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PERCUTANEOUS POSTERIOR FIXATION FOR DEGENERATIVE SPINE PROBLEMS

DEJENERATİF OMURGA SORUNLARINDA PERKÜTAN POSTERİOR FİKSASYON

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SUMMARY

Minimally invasive approaches to degenerative spine conditions have begun to be used more frequently in the last ten years, in order to minimize the disadvantages related to the traditional approach. There are a couple of advantages to using minimally invasive approaches as opposed to traditional open approaches. The incisions are small and require minimal muscle dissection and retraction. Surgical procedures, including instrumentation, can easily be performed through a tubular retractor. In this review, we discuss technical tips for percutaneous posterior fixation for degenerative spinal conditions, and recommended methods to lower the risk of complication.

Keywords: Percutaneous posterior fixation, degenerative spine.

Level of evidence: Review article, Level V.

ÖZET

Geleneksel yaklaşıma bağlı dezavantajları azaltmak için dejeneratif omurga sorunlarında minimal invazif cerrahi teknikler son 10 yılda daha sık olarak kullanılmaya başlanmıştır. Minimal invazif spinal cerrahinin geleneksel açık cerrahiye göre birçok avantajı vardır. İnsizyonlar küçüktür ve minimal kas disseksiyonu ve retraksiyonu gerekir. Enstrumantasyon da dahil olmak üzere cerrahi prosedürlerin çoğunluğu bir tübüler retraktörün içinden rahatlıkla yapılabilmektedir. Bu derlemede, minimal invazif omurga cerrahisi yöntemlerinden biri olan perkütan posterior fiksasyonun dejeneratif omurga sorunlarında uygulamalarına yönelik teknik bilgiler ve komplikasyonlardan korunmanın yolları vurgulanmıştır.

Anahtar Kelimeler: Perkütan posterior fiksasyon, dejeneratif omurga

Kanıt Düzeyi: Derleme, Düzey V.

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INTRODUCTION:

The main aim of minimally invasive spine surgery is to damage the normal anatomy and surrounding tissues a minimal amount, while effectively treating the underlying pathology. Percutaneous spine fixation is a common method, and it aims to provide less pain, less scarring, less blood loss, a shorter recovery duration and a shorter hospitalization period after surgery. In an experimental study conducted using rats by Kawaguchi et al.[3], they showed that subjects whose back muscles continuously received traction for two hours had more damage than subjects whose back muscles were relaxed for five minutes after one hour and forty minutes of traction. In a study by Taylor et al., in which theymeasured the intramuscular pressures of 20 patients and performed muscle biopsies[6], they detected an obvious increase in pressure, and therefore decreased muscle function, during retraction.

Traditional open surgery requires tearing off muscles from the bone in the region, with a long surgical incision and long-term retraction. This causes more soft tissue damage and a longer recovery period. Minimally invasive surgical applications have increased in recent years and become popular. In this review, we aim to investigate the outline of percutaneous posterior fixation for degenerative spine problems that surgeons commonly encounter.

THE ADVANTAGES OF PERCUTANEOUS POSTERIOR FIXATION:

The main advantages of percutaneous posterior fixation are that the muscle and soft tissues are preserved, the function of the paraspinal muscle is protected, the infection risk is lower, the postoperative pain is reduced, resulting in less treatment for postoperative pain, a more rapid recovery is provided, there is less bleeding and a shorter hospitalization period, the small incisions are less irritating cosmetically, and patients can return to their daily lives sooner.

General Indications:

1. Instability due to spondylolisthesis and degenerative disc disease;
2. Large and repeated disc hernia;
3. Instability after laminectomy;
4. Degenerative scoliosis.

General Contraindications:

1. Obesity with a body mass index of more than 40;
2. Phase 3–4 spondylolisthesis;
3. The presence of previously applied instrumentation that should be prolonged or removed.

