Clinics in Surgery

Research Article
Published: 27 May, 2021

Avoiding Cage Dislodgement after L5 Corpectomy: Technical Note

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Abstract

Objective: This technical note describes a simple, easily reproducible, and economical technique for securing an L5 cage after an anterior corpectomy. According to biomechanical and anatomical characteristics of the lumbosacral level, cage dislodgement after an L5 corpectomy is a challenging complication.

Methods: Based on a case report, the operative technique described consists of introducing two small screws in the superior plate of S1 avoiding an anterior displacement of the cage.

Results: These screws favor an adequate location of the cage, diminishing pseudoarthrosis, and vascular or abdominal injuries secondary to the cage dislodgement.

Conclusion: We suggest keeping in mind this technique in cases with an increased risk of cage displacement, or reoperations, which patients have an anatomical impossibility to secure the cage with an anterior plate. It could be a helpful resource in these cases.

Keywords: L5 burst fracture; Anterior retroperitoneal lumbar corpectomy; Lumbar cage dislodgement; Technical note

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Received Date: *20 Apr 2021*
Accepted Date: *20 May 2021*
Published Date: *27 May 2021*

Citation:
de los Ángeles Cañizares-Méndez M, Valencia-Anguita J, López-González A, Márquez-Rivas J, Díaz-Cano Carmona I, Jiménez-Mejías ME. Avoiding Cage Dislodgement after L5 Corpectomy: Technical Note. Clin Surg. 2021; 6: 3193.

Abbreviations

CT: Computed Tomography; Post-op CT: Post-operative Computed Tomography

Introduction

L5 burst fractures are a rare pathology, usually due to axial compression, that involves a 1.2% of spine fractures, and a 2.2% of thoracolumbar fractures [1].

They have two main indications for surgery: neurological impairment due to cauda equina or nerve root injuries, which require decompression; and spinal instability, which requires lumbosacral fixation [1].

The fifth lumbar vertebra has unique anatomical and biomechanical characteristics. In addition, in many cases an anterior or anterolateral surgical approach is needed to secure the anterior column. Corpectomy of L5 is a challenging surgery where complication rates can reach 36% in tumoral cases or reoperations. The special anatomical and biomechanical characteristics can cause the failure of the implant [2].

In this case report we describe the novel procedure used in our department to secure an L5 cage after an anterior corpectomy to avoid its dislodgement.

Methods

A 35-year-old male was admitted to our emergency room after a paramotor accident with lumbar pain and paraparesis. A physical exam following International Standard for Neurological

and functional Classification of Spinal Cord Injury [3] revealed cauda equina syndrome. Neurological impairment was paresia at ankle dorsiflexors 4-/4 right/left, long toe extensors 2/3 and ankle plantar flexors 2/2 myotomes using the Medical Research Council Power Scale [4], altered pin prick sensation at right L5-S2 dermatomes without sacral segments affection. Active hip movements could not be tested because of pain and pelvic splint.

A Computed Tomography (CT) scan showed an L5 burst fracture (Subtype A4 of the AO Spine classification [5]) with spinal canal invasion, as well as, a pelvic fracture (Figures 1a, 1b, 2a). The pelvic fracture was repaired urgently by orthopedic surgeons in the first 24 h by fixing the pubis symphysis with a plate (Figure 1c, 1d). A 360º surgical approach was planned by our neurosurgical team for the spine procedure.

In a first step, 36 h after the traumatism, a lumbosacral posterior arthrodesis was performed through an open midline access. Transpedicular Zodiac screws (Alphatec TM) were used from L3 to S1 to stabilize the lumbosacral spine (Figure 1c, 1d). In addition, a channel decompression was performed through a laminectomy, and posterior bony fragments migrated into the spinal canal were removed.

In a second step, a regular surgery was scheduled two weeks after the traumatism for an anterior approach to reconstruct the anterior vertebral column. The patient was placed in a supine position, with hiperlordotic lumbar position, and abduction of arms and legs (Figure 3a). An anterior left retroperitoneal approach through a Pfannenstiel incision [6] was done to reach the L5 vertebral body and perform a corpectomy (Figure 3b). A titanium expandable cage Fortify with 22º of lordosis (Globus medical TM) was introduced, and intraoperative X-ray control was satisfactory.

The post-op CT scan showed that the lower edge of the cage was quite anterior, very close to the edge of S1 plate (Figure 2b). A new CT scan was done 2 weeks later, and a progressive anterior dislodgement of the cage was confirmed (Figure 2c).

A new surgery, a month after the anterior approach, was needed to relocate the L5 cage. For the reoperation an anterior left retroperitoneal approach through the same Pfannenstiel incision was chosen. Unfortunately, tissues were extremely adherent, so it was necessary to move to a transperitoneal approach. Vascular structures were fixed to the spine due to fibrosis and left iliac vein was at risk of being damaged and hampered good access to the spine. Vascular surgeons were requested for assistance, and in spite of their help, we were allowed to relocate the same cage, but we did not have enough space to put an anterior plate Citadel (Globus Medical) to secure the cage. The cage was more expanded and impacted, but we were afraid to leave it without a security system to avoid a new anterior displacement. At that point we used two screws from the plate, to put in the superior S1 plate, in order to lock an eventual new anterior dislodgement of the cage (Figure 1c, 1d).

