Charité lumbar artificial disc retrieval: use of a lateral minimally invasive technique

Technical note

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Indications for total disc replacement (TDR) may include implant loosening, malposition, displacement, early wear, and infection. Each indication is likely to require different preoperative planning, testing, and strategies. Preoperative planning is the first and most important step in performing a TDR revision. An organized approach reduces operative time, minimizes risks, decreases stress, and increases the success rate. Primary revision of a failed total disc arthroplasty can be planned as a posterior fusion, leaving the TDR device in place, but an unstable anterior column may require retrieval and revision of the interbody device. An anterior revision approach is associated with significant risk due to scarring and adhesions resulting from the primary procedure, making mobilization of the vessels very difficult, especially at the L4–5 bifurcation.

The authors describe a new alternative for retrieval and revision of a TDR device. They present the details of two cases of TDR device revision in which they performed a minimally invasive extreme-lateral interbody fusion to effect a safer access route that avoids vascular structures and the creation of scar tissue.

KEY WORDS • total disc replacement • complication • arthroplasty • revision surgery

Abbreviations used in this paper: IDE = investigational device exemption; PLF = posterolateral fusion; PS = pedicle screw; TDR = total disc replacement; XLIF = extreme lateral interbody fusion.

Most lumbar TDR devices require an anterior abdominal approach that can be technically demanding, especially at the L4–5 level, because the great vessels must be mobilized. Given the access limitations, significant skill and experience are required to achieve optimal exposure and device placement. Inevitably, however, complications can occur, and some devices may need revision procedures. In the US IDE trial for the Charité Artificial Disc, for example, 8.8% of patients in whom the disc replacement device was implanted required reoperation.2

Primary revision of a failed TDR can be planned as a posterior fusion, leaving the device in place or, when necessary, as an anterior removal with subsequent anterior fusion or revision replacement of the prosthesis. It has been recommended, for patient safety, that a PLF involving PS fixation be the first revision option, but PLF can be difficult to achieve when the anterior column is unstable, and device removal is sometimes necessary. Of the 8.8% of Charité disc–treated patients in whom reoperation was required in the US IDE trial, the device needed to be removed in approximately half.2 Anterior retrieval of a TDR device and revision of an anterior lumbar interbody fusion is difficult, particularly after the first 2 weeks postoperatively, due to scar formation and the elevated risk of vascular injury. After approximately 5 days following anterior surgery, an intense inflammatory reaction occurs with fibrin and collagen deposition and neovascular formation. The retroperitoneal plane is obliterated early on, and it becomes very difficult to return to the region without the risk of vascular damage. Analysis of the data obtained in the Charité US IDE trial showed that, where-
as the primary TDR procedure resulted in a vascular complication rate of 3.4%, vascular injury occurred in 16.7% of the revision procedures.

The authors recently gained experience using an alternative approach to removal and revision of a lumbar TDR device that does not require anterior mobilization of the major vessels. The minimally invasive XLIF procedure has been performed successfully for single- and multilevel fusions above L-5. It is a direct lateral, retroperitoneal, trans–psoas muscle approach in which the following are used: blunt finger dissection of the retroperitoneal space, stimulated electromyography guidance (NeuroVision JJB; NuVasive, Inc., San Diego, CA) through the psoas muscle, and advancement of a split-blade retractor system (MaXcess; NuVasive, Inc.) for illuminated direct visualization of the lateral portion of the spine.

We present the details of TDR revision in two cases in which we used a minimally invasive XLIF approach to create a safer access route that avoids vascular structures and scar tissue.

**Materials and Methods**

**Operative Technique**

*Step 1: Surgical Exposure.* The patient is placed in the lateral decubitus position on a radiolucent breaking table; the iliac crest is flexed over the table break to open the space between the crest and the 12th rib (Fig. 1A and B). The disc of interest is targeted using lateral fluoroscopy, and the skin is marked over the direct lateral center of the disc space. A second incision is made just posterolateral to this direct lateral marking, through which a finger is inserted to dissect the retroperitoneal space and guide the dilators through the lateral incision to the surface of the psoas muscle. NeuroVision guidance is used with the blunt dilators to gently split the fibers of the psoas without causing nerve injury (Fig. 2A), an important consideration given that the exposure needs to be extended further posteriorly than is typically required in a more straightforward primary XLIF. The MaXcess retractor is advanced over the dilators, rigidly locked to the surgical table, and expanded over the disc space (Fig. 2B–D).

*Step 2: Removal of the Polyethylene Core.* The lateral aspect of the TDR device is easily accessed after anular discectomy. With the disc space angled open toward the access approach, the polyethylene core is easily grasped and removed using a Kocher clamp (Fig. 3).

*Step 3: Removal of the Device Endplates.* Without much force, the device’s endplates are pried loose from their osseous attachment using an osteotome. The endplates can then be grasped and withdrawn from the disc space with a Kocher clamp (Fig. 4). Loosening and removal of the endplates are repeated for the second surface (Fig. 5).

*Step 4: Insertion of the XLIF Implant.* The disc space is prepared for fusion by clearing any disc debris and releasing the contralateral anulus fibrosus using a long Cobb elevator. This step ensures parallel distraction and proper coronal alignment. The large fusion implant is inserted such that it rests along both sides of the ring apophysis to confer strong endplate support (Fig. 6).