OPTIONS FOR PERCUTANEOUS FIXATION:

Percutaneous posterior fixation can be performed with transpedicular screws or facet screws and is most commonly applied with the following procedures. We commonly use transpedicular screws in our practice.

1. Anterior lumbar interbody fusion (ALIF) and percutaneous posterior fixation;
2. Minimally invasive transforaminal lumbar interbody fusion (MIS-TLIF) and percutaneous posterior fixation;
3. Minimally invasive posterior lumbar interbody fusion (MIS-PLIF) and percutaneous posterior fixation;
4. Extreme lumbar interbody fusion (XLIF) and percutaneous posterior fixation;
5. Axial Lumbar Interbody Fusion (AxiaLIF) and percutaneous posterior fixation.

Surgical Technique:

When the surgeon decides to carry out percutaneous pedicle screw fixation, he should consider the key points listed below.

1. The lumbar spine anatomy, especially the pedicle anatomy, should be known in detail, as normal anatomical landmarks cannot be observed;

2. The patient should be in a suitable position on the operating table;

3. The presence of experienced personnel in the operating room is important during the use of fluoroscopy;

4. The use of intraoperative neuromonitorization is important to detect any misplaced pedicle screws;

5. Good knowledge of the implant system in use is important to resolve intraoperative problems.

The positioning of the patient and the placement of fluoroscopy are important for orientating the start points of the operation and the pedicle screws. The most important steps are to pass the guide wire from the lateral of the medial wall of the pedicle (in an AP image) when a lateral fluoroscopic image is at the connection point of the pedicle and vertebral body. However, it should be considered that fluoroscopy alone gives 68% accuracy for the placement of pedicle screws. Extra electrodiagnostic methods (nerve root monitorization) can increase this sensitivity to 98% for the detection of a misplaced pedicle screw. Nerve root monitorization can be dynamically performed using awls, taps, or guide wires, and it can also be performed statically after placement of the screw. The first stage in providing a suitable position to the patient is that the patient should be laid down in a prone position. The surgeon should ensure that the spine of the patient is parallel to the ground and vertical to the fluoroscopy that is locked at 0°. After correct positioning of the patient, fluoroscopic imaging of the pedicles is carried out. In fluoroscopic pedicle imaging, it is important to set the fluoroscopy at defined angles according to the anatomical structures.

In an AP image, the superior end plate of the vertebra should be in parallel with the nucleus of fluoroscopy. After detection of the transverse projection in an AP image, the incision is performed. A skin incision is carried out between the midline of the projection and the lateral end. The incision site is determined according to the weight and height of the patient. As the body size of the patient increases, the incision should be shifted laterally. After incision, a Jamshidi needle is inserted and moved towards the entry site in the bone by passing through the fascia and all layers. In an AP image, a guide wire is passed through the inside of the Jamshidi needle and pedicle, to the lateral of the medial pedicle wall. The guide wire is left at the entry hole and the Jamshidi needle is removed. The same process is applied for the other pedicle. Fluoroscopy is taken to the lateral position and the correct placement and orientation of the guide needle in the pedicle is confirmed. While the guide wire is being moved to the pedicle-vertebral body junction, a lateral image should be used, while an AP image should simultaneously be used for the pedicle. After this stage, procedures differ for specific instrumentation systems. Here, the CD Horizon Sextant II system (Medtronic Sofamor Danek, Memphis, TN) will be described as an example.

