Minimally invasive double approach (anterior and posterior) to the lumbar spine in revision surgery

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Introduction

Minimally invasive surgical approaches (MIS) to the lumbar spine have rapidly evolved, and the technical feasibility and safety of minimally invasive interbody fusion is well established. Revision surgery is technically more challenging and may cause avoidance of such approaches because of altered anatomy and absent bony landmarks. Furthermore revision surgery is often associated with an increasing complication rate. Description of minimally invasive surgery approaches among revision patients and the feasibility of such techniques demands clarification [8]. In some cases the result of a double approach, combined anterior (minimal invasive ALIF) and posterior (dynamic neutralization with MIS paraspinal approach) is less invasive in terms of duration, bleeding and recovery compared to a pure, single posterior traditional approach [11, 16]. The anterior approach has several advantages over the posterior: allows direct access to the disc, avoids epidural fibrosis and, above all the damage of the back muscles due to denervation often responsible for residual “low back pain” [9, 14]. The development of new technologies has led to the introduction of the concept of minimally invasive spinal surgery [1, 2, 4]. At the lower-lumbar levels (L4–S1), the anterior

approach can be performed through a small video-assisted retroperitoneal exposure, allowing optimal illumination and magnification of the fieldwork [1, 5, 6]. The Wiltse approach has been described in 1968 [10]. It is an intermuscular lumbar approach with two vertical incisions made at 30 mm each on both sides of the midline. In this paper, the goal of the authors was to determine the advantages of a double approach to perform a solid fusion in L5–S1 from the front and a dynamic neutralization in L4–L5 with pedicle screws (Dynesys) from the back through the paraspinal approach dealing with a case of failed back surgery (posterolateral fusion for DDD L5–S1 and interspinous device L4–L5).

Case description

45-year-old-woman, normal weight.

- Worsening of severe chronic low back and buttock pain about 5 years left.
- Operated 3 years before of an instrumented posterolateral fusion (PLF) L5–S1 and interspinous device (ID) in L4–L5 for severe degenerative disc disease L5–S1 and mild instability L4–L5. Worsening of the symptoms after this operation.
- Has performed several cycles of physiotherapy and rehabilitation without benefit.
- Has performed several pain procedures (epidural steroid injections, medial branch denervation) without any benefit. Daily opioids intake.
- Positive L4–L5 facet joint injection test (2 h benefit).

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VAS 9; Oswestry score 48.

Physical examination: Lasègue negative; no deficit; severe limited movement of the lumbar spine in flexion and extension to pain.

X-rays: presence of rods and pedicle screws in L5–S1 without any signs of fusion. Presence of ID in L4–L5. Narrowing of L5–S1 disc space without mild L4–L5 instability (flex-ext, X-rays). CT scan and MRI: degenerative disc disease L5–S1 (Pfirschnig 4), mild discopathy L4–L5. No evidence of fusion in L5–S1.

Surgical procedure

The first step is the anterior approach for L5–S1 ALIF. The supine position is used to address L5–S1. At this level, the intervertebral space is easily approached from anterior. If fluoroscopy might be needed to identify the level to be operated on, special care is taken to position the patient in a manner that allows proper C-arm movement over and around the operative level. The whole procedure is performed by the same surgeon without any access or vascular surgeon, and the execution time was 75 min. The approach is performed through a Pfannenstiel amended incision of about 4 cm on the projection of the L5 disc. After the incision of the anterior sheath, the left rectus muscle is raised up, and then through a blunt dissection, retroperitoneal space is quite easily reached. Introduction of the endoscope (with an angle of 30°) connected to a monitor allows optimal illumination and magnification. Next step is to identify the structures to take care and mobilize: genitofemoral nerve, ureter, bowel and iliac vessels. L5–S1 is seated caudal to the aortic bifurcation and exposed by dissection over the psoas muscle and the left iliac vessels. The abdominal retraction system is placed to retract the peritoneal sac medially with the ureter, and further dissection is performed to expose L5–S1. Mobilization of the iliac vessels needs great care because of possible adhesions. This especially accounts for the left common iliac vein as this often runs across the L5–S1 disc. Careful use of cautery is advised to minimize the risks of retrograde ejaculation, impotency, and vaginal numbness owing to damage of the hypogastric plexus. The median sacral segmental vessels need to be tied or coagulated, when possible, through the use of bipolar coagulation in order to avoid injury of the sympathetic plexus as well [3]. Then disc space will be easily identified. After exposure, the surgeon puts in place the endoring system (retractor pins) to give a wide and stable exposure [1]. Then the entire disc is carefully removed by using a chisel and rongeurs to obtain a complete discectomy. Perfect preparation of the end plates, stretching of the posterior annulus and interbody fusion using a tantalum cage (10 mm TM 400 Zimmer) filled with

tricalcium-phosphate is then performed. Finally a neutralization plate (Pyramid-Medtronic) with three 6.5×35 mm screws was placed. After ensuring that there are no vascular lesions to be addressed, the retraction system is removed. The wound is closed in layers in the standard manner. A suction drain is in place for 24–48 h. Second step is the posterior approach (hardware removal and dynamic neutralization L4–L5).

