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Commentary

Commentary: An increasing awareness of the complications after transpsoas lumbar interbody fusion procedure

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COMMENTARY ON: Brier-Jones JE, Palmer DK, Ĭnceoğlu S, Cheng WK. Vertebral body fractures after transpsoas interbody fusion procedures. Spine J 2011;11:1068–72 (*in this issue*).

Brier-Jones et al. [1] in their article ''Vertebral body fractures after transpsoas interbody fusion procedures'' present a series of patients with complications in nonosteoporotic patients after transpsoas lumbar interbody fusion with lateral plate instrumentation. The authors bring to attention four cases of unanticipated vertebral body fractures in the early postoperative period, with two coronal plane fractures and two compression fractures. The transpsoas lumbar interbody fusion procedure is a modification of the retroperitoneal approach to the lumbar spine using a tubular dilator/retractor system and was first reported in the literature by Ozgur et al. in 2006 [2]. Other terms in the medical literature commonly used to reference this technique include lateral lumbar interbody fusion, lateral transpsoas interbody fusion, direct lateral interbody fusion (Medtronic Sofamor Danek, Inc., Memphis, TN, USA) and extreme lateral interbody fusion (XLIF; Nuvasive, San Diego, CA, USA). Both direct lateral interbody fusion and XLIF are instrumentation/retractor systems, not implantable devices, for the transpsoas lumbar approach. Despite the limited literature regarding clinical outcomes and complications of transpsoas lumbar interbody fusion, this minimally/less invasive procedure continues to gain popularity among spine surgeons as an alternative to open and endoscopic anterior lumbar interbody fusion [2].

The purported advantages of the lateral transpsoas approach compared with anterior lumbar procedures include the avoidance of an approach/access surgeon, eliminating the need to violate or retract the peritoneum and obviating the need for great vessel mobilization [2]. This minimizes the risk for visceral and vascular complications and, in males, retrograde ejaculation from superior hypogastric nerve plexus disruption [3]. Recently, the risk of retrograde ejaculation with the anterior lumbar interbody fusion approach has been revisited [4]. The transpsoas approach also allows for a broad discectomy and placement of a wide anterior interbody spacer spanning the entire width of the vertebral body so the cage rests on both lateral margins of the epiphyseal ring. This provides increased biomechanical support and distributes compressive loads over a larger surface area [5–7]. Inherent stability of the motion segment is also maintained by preservation of the anterior and posterior longitudinal ligaments that are violated during anterior and posterior interbody procedures, respectively [3,8]. Limitations of the lateral transpsoas approach include anatomic constraints such as the inferior aspect of the 12th rib, which can compromise potential exposure to the L1–L2 disc space, as well as the superior aspect of the iliac crest or aberrant lumbar plexus anatomy, which can obstruct access to the L4–L5 disc space. Therefore, the surgeon should carefully evaluate lateral lumbar spine radiographs and all other available imaging, such as computed tomography or magnetic resonance imaging, to determine the accessible lumbar levels [2].

Spine surgeons postulate that the minimally/less invasive transpsoas approach results in less tissue disruption and

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therefore allows the patient to have reduced postoperative pain, shorter hospital stays, quicker recovery/return to activities of daily living, and better improvement in disability/functional scores [2]. Outcomes reported in the literature after the transpsoas lumbar interbody fusion procedure include mean surgical time ranging from 67 to 477 minutes, mean estimated blood loss from 50 to 401 mL, average hospital length of stay between 1 and 6.2 days, fusion rates from 91% to 100%, patient-reported clinical outcome scores ranging from 32.4% to 80% decrease in visual analog pain scale and 39% to 82.1% decrease in Oswestry Disability Index [3]. However, there is no randomized prospective study directly comparing the benefits of the transpsoas approach to other anterior or posterior lumbar interbody procedures. In fact, evidence in the published literature addressing the efficacy and safety of the transpsoas lumbar interbody fusion is limited to observational studies, retrospective reviews, and case reports, with most comparing their perioperative outcomes and complications to historical controls for other anterior and posterior lumbar procedures. Interestingly, in a recent literature review by Youssef et al. [3], the authors found only 14 peer-reviewed articles reporting outcomes scoring with visual analog pain scale and Oswestry Disability Index, complication rates, fusion status, radiographic assessments, and long-term follow-up related to the lateral lumbar approach. Since their report, we found only four additional recent studies adequately reporting clinical outcomes and complications [5,9–11].