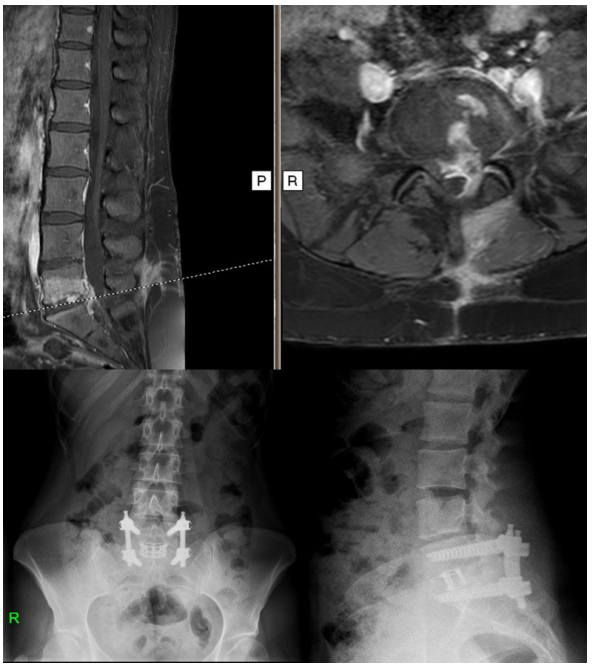

Figure-1. Female patient aged 31 who had lower back pain and left radicular pain after discectomy for nine months. She received ALIF in the first session and percutaneous posterior fixation in the second session, and her complaints still remained after conservative treatment and epidural steroid injection.

Serial incision expanders are placed through the guide wire and the pedicle is tapped with a cannulated tap placed over the guide wire. The other pedicle is also prepared with the same process. After preparation of the pedicles, the expanders are removed. Cannulated pedicle screws are placed through the guide wire. At this stage, neuromonitorization is used to test whether the pedicles are intact and to confirm that the pedicle screw is inside the pedicle and the nerve tissue is protected. The same process is carried out for the second pedicle screw. A sextant alignment guide is placed with a rod suitable to the length projections of the screws, and a small incision is performed proximally. The rod is placed from this incision with the help of the guide. Then, the hill nuts of the pedicle screws are placed inside the screw projections and tightened. Clinical application samples are shown in Figures 1–4.

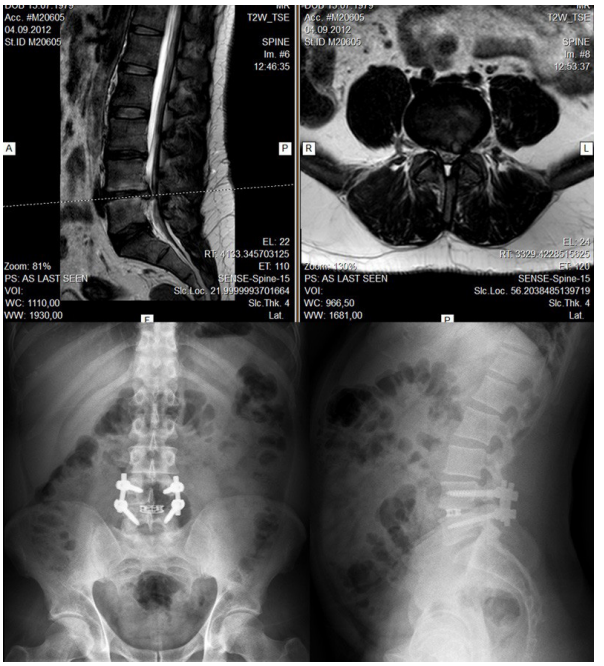

Figure-2. Male patient aged 27 who had discectomy one year previously. Radicular pain through the lower back and left leg was present with recurrent disc herniation. MIS-TLIF was applied to the patient, who did not respond to conservative treatment and transforaminal epidural steroid injection.