Results

In an early post-op CT scan, normo-position of the cage was seen (Figure 2d), and the patient could start his physical rehabilitation. At the time of hospital discharge, 2.5 months since the trauma, after rehabilitation treatment, motor impairment was improved, consist on paresia against gravity without provide resistance at L5 and S1 myotomes. Normo-position of the cage still being seen in CT scan (Figure 2e).

Our follow up continued until 9 months after last surgery. Last CT scan showed no subsidence or dislodgement of the L5 cage (Figure 2f). At that moment the patient was independent for his basic and instrumental activities of daily living, he was able to walk without any walking aids or orthosis, to drive, and he had recovered full mobility, although he still having bilateral S1 paresia 3/4 using the Medical Research Council Power Scale [4].

In this patient, complications related to this novel technique have not been observed.

Discussion

Indications and techniques for L5 corpectomy

Corpectomy of L5 is an uncommon procedure [2] indicated in fractures affecting the three columns of the L5 vertebra, as well as other pathologies like tumors or infections. In these cases, a reconstruction of the anterior column with a cage and a posterior stabilization should be necessary to tolerate the important loads of the spine at this level [7].

Classically, anterior access to the lumbar spine has been done through a transperitoneal or retroperitoneal approach [6]. These approaches to the lumbosacral junction have a high risk of damage to many anatomical structures [8]. Nevertheless, they provide fantastic access to the vertebral L5 body and enable the reconstruction of the anterior load-bearing structures [8]. In recent years, the anterior retroperitoneal approach has increased its popularity against anterior transperitoneal and lateral retroperitoneal [9]. It provides a wider access using a natural avascular plane, minimizing viscera manipulation, and consequently resulting in a lower rate of blood loss [6].

The posterior-only approach has also been described for a 360º reconstruction with L5 corpectomy [7], as well as minimally invasive corpectomy techniques combined with a short posterior

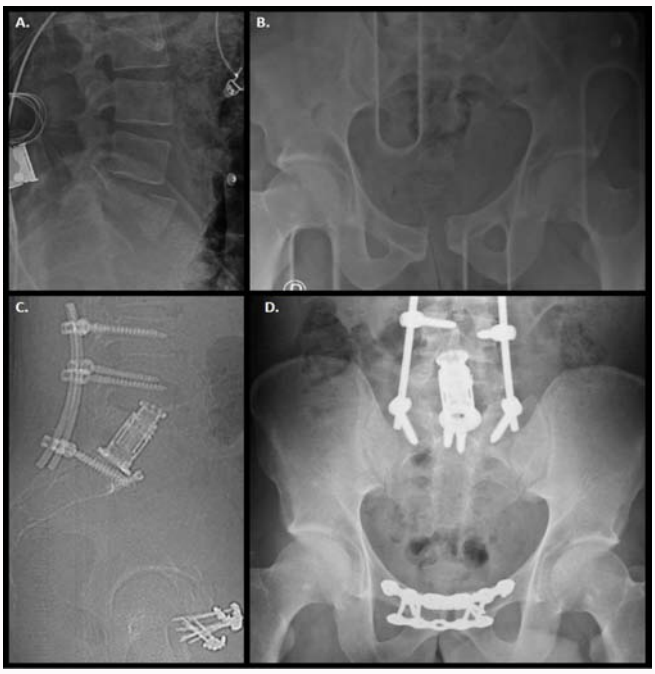

Figure 1:

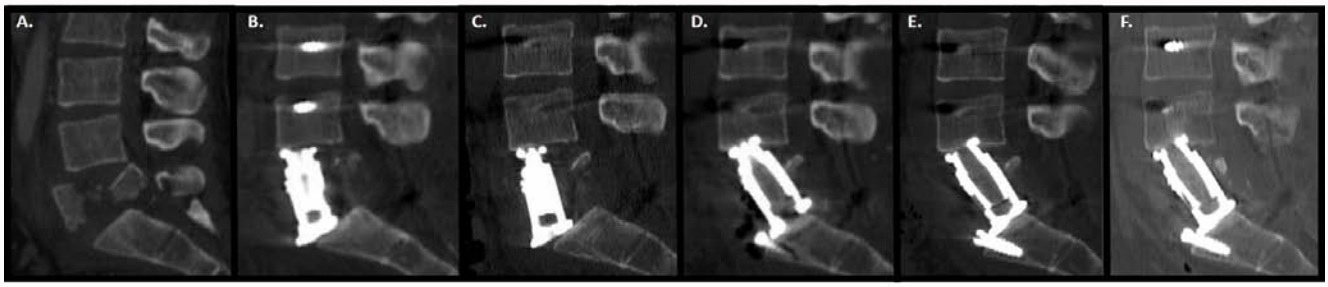

Figure 2:

Figure 3:

instrumentation [10]. Nevertheless, some spinal surgeons still promote reconstruction of sagittal profile with transpedicular screws combined with laminectomy, and nerve decompression, avoiding the anterior approach, as treatment of choice for L5 burst fractures [1].

