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Original research

Risk factors for cage retropulsion after lumbar interbody fusion surgery: Series of cases and literature review

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HIGHLIGHTS

- Cage retropulsion after lumbar interbody fusion surgery was a disaster.
- There were multiple risk factors for cage retropulsion after lumbar interbody fusion surgery.
- Revision surgery was essential for the patients who presented neurological deficits.

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ABSTRACT

Objective: To identify the risk factors for cage retropulsion after lumbar interbody fusion surgery.
Methods: 667 patients underwent lumbar interbody fusion surgery between November 2011 to December 2014 were retrospectively reviewed by the medical recording system in our institute. 8 patients experiencing cage retropulsion were included and 2 underwent the initial surgery in other hospitals. The clinical outcomes were evaluated by visual analog scores (VAS) and Oswestry Disability Index (ODI). Plain radiographs and three-dimensional computed tomography scans were used to analyze the incidence of cage retropulsion. Data were analyzed by SPSS 19.0.
Results: The incidence of cage retropulsion was 0.90%(6 out of 665) in our institution. There were 6 male and 2 female with an average age of 45.63 ± 15.48(range, 21–60). The average follow-up time was 23.88 ± 12.69 months(range, 6–43 months) and average retropulsion onset time was 2.75 months(range,1–6 months). 6 patients experienced cage retropulsion at L5/S1 and 2 at L4/5. 6 used bullet-shaped cages and two had kidney-shaped cages. Average bed rest time after the initial surgery was 5.75 ± 1.67 days. 6 patients had neurological deficits and underwent revision surgery. Average operation time and blood loss for revision surgery were much higher than those of the initial surgery ($P < 0.05$). All the patients got a good result in VAS and ODI both from initial surgery and revision surgery ($P < 0.05$).
Conclusions: There were multiple risk factors for cage retropulsion after lumbar interbody fusion surgery, including patient factors, radiological characteristics, surgical techniques and postoperative reasons. In case of retropulsion, revision surgery was essential for the patients who presented neurological deficits and conservative treatment was recommended for asymptomatic patients.

1. Background

Since 1993 when Brantigan and Steffee first described the use of interbody implants and reported successful fusion in 26 patients, a series of biomechanical tests and clinical studies of interbody fusion cage have been published. The biomechanical advantage and clinical safety and effect achieved by using interbody implants is impressive [1,2].

In recent years, posterior lumbar interbody fusion (PLIF) and transforaminal lumbar interbody fusion (TLIF) have become widely accepted treatments for patients with degenerative spondylolisthesis, degenerative disc diseases, and spinal deformity [3]. These techniques offer several theoretical advantages over the traditional posterolateral fusion techniques in terms of providing stability to spinal levels, anterior column support, and restoration of disc space height and the neuroforaminal area [4].

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Although current techniques are advanced and sophisticated, major complications such as cage migration into the adjacent vertebral bodies and dislocation into the spinal canal are well-known. Cage migration might result in the loss of lumbar lordosis, a narrowing of the disc space and foraminas, direct compression of the dural sac and the nerve roots, as well as a lower fusion rate [3,5]. Of these, cage retropulsion is a type of migration and is defined as the movement of the posterior margin of the cage into the spinal canal [3].

We conducted a retrospective study on cage retropulsion cases undergoing treatment at our hospital and reviewed the related articles in literature. We aim to identify potential risk factors of this severe complication and the best methods for its management.

2. Materials and methods

2.1. Patient population

From November 2011 to December 2014, we retrospectively reviewed the follow-up records of totally 667 patients underwent PLIF or TLIF in our department. Of these, 8 patients experiencing cage retropulsion were included and 2 underwent the initial surgeries in other hospitals. The 8 patients were followed up for 6–43 months postoperatively. Medical records and pre and postoperative radiographs obtained from these patients were reviewed. Conservative treatment was generally the first choice. Surgical intervention was considered if conservative treatment failed to achieve satisfactory results. The decision to proceed with surgical intervention was made by the doctor and patient together.

This retrospective review was approved by the Ethics Committee of East Hospital affiliated to Tongji University and were conducted based on medical records, physical examinations, and final patient interviews. The individuals in this manuscript have given written informed consent (as outlined in PLOS consent form) to publish these case details.