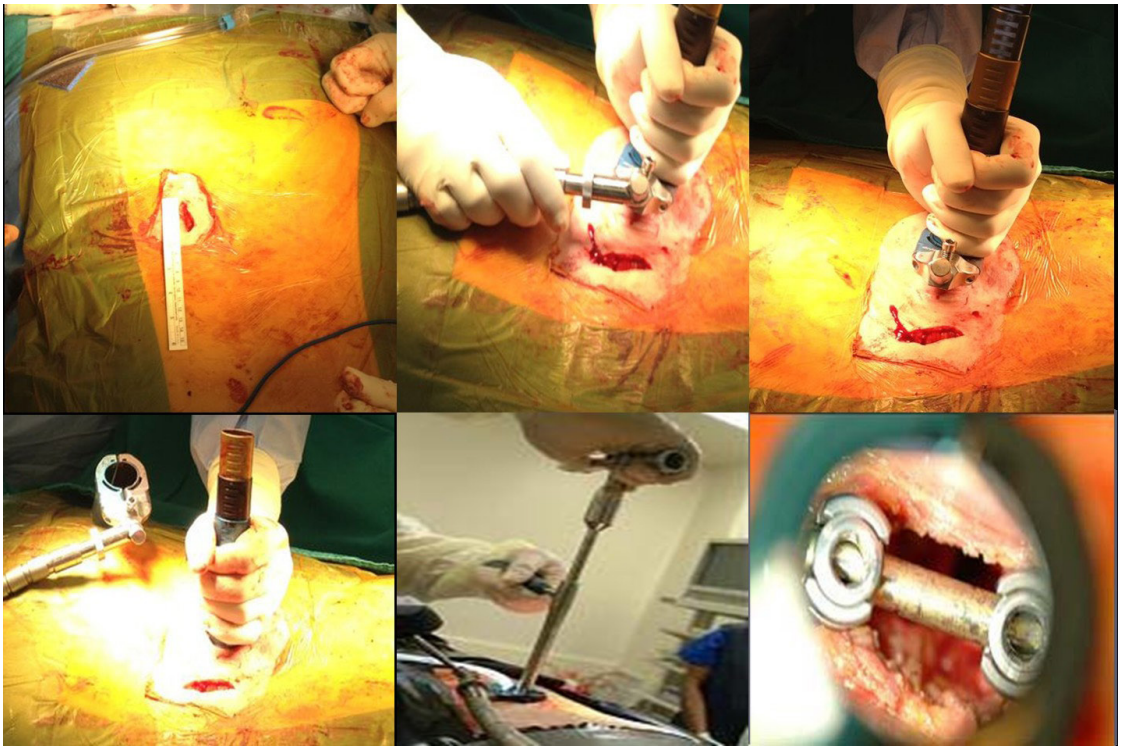

Figure-3. MIS-TLIF application showing placement of tubular retractors though the minimal incision with the help of a dilatator, and pedicle screw application from the same incision and the inside of retractors.

