

The Anterior Retroperitoneal Approach to the Degenerative Lumbar Spine: Clinico-Therapeutic Remarks

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Keywords: ALIF; XLIF; Anterior lumbar surgery; Retroperitoneal surgery; Lumbar spine; Lumbar disc arthroplasty

Introduction

The anterior approach is a well-known surgical technique for the treatment of degenerative diseases of the lumbar spine. Through this approach is possible to perform arthrodesis, arthroplasty, discectomy, corpectomy to treat a lot of degenerative conditions. The ALIF procedure is one of the most widely used technique, and is argued to have biomechanical advantages over posterior approaches for lumbar spinal fusion: restoration of disk height and lumbar lordosis, reduction of listhesis, restoring of coronal and sagittal balance. Through this approach is also possible to perform a lumbar disc arthroplasty, a motion preservation technique which aim is to restore the biomechanical properties of the lumbar spinal motor unit. Moreover, in a more recent period, a lot of alternative anterior approaches are described and used, such as Extreme Lateral trans-psoas approach (the XLIF technique). In the current clinical practice, anterior approaches seem to play an extremely important role for the management of lumbar degenerative diseases. In this editorial we want to describe systematically the classic anterior approach, highlighting advantages and disadvantages of the surgical technique and related complications based on personal experience and literature review. Aim of this article is to provide an updated window on the surgical technique for the anterior retroperitoneal approach, frequently used for the treatment of degenerative pathology of the lumbar spine.

The ALIF Technique

Anterior lumbar interbody fusion ALIF is a commonly performed procedure for the treatment of degenerative diseases of the lumbar spine. ALIF was first described by Capener in 1932 for the treatment of spondylolisthesis [1] and Ito et al. in 1934 for the treatment of Pott disease [2], and it has since become a widely-used technique for the treatment of a range of lumbar spine disorders. The ALIF technique didn't make significant improvements until 1980s, when several advancements were made to reduce morbidity including bone grafting substitutes, metallic hardware instrumentation, improved surgical technique and superior lighting and retraction [3-5]. However, the controversy regarding which is the best surgical approach to treat the degenerative lumbar spine still exists [6]. Despite being an established treatment option, current indications of ALIF are yet to be clearly defined in the literature [7,8]. Obviously the ALIF option could be taken in consideration when an interbody fusion is mandatory; in the light of this is important to underline that the ALIF technique allows one of the better fusion surface in the disc space, due to the big dimension of the cage. The indications for ALIF surgery are directly related to the surgeon (her/his comfort with the approach) and could varies relating to the disease. ALIF has some biomechanical advantages over posterior approaches for lumbar spinal fusion. Firstly, is a direct access to the anterior column and permits a very clear surgical exposure: moreover, the possibility to insert a big cage is extremely important because the bigger is the contact surface between cortical bone and cage, the better is the bone fusion obtained [2,3,9-13]. From a biomechanical point of view, the ALIF technique could restore lumbar lordosis or allows a correction of a lumbar kyphosis in a better way than an only posterior

approach, achieving coronal and sagittal balance [2,3]. Moreover, the possibility to use a high lordotic interbody cage is extremely useful to redistribute the weight-bearing to the original ratio. Compared to the other posterior approaches, the anterior one reduces blood loss, operative times, and lack of blood transfusion, spares iatrogenic trauma to the paraspinal musculature, posterior spinal nerves and posterior bony elements compared to posterior lumbar interbody fusion (PLIF) or the transforaminal route (TLIF). The surgical technique is well known: the patient is in supine position; this is the first advantage because avoid all of complications related to prone position used in the classic posterior approaches. A lateral fluoroscopic image should be obtained before incision to localize the surgical level, so the fascia of the muscles rectus abdominis can be incised and mobilized. The fascial incision can be made either horizontally (in line with the skin incision) or vertically (surgeon's preference). Anatomic landmarks are fundamental: At the L5-S1 level, there is the bifurcation of the aorta and vena cava; at the L4-L5 disk space level, the great vessels are retracted to the right side and the ascending lumbar vein may need to be ligated to mobilize the vessels. The rectus sheath, posterior to the rectus, is incised for exposing the retroperitoneum. Care should be taken to identify the ureter. At L5-S1, the median sacral artery may need to be ligated or cauterized prior to the disk space exposure. Once the disk space is identified, an annulotomy can be made with either a knife or an electrocautery device. Care is taken to preserve the integrity of the vertebral end plate. It is helpful to identify the midline prior to make the annulotomy, for the appropriate positioning of the implant in the anteroposterior direction. Endplate violation may result in implant subsidence and migration. Lateral fluoroscopy should be used to recess the implant below the level of the anterior vertebral body margin. Concerning the postoperative management, the patients were encouraged to walk within 24 hours of surgery. The rehabilitation and the level of physical exercise were based on the recommendation of the treating surgeon. The indications for an ALIF vary from patient to patient. The ideal candidate has chronic, disabling Low back pain due to 1 or 2 levels degenerative disease [2,11,12]. All conservative, medical approaches must be exhausted and pain is refractory to these methods [2,12]. Patient selection is the main step for successful outcomes (osteoporosis or infection are a contraindication). In literature is demonstrated that ALIF has been employed widely in isthmic and degenerative spondylolisthesis with good outcomes because provides slip reduction and a biomechanical solution to the anterior translational instability. In case of high dysplastic developmental spondylolisthesis, the posterior approach

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Received November 07, 2016; **Accepted** December 01, 2016; **Published** December 03, 2016

Citation: Landi A, Maiola V, Delfini R (2016) The Anterior Retroperitoneal Approach to the Degenerative Lumbar Spine: Clinico-Therapeutic Remarks. J Spine 5: 347. doi: [10.4172/2165-7939.1000347](https://doi.org/10.4172/2165-7939.1000347)

