

A novel modification for removal of the polyethylene core in artificial disc retrieval using a transpsoas minimally invasive technique

Technical note

WAYNE K. CHENG, M.D., VIKRAM JADHAV, M.D., PH.D., AND DANIEL K. PALMER, B.S.

Department of Orthopaedic Surgery, Loma Linda University School of Medicine, Loma Linda, California

Total disc replacement (TDR) surgeries have significantly increased in number since US FDA approval. However, the associated complications such as implant malposition, loosening, subsidence, implant migration, fractures, and infection may necessitate retrieval of the artificial disc and proceeding with interbody fusion. Retrieval of artificial discs in proximity to important vascular, urological, and other vital anatomical structures (for example, L4–5) presents numerous difficulties to spine and approach surgeons. To avoid the impediments of an anterior revision approach, in 2006 Pimenta et al. described an effective transpsoas lateral minimally invasive approach to retrieve the TDR device. In this paper, the authors adopted this technique in their surgical practice; however, they realized that a complex step involved the removal of the polyethylene core. The polyethylene core is compressed between the device endplates and is difficult to remove with the aid of a Kocher clamp as advised by Pimenta et al. Moreover, distraction on the endplates or the vertebral bodies to decrease the compression across the core is laborious, time consuming, and often not possible due to the approach and location of the lumbar plexus. In the present paper, the authors propose a novel modification to the polyethylene core removal with the use of a screw to create a better lever arm, apply effective distraction, and secure a good grip to enable core retrieval. This modification significantly reduced the operating time. (DOI: 10.3171/2010.12.SPINE09429)

KEY WORDS • artificial disc retrieval • polyethylene core • transpsoas minimally invasive approach

TOTAL disc replacement procedures are routinely performed;^{2,3,5,6,9,10} however, they are not bereft of complications.^{1,3,4,7,11} Previous studies have shown that retrieval of these artificial discs is necessary in some cases that are complicated by implant migration, malposition, and fractures.^{1,3,7} An anterior approach for revision surgery is likely to encounter vascular and urological complications, especially at the L4–5 level. The scar tissue from previous surgery presents further challenges. In 2006, Pimenta and colleagues⁸ detailed a minimally invasive transpsoas retroperitoneal approach to retrieve the TDR device. We adopted their technique and introduced further modifications to decrease the operating time. We present the details of 4 cases (summarized in Table 1) in which we used a screw to remove the polyethylene core and proceeded with artificial disc retrieval using the transpsoas minimally invasive approach.

Operative Technique

Step 1: Surgical Exposure

The choice of side depends on the position of the TDR device. We begin the approach through the side that is closest to the TDR device. The surgical approach is similar to the one advocated by Pimenta et al.,⁸ with minor modifications. Briefly, the patient is placed in the lateral decubitus position on a radiolucent breaking table. The patient is well padded, and the table breaks right at the disc space of interest, which is confirmed by lateral fluoroscopy. One 3-cm lateral incision is centered over the TDR device parallel to the disc space. A handheld retractor is used to assist visualization of the retroperitoneal space and psoas muscle. Continuous nerve monitoring and fluoroscopic guidance are used during the serial muscle dilations, retraction, and retractor expansion. Multiple Steinmann pins are used to further retract any soft tissue caught underneath the retractor blade. It is very important for surgeons to be aware that the current nerve

Abbreviation used in this paper: TDR = total disc replacement.

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TABLE 1: Summary of 4 cases in which the polyethylene core of the artificial disc was removed using a screw*

Case No.	Age (yrs), Sex	Initial Op	Indications for Disc Retrieval	Fusion Procedure Following TDR Device Retrieval†	FU Status
1	43, M	2-level TDR at L2–3 & L3–4	scoliosis w/ increased back pain	16 × 50–mm PEEK cage w/ BMP placed followed by posterior pedicle screw instrumentation	1) correction of scoliosis; 2) thigh dyesthesia that improved but did not completely resolve over 21 mos of FU
2	48, M	TDR at L4–5 & ALIF at L5–S1	fracture of L4–5 w/ spondylolisthesis 5 mos postop	interbody fusion w/ 16 × 50–mm cage w/ BMP used inside the cage; lat plates w/ 2 screws were applied	paresthesia w/ lt hip flexor weakness that resolved after 6 mos
3	39, F	2-level TDR at L4–5 & L5–S1	progressive scoliosis w/ back & leg pain after 1 yr	interbody fusion w/ 14 × 50–mm cage w/ BMP; 1-level posterior fusion performed at L4–5	1) scoliosis corrected from 47° to 25°; 2) significant improvement in leg & back pain; 3) no neurological complications
4	42, F	TDR at L3–4 & ALIF at L5–S1	TDR device significantly tilted & rotated immediately postop	removal of TDR device at L3–4 after 1 yr; interbody fusion at L3–4 w/ 14–mm cage & at L4–5 w/ 10–mm cage; BMP was used inside both cages; posterior L3–5 instrumented fusion performed	postop hip flexor weakness & L-3 dyesthesia that almost completely resolved after 3 mos

* ALIF = anterior lumbar interbody fusion; BMP = bone morphogenetic protein; FU = follow-up; PEEK = polyetheretherketone.