In particular, complications after transpsoas lumbar interbody fusion have been incompletely characterized as a result of inconsistent reporting and variations in definitions. In the literature review by Youssef et al. [3], the authors found that overall complication rates range from 2% to 30.4%, with up to 20% described as minor and up to 8.6% as major complications. The most common early postoperative complication is thigh weakness and/or numbness, occurring in 1% to 60.1% of cases, with the majority being transient and fully resolved within 3 to 6 months after surgery. Conversely, an uncommon early postoperative complication after transpsoas lumbar interbody fusion is vertebral body fracture. In fact, Rodgers et al. [12], in the largest prospective observational study to date, specifically evaluated complications after XLIF in 600 patients and experienced only four (0.6%) vertebral body fractures. In another study by Rodgers et al. [9], the authors retrospectively reviewed XLIF in 40 patients older than 80 years and reported one (2.5%) compression fracture of an adjacent vertebral body 4 weeks after XLIF, which was treated successfully with percutaneous vertebroplasty. In an additional study, Rodgers et al. [13] found a similarly low rate of vertebral body fractures in a retrospective review of 313 patients comparing the outcomes of XLIF in 156 obese versus 157 nonobese patients. The authors reported two (1.3%) vertebral body fractures in the obese group, with one requiring posterior stabilization and one treated with observation, and both experienced uneventful healing. The nonobese group had one (0.6%) vertebral body fracture, which was treated with observation and uneventful healing. Rodgers et al. [12] have provided the most substantial body of literature to date concerning the outcomes and complications after XLIF and have highlighted the overall low incidence of early postoperative complications and specifically vertebral body fractures. However, the reader must take into account that these procedures were done by a single surgeon highly experienced with the XLIF procedure and may not be representative of the typical complication profile in a heterogeneous group of spine surgeons. As an example, in a smaller retrospective study of a surgeon's earlier experience with the XLIF procedure, Kepler et al. [5] and Dua et al. [14] reviewed 13 patients after one-level XLIF with unilateral posterior stabilization. The authors found a high rate of vertebral body fractures, with two (15.4%) osteoporotic patients sustaining atraumatic coronal plane vertebral body fractures, with one treated by kyphoplasty and one with observation, and both experienced uneventful healing.

The previous studies demonstrate vertebral body fractures as a relatively rare complication after transpsoas lumbar interbody fusion. As a consequence, we believe that the case report by Brier-Jones et al. [1] is a valuable contribution to the literature and further increases awareness of this early postoperative complication. However, the patient demographics and instrumentation constructs for each of the four cases varied to such a degree that there is difficulty discerning a causality or mechanism of failure. The authors speculate the technique-related error from lateral plate screw violation of the end plate or subchondral bone may have contributed to the development of coronal vertebral body fracture [1]. This is in concordance with Kepler et al. [5] and Dua et al. [14], who suggested that cage subsidence with propagation of the fracture through the anterolateral plate screw holes and compromised bone quality may be factors contributing to coronal vertebral body fracture after XLIF. Brier-Jones et al. [1] also suggested the possibility of "cage rolling or migration during flexion and extension of the spine" and that the interbody cage design "… may not have provided the necessary biomechanical stability to restrict anteroposterior movement;" however, these statements may be misleading. Furthermore, this type of gross anteroposterior cage instability/movement has not been demonstrated in biomechanical studies and is highly unlikely given the inherent stability provided by interbody device and supplemental fixed-angle lateral plate, as well as by the intact anterior and posterior longitudinal ligaments [15]. The more likely scenario is technique error with improper interbody implant sizing or positioning and may also be the result of changes in interbody implant position with asymmetric subsidence, leading to a stress point along the vertebral body end plate. The authors also reported the use of bone morphogenetic protein in three of their four cases in nonosteoporotic patients, which may have also been a factor resulting in interbody implant subsidence from vertebral body osteolysis [16,17]. As discussed, there appears to be many factors involved in the development of coronal vertebral body

fractures after transpsoas lumbar interbody fusion; however, proper surgeon education/training, meticulous surgical technique, and knowledge of the possible consequences of improper instrumentation may help prevent this complication.

As with any new technology or emerging technique, the surgeon should carefully evaluate the available evidence concerning the outcomes and complications after transpsoas lumbar interbody fusion procedure. Although recent reports have been encouraging and appear to espouse XLIF as safe and efficacious, evidence comparing this technique to other anterior or posterior lumbar fusion procedures is insufficient to draw conclusions regarding potential adverse effects and complications. Also, there is no clear definition of a ''minimally invasive'' procedure, and although the transpsoas lumbar interbody fusion has been termed ''minimally invasive,'' we should recognize that this does not imply ''maximally effective.'' As surgeons, we should apply the term ''least invasive'' technique for any type of procedure, seeking to use the least disruptive method and appropriate surgical exposure to obtain the desired patient outcome and surgical goals. Although we have an increasing awareness of complications after transpsoas lumbar interbody fusion procedure, further studies with larger number of patients and long-term follow-up are necessary to establish this procedure's true benefits and shortcomings. It appears that this technique offers distinct advantages when appropriately used for selected patients, and future studies comparing its clinical benefits with prospective, randomized, multicenter trials will further delineate its efficacy.

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