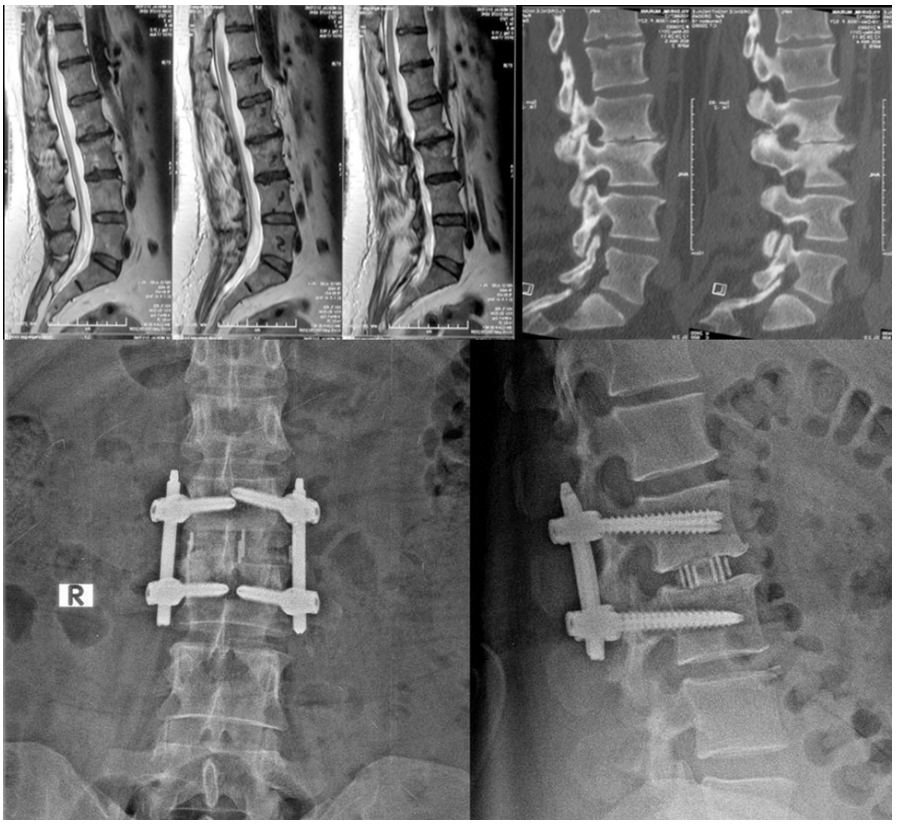

Figure-4. XLIF in the first session and percutaneous posterior fixation in the second session were applied to a female patient aged 52 with severe lower back and right groin pain.

DISCUSSION:

Traditional pedicle screw application requires wide dissection, and so obvious damage occurs to the surrounding soft tissues. Retractors used in classical open surgery cause relative compartment syndrome in muscles, and neurogenic damage consequently occurs due to disruption of the blood circulation of the muscle[3,6]. There are many advantages to minimally invasive spinal surgery when compared to traditional open surgery. The incisions are small, and it requires minimal muscle dissection and retraction. Surgical procedures including instrumentation can be easily carried out through a tubular retractor. This prevents muscle devascularization, denervation and facet joint damage. With minimally invasive techniques, the muscles, the most important dynamic stabilizers of the spine, remain functional. When compared to traditional open surgery, it seems that minimally invasive techniques markedly reduce the surgical duration, blood loss and postoperative pain[5]. In a study including 20 patients, Datta et al.[1] showed that the VAS, ODI and SF36 scores at month six were worse for the patients who received retraction for more than 60 minutes, and this situation was not dependent on retractor type, surgeon, or incision length.

To reduce the disadvantages due to a traditional approach, minimally invasive techniques have begun to be commonly used in degenerative spine problems in the last ten years. Initially, a posterior minimally invasive approach was used for cases requiring basic decompression such as discectomy or foraminotomy. With the development of clinical experience and implant systems, pedicle screw fixation and interbody fusion have begun to be performed in minimally invasive ways.

Minimally invasive spine surgery requires good topographical anatomical knowledge and the ability to perform operations through small study portals. This is only possible with the use of good intraoperative imaging and suitable implants[5]. However, it should be considered that these methods have a learning curve. During the learning curve, although the application of posterior pedicle screws can take longer than traditional open surgery, this duration decreases with experience. During the learning curve, care must be taken to avoid intraoperative complications with solutions that are difficult using small incisions. In a study including 20 patients treated with percutaneous screw fixation and minimally invasive interbody fusion with a cage, Isaacs et al.[2] evaluated these cases and compared this with the traditional method. They showed that the intraoperative blood loss and average duration are significantly reduced when compared to the traditional method. In a study including 80 patients, Kotani et al.[4] compared MIS-PLIF with percutaneous pedicle screw fixation and open PLIF surgery. They found that intraoperative and postoperative bleeding was less in the MIS-PLIF group than the other group, and the ODI scores were lower in the MIS-PLIF group postoperatively, in the second week and at 3, 6, 12 and 24 months.

As a result, percutaneous fixation has many advantages when compared to other fixation methods. When the basic rules are followed, percutaneous posterior fixation can be safely applied with the help of two-panned fluoroscopy. Indications of static stabilization increase by modifying these systems, and minimally invasive dynamic systems have begun to be used.

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