Problems related to L5 corpectomy

Corpectomy of L5 is a challenging procedure due to three main concerns to face during surgery.

Access injuries: Anatomical surrounding structures narrow the access to the L5 body, and increase the risk of major complications [11]. The main problems are vascular, gastrointestinal and/or urological damage, and retrograde ejaculation in males [2,8,10]. The highest complication rates are reported in oncological surgery and reoperations (36%) [2].

Vascular injury is the most common complication in anterior approaches to L5 varying from 7.9% to 13.8% [2]. According to one study, the average blood loss in fracture's corpectomies is 4.7 liters [11]. Besides the bleeding, iliac artery thrombosis is a possible vascular complication in anterior corpectomies with a reported incidence of up to 0.9% [12]. A study with ALIF and total disc replacement procedures shows that heparin (a single dose of 50 U/kg to 75 U/kg of unfractionated heparin) can be administered safely to help prevent thrombotic intraope rative vascular complications without increasing blood loss [12].

Access complication in anterior retroperitoneal approach performed by spinal surgeons, according to a ten-year retrospective study, have comparable results to other studies in which anterior accesses have been performed by vascular surgeons. Vascular problems are the most frequent 7.8%, although in only 3% of cases a vascular surgeon was required. This study supports the idea that anterior lumbar spinal surgery can be performed safely by spinal surgeons with adequate training and experience, although vascular surgeons should be available if required [13].

Biomechanical aspects: The lumbosacral zone has dynamic singularities. The lumbosacral junction is a transition area between the flexible lumbar spine, and the sacrum, which is relatively fixed [7]. These aspects mean that implants are subjected to greater stresses relative to other areas of the spine [11], causing a high rate of pseudoarthrosis [7].

A cadaveric L5 corpectomy model shows that the addition to the instrumentation of an anterior plating (L4-S1) increases the construct rigidity. Nevertheless, there is no significant range of motion difference between a short (L4-S1) and long (L3-4-S1-ilium) posterior fixation [14].

General biomechanical aspects should also be remembered to understand subsidence risk or pseudoarthrosis. Bony strength depicted as trabecular bone density, and the strain applied to the vertebral endplate can affect this risk. A lower bone density increases the risk, as well as a high stress over the endplates. The force applied to the vertebral endplates can be increased by a small contact surface between the implant and the endplate, and by high charge like obesity, that increase the stress forces in the lower spine [15]. Our patients did not have any of those risks.

Lumbosacral geometry/L5 anatomy: The largest vertebra in the human body is L5, which has a lordotic angle between L4 and S1 endplates. Due to this, L5 corpectomy causes an irregular trapezoidal hole, difficult to fit with cylindrical cages or most allografts [11].

The clinical and radiological results seem to be better in patients with small lordosis. Patients with higher lordosis are more likely to

experience cage displacement. An angle of more than 50 degrees between L4 and S1 seems to facilitate cage dislodgement [2]; this angle was 37.5 degrees in our patient in a supine decubitus position. In these patients anterior plating should be considered to prevent implant failure. To prevent these later dislocations of the cages, it is essential to carefully size the cage with the right height, and especially, the proper angulation. There are lordotic cages, which have a lower rate of dislodgement [2].

Described Solutions in the Literature

In a first step, a wide exposure of the operative field should be provided to have enough space to handle the surrounding structures without damage and perform a proper corpectomy leaving a tailored gap. Vascular surgeons can be asked for help if vascular structures could be at risk.

To fight against the implant failure, dislodgement and consequent pseudoarthrosis, the literature offers some tricks. It is mandatory to properly customize the implant, giving an appropriate shape and introducing it deeply enough, especially in patients with a high lordotic lumbar curve [2].

In a human cadaveric study [15], expandable cages with self-adjusting, multiaxial end caps could help to achieve this objective by significantly increasing the vertebral endplate. That could decrease the risk of implant failure, subsidence or replacement. An anterior plating (L4-S1) also can raise the construct rigidity [14].

There are also medications available in the market to improve bone mineral density, although the increase is quite small, and they need a long time to take the effect, which most of the patients do not have [15].

Usefulness of Our Technique

Aspects of the anatomy, and surgical procedure, can influence the surgical results of an L5 corpectomy. There are some cases with anatomical variants or bone characteristics that do not allow the planned surgery to be performed. Our alternative secure-cage-system with two small screws in the anterior edge of S1 superior plate provides a tip for cases with anatomical difficulties to secure a cage with an anterior plate. It can also be used in cases without special risk of dislodgement, or reoperations, in which we want to, reassure ourselves with a lock system. Surgeons' feelings about the reliability of the implant are also a useful surgical tool.

Conclusion

The technique described by our team to secure the L5 cage and prevent its anterior displacement, is of relevance in certain cases, because it can prevent pull out complications. It is a simple, cheap, and reproducible technique, the cage lies protected by 2 anterior screws acting as a lock, avoiding its dislodgement. This technical note could be of special interest in cases with anatomical difficulties to secure the L5 cage, or cases of reoperations after a previous dislodgement.

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