† Cage sizes are listed as height × width.

monitoring methodology does not pick up any sensory nerve changes. Therefore, all soft tissue above the anulus needs to be retracted away gently prior to anulotomy to minimize the chances of nerve injury.

Step 2: Removal of the Polyethylene Core

After identification of the polyethylene core and its marker wire, a high-speed drill (Midas 15MH22 matchstick bur) is used to create 2 small holes on either side of the marker wire to gain access to the medial side of the wire. A Kocher clamp is used to remove the marker wire entirely from the core. Thereafter, a 2.5-mm drill bit is used to drill through the middle of the polyethyl-

ene core followed by insertion of a 25 × 3.5–mm screw. Fluoroscopic images are taken to confirm the position of the screw. A narrow vise grip is used to hold on to the head of the screw to apply constant and gentle distraction to remove the polyethylene core (Fig. 1A–D). If there is difficulty with removing the core, then additional anulotomy, scar removal, and further increase in the angle of the table in a jackknife position may be needed.

Step 3: Removal of the Device Endplates

Endplates are loosened from the bone using a curved osteotome and removed using a Kocher clamp (Figs. 1E and F, and 2).

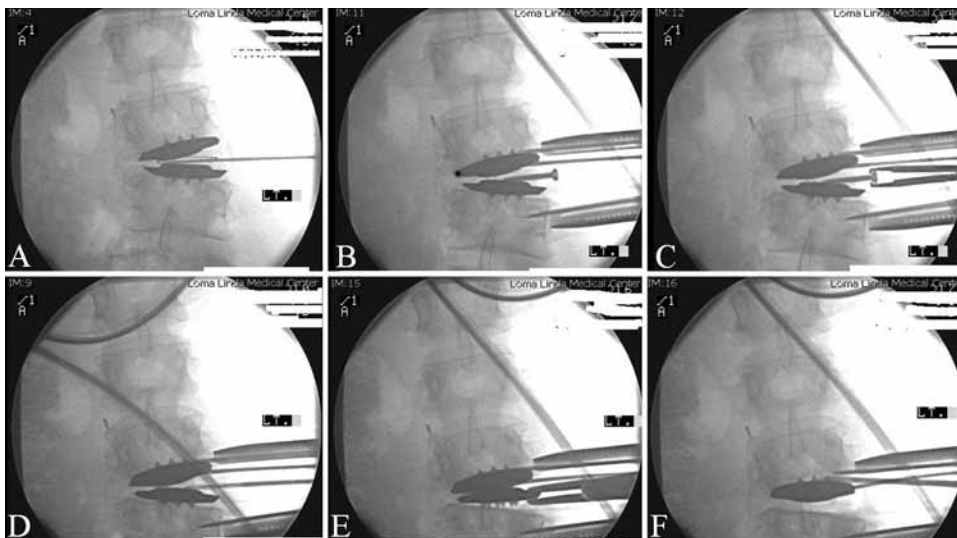


FIG. 1. Fluoroscopic images showing stepwise removal of the TDR device in situ. An anteroposterior view of the TDR device at L3–4 before retrieval (location marked with the K-wire (A)). Images showing insertion of screw (B), application of the vise grip (C), and removal of the core (D). Images depicting removal of the lower (E) and upper (F) endplates.

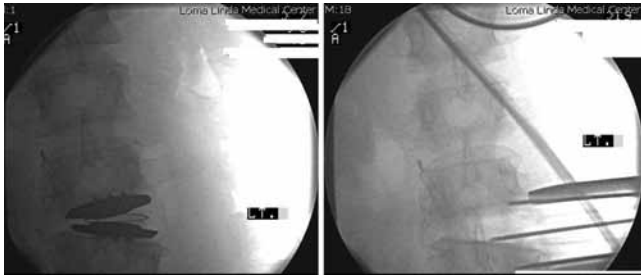


FIG. 2. Anterosuperior fluoroscopic images before (left) and after (right) removal of the TDR device.

Step 4: Insertion of Fusion Implant and Fixation

After thorough irrigation of the disc space, careful removal of cartilaginous endplates and contralateral anulotomy are routinely performed. An appropriate cage with optimal width to straddle both apophyses is selected. Contralateral anulotomy allows secure placement of the cage across both sides of the biomechanically sound apophysial ring.⁹ This reduces the chance of subsequent subsidence. The anterior reconstruction is further backed up with either a lateral plate or posterior pedicle screw construct.

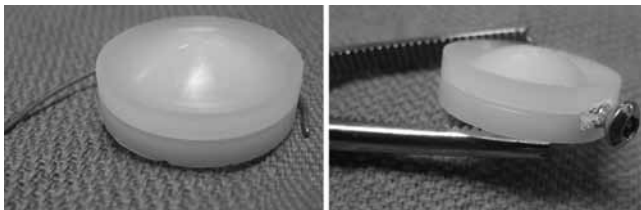


FIG. 3. Photographs showing the polyethylene core stripped off the marker wire (left) and the screw drilled into the body (right).

