress protection properties (12,2-18,5%), osteopenia (55), and loss of motion in spinal segment fusion. Successful results with dynamic screw and rod combination can be found in the literature (16, 17).

Instruments for Dynamic Stabilization of the Frontal Colon

These instruments support artificial intervertebral disc prostheses, disc cushions, and nucleus pulposus.

Surgical Equipment

Surgical equipment for spinal surgery includes C-arm fluoroscopy, operating microscope, high-speed drill, and percutaneous transpedicular dynamic stabilization system hand tools (Figure 1).

In addition, the use of a neuromonitoring system may also decrease the risk of surgical complications.
Patient Selection
Dynamic stabilization systems are used in patients with chronic instability, such as degenerative disc disease, recurring disc herniation, degenerative spondylolisthesis, and lumbar spinal stenosis. However, these systems are not suitable for patients with significant instability.

Layout of Operating Room
Patients should be in the procumbent position, while the C-arm fluoroscopy and monitor should be opposite to the surgeon. Physician assistants should also be opposite to the surgeon, with the nurse at the foot of the bed (Figure 2).

Surgical Technique
Posterior percutaneous dynamic stabilization should be performed under general anesthesia. One dose of prophylactic antibiotic (IV-1.5 g cefuroxime) can be administered a half-hour before skin incision is performed. The patient should lie in a procumbent position on the operating table, with the support of thorax and pelvis gel cushions (Figure 3). Posterior dynamic stabilization levels should be marked with C-arm fluoroscopy the associated x-ray machine is covered and the necessary cleaning is done.

After pathology is detected with C-arm fluoroscopy, 1.5 cm incisions are performed for any screw 3 cm from the midline towards the side. A first guide-wire is advanced from the previously marked pedicle towards the midline of the vertebral body, at which point a thread for the screw is opened with the help of corrugated drill: this dynamic screw is directed to the vertebral body through the guidewire in the frontal and lateral position, with verification

Figure 2: Schematic view of operating room

Figure 3: Patients position.
by the C-arm x-ray machine (Figures 4a, 4b, 4c, 4d, 4e and 4f). After the same procedure is performed for the opposite screws, target wires are withdrawn, while the rod is bent according to the physiological curvature of the patient: the system is locked in place by slipping on screw heads (Figures 4g, 4h, 4i and 4j).

After hemostasis is performed with the help of bipolar cautery and thrombin soaked gelfoam, epidural morphine or similar drugs can be used to alleviate post-surgery pain and enable a fast recovery. If sufficient hemostasis is obtained, there is no need for placing a drain. Fascia absorbable 0 Vicryl suture and 0.25% Marcaine are used subcutaneously, and then closed with 3.0 fast absorbable Vicryl. Steri-Strips® or Dermabond® can be used for closure because of their water resistant properties.

**Post Surgery**

**Post-operative** Care

After the patient is transferred to a hospital bed, non-steroidal anti-inflammatory drugs (NSAIDs) and myorelaxants should be started systematically; the patient is moved to loosen paravertebral muscles 4 to 6 hours after surgery, and is discharged from the hospital one day after surgery with NSAIDs and myorelaxant prescriptions.

**Complications**

Severe neurological complications from monoparesis to paraplegia can occur from penetration of the instruments to neural tissue. Injury in major veins or intra-abdominally can also occur due to use of guide wire or screws.

Operation area and instrument preparation (including the C-arm x-ray machine) and sterilization can prevent the formation of deep and superficial infections. Celebrospinal fluid (CSF) fistula can be repaired by suturing dura directly or with fat, as well as muscle and dura patches. “Fibrin glue” may be poured on the suture line to prevent CSF leakage for sutured dura.

**Sample case**

A 63 year-old male patient with hypertension and diabetes presented with low back and leg pain that continued for 30 days. Neurological examination was regarded to be normal, with the exception of low back pain. During radiological examination, degenerative Phase I spondylolisthesis and disc degeneration (Figures 5a, 5b, 5c and 5d) were detected at the fourth and fifth lumbar (L4-L5) vertebrae: a pain provocation test with discography was found to be positive. The percutaneous transpedicular dynamic screw rod system was performed on L4-L5 (Figures 5f, 5g and 5h). The patient was discharged one day after surgery.
Figure 5: a and b) AP and lateral lumbar sacral direct graphies of the patient after the surgery, c and d) T2 weighed sagittal and axial MR sections, e) Provocative discography in computerized tomography (CT) f) axial magnetic resonance (MR) images of dynamic screws after the surgery, g and h) bilateral lumbarsacral graphy after the surgery.
References