Two lateral incisions made of 30 mm each on both sides of the midline. The two lateral incisions have the advantage compared to a single median incision of being short, and of allowing a direct access to the muscular plan of cleavage without subcutaneous detachment, with a less pressure retraction. It is a longitudinal separation of the sacrospinalis group between the multifidus and longissimus. Found the hardware of the previous surgery all four screws and rods were removed and the dynamic system (Dynesys-Zimmer) was implanted. New revision screws (7.2×45) in L5 and standard (6.4×45) in L4 were implanted as well as the cords and spacers to neutralize facet joints hypermobility. ID was not removed to avoid a new incision. Two suction drains were in place for 2 days. The execution time of MIS posterior approach was 55 min. Total execution time was 130 min (surgical time). Total bleeding was 120 cc.

Postoperative information

Postoperatively opioids are used for pain control (in the first 48 h), then NSAIDs (Ketorolac). The patient is mobilized on the first day postoperative using a lumbar corset for about 2 weeks. The discharge occurs, in absence of complications, on the fifth postoperative day. After about 20 days the patient is starting water exercises (in a pool), stretching and muscle strengthening. Moderate physical activity can be resumed after about 60 days.

Discussion and conclusion

Revision surgery is technically more challenging and may often be associated with an increasing complication rate. Description of minimally invasive surgery approaches among revision patients and the feasibility of such techniques need to be clarified. In some selected cases the result of a double approach, combined anterior (minimal invasive ALIF) and posterior (dynamic neutralization with MIS paraspinal approach) is less invasive in terms of duration, bleeding and recovery compared to a pure, single posterior traditional approach. Open retroperitoneal exposure to the lumbar and lumbosacral spine can be performed safely but requires high surgical skills and a long learning

curve to minimize and address possible complications (vascular). A small 4–5 cm skin incision and a video-assisted retroperitoneal exposure allow optimal illumination and magnification of the fieldwork ideal for L5–S1 and L4–L5 exposure. This technique offers a direct access to the intervertebral disc and permits, by means of a thorough discectomy, the total removal of the chemical and mechanical nociceptive stimulation. The anterior approach avoids muscle damage and neurologic risks inherent to the posterior approach with no blood loss whether in case of fusion (ALIF) [7].

The standard posterior approach to the spine induces muscle denervation and atrophic changes, which can lead to persistent low back pain and prolonged postoperative rehabilitation. The factors responsible for muscle injury during surgery have been well studied in both animals and human beings. Direct injury to the muscle is caused by dissection and stripping of tendinous attachments from the posterior elements of the spine [13]. Additionally, extensive use of the electrocautery causes localized thermal injury and necrosis to the tissues. However, the most significant factor responsible for muscle injury is likely because of powerful self-retaining retractors [15]. The Wiltse approach has been described in 1968 to minimize this. It is an intermuscular lumbar approach with two vertical incisions made at 30 mm each on both sides of the midline. We think that an incision at 30 mm from spinous processes is less noxious for the skin because it is located at the border of two vascular territories, which depend of a median network for one, and a lateral network for the other [12]. The Dynesys spinal system (Zimmer Spine, MN) is a pedicle screw-based dynamic stabilization system consisting of titanium pedicle screws, hollow polycarbonate urethane (PCU) spacers, and polyethylene terephthalate (PET) cords. The Dynesys system intends to provide spinal column “soft stability” by changing spinal load distribution on the disc and facet joints while preserving motion of the stabilized segment, and hence, convey minimal effects on adjacent segments [17]. Both procedures (MIS anterior and paraspinal posterior) give the advantage to reduce surgical time, spare muscles, reduce bleeding allowing a prompt recovery to the patient. This kind of MIS leads to a quick recovery even in selected cases of revision surgery when a hybrid construct (fusion and dynamic) is needed. Minimally invasive lumbar interbody fusion associated to a dynamic pedicle screws neutralization by revision surgery is technically feasible and is not associated with more blood loss or neurologic morbidity. However, revision surgery has a higher minor perioperative complication rate. These outcomes demand significant experience before

attempting minimally invasive revision surgery in the lumbar spine.

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