Step 5: Lateral Closure

The retractors are removed, and the fascia and skin are closed using standard techniques.

Discussion

Pimenta et al.⁸ advocated an effective method for TDR retrieval using a lateral transposas approach. We agree that this minimally invasive approach can be easily performed from L-2 to L-5, which obviates the need for mobilization of the great vessels, reduces possible vascular and urological complications, and avoids the anterior adhesions. In our experience, however, the most difficult part of the procedure is associated with removing the polyethylene core. None of our cores could be easily removed using a Kocher clamp as outlined previously.⁸ Here, we have described a novel technique of polyethylene core removal using a screw (Figs. 3 and 4). The screw provided secure purchase, a better lever arm, and the ability to provide gentle distraction to remove the core. This modification has significantly reduced our operating time.

The operative procedure described here may be associated with neurological, vascular, and urological complications. We advocate a single-incision technique to fully visualize the retroperitoneal space before the insertion of retractor blades to minimize soft-tissue trauma. It is important to realize that current neuromonitoring techniques are limited to motor nerves only; therefore, we now routinely retract all soft-tissue creeping under our retractor blade with multiple Steinmann pins to prevent entrapment of sensory nerves.

The debris produced from the drilling of the polyethylene core prior to screw insertion is unlikely to cause immediate or major complications, as most of this debris would be irrigated from the field of operation. There is limited information on long-term effects of debris gener-

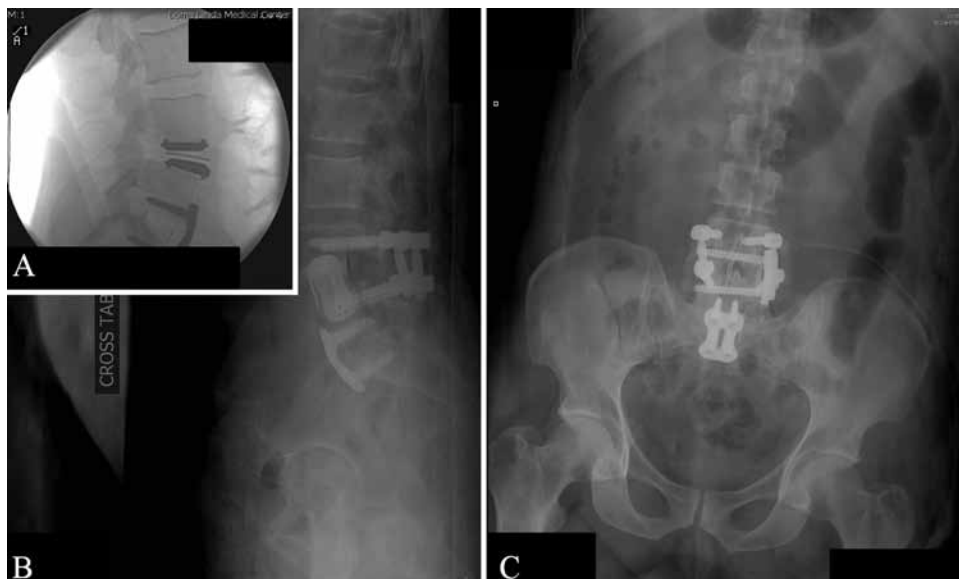


FIG. 4. Case 2. **A:** Fluoroscopic lateral view image obtained preoperatively, showing the presence of the TDR device at L4-5. **B and C:** Postoperative lateral (B) and anteroposterior (C) radiographs.

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ated from wear and tear of the polyethylene core. One study by van Ooij et al.¹² reported that particles caused by biologically active wear may be generated from the polyethylene core during the lifetime of the artificial disc replacement device. This biologically active debris may, in rare cases, lead to osteolysis.

Conclusions

The transpoas approach for TDR device retrieval is effective. In our experience, the operative step of polyethylene core removal is the most time-consuming and daunting task. We recommend a novel modification to this technique to safely remove the implant and reduce operative time. Our modification is simple, inexpensive, biomechanically sound, and does not require additional training methods. Ipsilateral thigh dysesthesia and ipsilateral hip flexor weakness were encountered. With the exception of thigh dysesthesia in 1 case, all neurological deficits resolved over time.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author contributions to the study and manuscript preparation include the following. Conception and design: Cheng. Acquisition of data: Cheng. Analysis and interpretation of data: Cheng. Drafting the article: Cheng, Jadhav. Critically revising the article: Jadhav, Palmer. Reviewed final version of the manuscript and approved it for submission: all authors. Administrative/technical/material support: Jadhav, Palmer. Study supervision: Cheng.

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Address correspondence to: Wayne K. Cheng, M.D., Department of Orthopaedic Surgery, Loma Linda University School of Medicine, East Campus Ambulatory Services Building, 11406 Loma Linda Drive, Suite 213, Loma Linda, California 92354. email: md4spine@yahoo.com.