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with decompression and fusion with screws and rods must be always associated with an anterior support such as ALIF. The literature shows that ALIF is a long-term solution to radicular symptoms (leg pain and neurological deficits) because permits an indirect decompression through the enlargement of the neural foramen and the retensioning of the ligamentum flavum. In case of Degenerative Disc Disease DDD, the clinico-radiological pathway should be extremely different: In DDD with mechanical pain, the disc is considered the primary pain generator: the surgical intervention is targeted to removing the intervertebral disc because disc degeneration and posterior annular fissuring are causes of mechanical pain; In DDD with foraminal stenosis the overriding issue is radiculopathy caused by nerve root compression. The segmental stenosis and radiculopathy is a result of disc herniation, posterior osteophyte formation, facets overriding and hypertrophy that reduces neuroforaminal and canal volume. In this case the surgical choice is directly dependent to the grade of decompression, to the grade of deformity correction and the grade of stability that the pathology requires. In the light of this ALIF is considered a reliable option in degenerative lumbar scoliosis because it allows for thorough release of contracted tissue and osteophytes, complete discectomy and distraction of the intervertebral space and placement of a larger interbody fusion device. Additionally, ALIF can be used as a revision surgery option in case of pseudoarthrosis.

Lumbar Total Disc Replacement Technique

Through the same anterior retroperitoneal approach is possible to perform a Lumbar disc arthroplasty also called total disc replacement: The lumbar total disc replacement (LTDR) was introduced for the first time for the surgical management of DDD [14]. Lately, LTDR has been expected to replace fusion surgery therefore a great deal of LTDR reports has come out: the prospective randomized controlled studies were expected to elucidate whether for LTDR to have therapeutic benefit compared to fusion. The results revealed that LTDR was not inferior to fusion. In 1984, Schellnack and Buttner-Janz in Germany implanted the prosthesis using anterior approach [15] The implant was a semi-constrained type of lumbar artificial disc (LAD) and comprised two metallic upper and lower plates and a sliding polyethylene core. Since then, many different designs and composition of LAD have been launched. LAD can be classified into 3 types, per the direction of back motion limitation: non-constrained, semi-constrained with translation and semi-constrained without translation. Non-constrained design has no specific limitation in its mobility; semi-constrained design has two types, the one has no specific limitation including partial translation, the other no specific limitation but translation. The contraindications for LTDR include conditions that may compromise the safety and integrity of the implants as: vertebral fractures, spondylolisthesis of any grade, osteoporosis, previous laminectomy or laminotomy, history of major intraperitoneal surgeries, severe abdominal obesity. The efficacy of LTDR is extremely debated, in the light of controversies showed about cervical arthroplasty. Many studies described poor results in terms of heterotopic ossification or dislocation of the prostheses in the cervical spine, so many doubts are emerging concerning lumbar arthroplasty; thus, because the biomechanical properties of each type of disc prosthesis, both cervical than lumbar, does not reflect the biomechanics of the functional spinal motor unit in terms of resistance and mobility. In this way, the physiological evolution of a total disc arthroplasty is unavoidably the progression of the degeneration. Long term results are available only for the cervical arthroplasty; Consequently, longer follow-up should be necessary yet to observe any complications.

Complications of the Anterior Approach

Historically, the anterior retroperitoneal approach hasn't been

considered the first surgical choice because of the difficult technical elements required and the complications were considered too high for the potential benefits [6,9,10]. Nowadays, improvements in instrumentation, retraction and surgical techniques issues has led the anterior surgery the main approach, particularly in degenerative pathologies which requires biomechanical and structural restoring [6,9,10,16]. Approach-related complications are distinct from those of posterior approaches to the lumbar spine and predominantly relate to visceral and vascular injuries. The published rates of vascular injury vary considerably, ranging from 1.9% to 24%, [17,18] and the complication occur most commonly in the L4–L5 disk space [19]. Laceration of the left common iliac vein is the most commonly reported injury [19], whereas arterial injuries are much less frequent, with the rate of injury to the left iliac artery reported to be 0% to 0.9% [19]. Other vascular complication includes laceration of the ilio-lumbar vein, avulsion of the median sacral and lumbar vein, and injury to the inferior vena cava or abdominal aorta, as well as thrombosis of the left iliac artery and retroperitoneal hematoma. Visceral complications are uncommon and include inadvertent enterotomy and ureteric injury. Injury to neural structures can result in femoral nerve palsy [20], retrograde ejaculation, erectile dysfunction, and sympathectomy manifesting in symptoms such as altered lower limb temperature and unilateral lower limb edema. Incomplete discectomy can result in retropulsion of fragments into the canal. A laterally and posteriorly placed implant can cause neuroforaminal impingement. Poor bone quality and healing potential may result in a symptomatic pseudoarthrosis. Retrograde ejaculation is rare but possible, particularly at the L5–S1 level.

Conclusion

Thoraco-lumbar spine is particularly affected by degenerative issues, affecting 60% to 70% of the population. Patients can present with a broad spectrum of problems from minimal symptoms to severe pain and marked disability, that often play a significant role in the surgical care and treatment offered by spine surgeons. The anterior retroperitoneal approach appears to be a viable option in several degenerative pathologies of the lumbar spine, clearly depending to the surgeon and to the patient conditions, and could be performed alone or in association to a posterior approach. In many cases the anterior approach must be always performed, such in high dysplastic spondylolisthesis in association with a posterior approach. In other cases, the surgical choice mainly depends to the surgeon and to the clinico-radiological results to be achieved.

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