*Step 5: Lateral Closure and Posterior Fixation.* The retractor is closed and gently removed. Supplemental percutaneous PS fixation is performed. The fascia and skin are closed in a standard fashion.


Fig. 1. Illustration and photographs. A: Illustration showing the position of the patient during surgery. B: Photograph demonstrating how the patient is placed in a lateral decubitus position on a radiolucent breaking table with the iliac crest flexed to open the space between the crest and the 12th rib. C: Photograph showing that the size of the incision is approximately 5 cm.
Illustrative Cases

Case 1

A No. 5, 31-mm-wide Charité Artificial Disc (DePuy Spine, Raynham, MA) was implanted in this 39-year-old woman with L4–5 degenerative disc disease. The patient’s back pain reappeared 15 days postoperatively, and radiography showed instability caused by an unrecognized isthmic pars defect fracture at the treated level. An instrumentation-augmented PLF was performed in which the fixation device was filled with autologous bone graft. One month later, the posterior fusion site became infected, and intravenous antibiotic therapy was administered. The patient’s back pain persisted for another 18 months, and radiography revealed failure of one of the fixation rods (Fig. 7 left). We performed the TDR device removal and revision via a left-sided XLIF approach through a 2-in lateral incision (Fig. 7 right).

Case 2

This 50-year-old woman with a history of L4–5 fusion underwent a TDR procedure in which a No. 4, 29-mm-wide Charité Artificial Disc was placed to treat symptomatic adjacent-level L3–4 disease. Two-month follow-up radiography showed an improper position of the device and iatrogenic segmental scoliosis (Fig. 8 left). At 12 months the patient complained of lumbar pain, and computed tomography scanning revealed improper position-
ing of the implant and heterotopic bone formation. The patient’s neurological status was intact at this time, and she received medical and rehabilitation treatment but made no significant recovery. Artificial disc removal and revision were performed 2 years postoperatively. We used the XLIF technique and supplemental percutaneous PS fixation (Fig. 8 right).

**Discussion**

No fibrosis or scar tissue was encountered in the retroperitoneal space. On exposure of the lateral aspect of the spine and anular discectomy, the disc was found to be unstable; the polyethylene TDR core was exposed and removed quite easily using a simple Kocher clamp. Bone in-

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**Fig. 3.** Illustration demonstrating how the polyethylene core is easily grasped and removed using a Kocher clamp.

**Fig. 4.** Fluoroscopic image (left) and illustration (right) showing how, without much force, the metal endplates are pried loose from their osseous attachment using an osteotome; the metal endplates can be grasped and removed from the disc space with a Kocher clamp.

**Fig. 5.** Fluoroscopic image (A) and illustrations (B and C) demonstrating how endplate loosening and removal are repeated for the second surface, using an osteotome and Kocher clamp.
growth onto the device endplates was superficial and sporadic, such that the endplates were separated from the bone using an osteotome, which did not require significant force. Standard intradiscal instruments were used to prepare the disc space. During disc space preparation, the contralateral anulus was disrupted using a Cobb elevator to ensure symmetrical disc distraction. This step also permits the insertion and placement of a large interbody implant across the peripheral apophysial ring, providing good endplate support and coronal and sagittal alignment.

In Case 1 the 31-mm-wide, No. 5 Charité device was replaced with a polyetheretherketone cage 50 mm long in the mediolateral dimension, 18 mm wide in the anteroposterior dimension, and 12 mm tall; the implant was filled with tricalcium phosphate and iliac crest bone marrow aspirate. A posterior revision was also performed during the open procedure in which the slipped rod was repositioned (Fig. 7 right). No infection or neurological signs or symptoms were observed in the postoperative period, and the patient was well at the 1-year follow-up examination.

In Case 2 the 29-mm-wide, No. 4 Charité device was replaced with a 45-mm-long, 18-mm-wide, 12-mm-tall polyetheretherketone cage filled with iliac crest bone autograft. Supplemental posterior percutaneous PS fixation was added (Fig. 8 right). During the postoperative period, transitory weakness (Grade 3/5) was observed during the knee-raising exercise, but this resolved on Day 3. No other neurological signs or symptoms were observed. The patient is now progressing without complaint at 10 months after revision surgery.

Conclusions

An anteriorly placed Charité TDR device can be successfully and more safely revised using an XLIF approach. The direct lateral trajectory avoids the anterior adhesions created by the primary procedure, does not require mobilization of the great vessels, and, with careful electromyography-guided dilation of the psoas muscle, provides ample exposure for removal of the device. The polyethylene core is easily removed upon lateral annulotomy, and the limited bone ingrowth onto the endplates does not hinder revision of the fusion. A large stabilizing fusion implant makes use of the more biomechanically sound apophysial ring, which is typically undisturbed by the primary procedure, and is located at the periphery of the osseous endplates. The procedure provides correction
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and/or restoration of proper sagittal and coronal balance. Careful and appropriate patient selection, proper surgeon training, and excellent implant technique are essential to ensure optimal outcomes.

Disclosure

Dr. Pimenta is a consultant for NuVasive, Inc.

References


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