2.2. Surgical procedures

Patients were placed in a prone position on the Wilson frame. A midline skin incision was made on the patient's back, and traditional PLIF or TLIF procedure was performed under general anesthesia. The cage position was insured to be right by intra-operative C-arm X-ray. All the patients recovered uneventfully from the initial surgeries. After the procedures, 8 patients presented cage retropulsion and 6 of them underwent revision surgeries. The revision surgeries were all performed from the original incision point and subperiosteal dissection of the multifidus muscle and the scar tissues were performed. After complete bone and interbody exposure, we removed the migrated cages carefully and obtained bone grafts of adequate quantity and quality from the spinous process, lamina, and enlarged superior and inferior articular surfaces. Then, the nerve roots were retracted medially. Complete discectomy was performed, following which the disc space was sequentially distracted, and the endplates were prepared. After completion of central and/or foraminal decompression, interbody cages filled with morselized local bone chips were placed. Meticulous hemostasis, placement of drain, and layered wound closure were performed serially.

2.3. Radiological and clinical assessment

Prior to surgery, we performed anteroposterior(AP) and lateral radiographs in the neutral position and lateral radiographs in maximally flexing and extending positions. Before the patients were discharged, postoperative radiographs were taken, and it was confirmed that positioning of fusion cages had not changed. To check the positioning of fusion cages, further radiographs were taken at 1, 3, 6, and 12 months postoperatively. Radiographic measurements were performed by one of the authors, who was blinded to the status of the patients. The clinical outcomes were evaluated by visual analog scores (VAS) and Oswestry Disability Index (ODI).

2.4. Data analysis

The paired *t*-test was used to analyze the pre- and postoperative radiographic parameters, surgical results and clinical outcomes. A P value < 0.05 was considered to be statistically significant. Data analysis was performed using statistical package SPSS 19.0 (SPSS Inc., Chicago, IL, USA).

3. Results

Of the 8 patients experiencing cage retropulsion, 6 underwent initial surgeries in our department. Thus, the incidence was 0.90%(6 out of 665) in our institution. There were 6 male and 2 female with an average age of 45.63 ± 15.48(range, 21–60). The average follow-up time was 23.88 ± 12.69 months(range, 6–43 months) (Table 1).

The average retropulsion onset time was 2.75 months(range, 1–6 months). 3 patients underwent PLIF and 5 underwent TLIF. 6 patients experienced cage retropulsion at L5/S1, which was significantly more frequent than 2 at L4/5 ($P < 0.05$). Average operation time for the first surgery was 168.75 ± 25.32 min and the blood loss was 456.25 ± 87.00 ml. Six patients had bullet-shaped cages and two had kidney-shaped cages, which was significantly different ($P < 0.05$). One patient underwent osteoporosis, one underwent osteochondritis, one underwent an infection preoperatively, one required the use of two cages at a single level, one had a titanium cage, one underwent unilateral fixation, one used a smaller cage, and two underwent over-management of the endplate. Average postoperative bed rest of the 8 patients was 5.75 ± 1.67 days (Table 2). VAS and ODI after the initial surgery were much lower than before surgery ($P < 0.05$) (Table 4).

6 out of 8 patients called for revision surgery when these patients had neurological deficits after cage retropulsion. Average operation time for revision surgery was 246.67 ± 47.19 min and blood loss was 608.33 ± 86.12 ml, which were much higher than those of the first surgery (Table 3). All the 6 patients got a good result in VAS and ODI from revision surgery ($P < 0.05$) (Table 4).

4. Discussion

Lumbar interbody fusion techniques have increased in popularity as surgical treatment for patients with spinal deformity, degenerative disc disease and degenerative spondylolisthesis, particularly for patients that have not improved with conservative treatment [6]. However, a frequent cause for implant failure in lumbar interbody fusion is cage migration into the vertebral endplates or the spinal canal [5]. Several previous studies have focused on this issue and reported several risk factors for cage migration [2,3,7]. In the present report, we refer to migration into the spinal canal as cage retropulsion.

This complication could impede successful fusion in patients and cause low back pain or neuralgia because the migrated cage compresses neural elements in the lumbar spinal canal [3]. Because cage retropulsion is associated with severe outcomes, it is important to identify its potential risk factors. In our study, we retrospectively reviewed the follow-up records of 8 patients who experienced cage retropulsion that underwent treatment at our hospital from November 2011 to December 2014. Furthermore, we