CASE REPORT

Adjacent Single-level Combined Fixation Using Kyphoplasty and Percutaneous Pedicle Screws in Type A3 Unstable Vertebral Fractures in Elderly Patients

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We present a series of cases of type A3.1.2 unstable fractures of the thoracolumbar hinge treated percutaneously with third-generation kyphoplasty and only one next level percutaneous screws. Four women aged 75 to 85 years with thoracolumbar vertebral fractures, classified as type A.3.1.2, were treated with Precept® monosegmental percutaneous fixation and the third-generation SpineJack® augmentation system.

The traditional treatment of type A3 unstable vertebral wedging fractures is performed with transpedicular fixation of two or more levels adjacent to the fracture causing great rigidity. Recently, the concept of bridge fixation combining one segment intrapedicular fixation with kyphoplasty has emerged as a more stable and less invasive system that allows greater mobility in this type of fractures. The combination of third-generation kyphoplasty and monosegmental bridge fixation may improve results to other fixation systems in type A3 vertebral fractures.

INTRODUCTION

AO Type A3 burst fractures of the vertebral body (VB) account for 17% of spinal fractures in the thoracolumbar region (T11-L2)1, with 30% of patients presenting neurological lesions2. In the absence of neurological deficits some of those tend to be treated conservatively.1,3 Surgical treatment aims to reduce, decompress, stabilize, resolve the pain, and shorten the treatment, all of these via a posterior or anterior approaches. There are three common procedures4: a) one level fixation of a VB above and below the fracture; b) fixation of two or more VBs above and below; c) fixation of the fractured VB using intersomatic grafts and boxes to merge and stabilise adjacent VBs.

Recently the concept of monosegmental bridge fixation (MBF) combined with kyphoplasty has emerged, this procedure stabilises fractures by fixing only the segment adjacent to the fracture, thereby preserving mobility.

Few studies have described a MBF combined with the first generation vertebroplasties without VB height restoration.5 Others have presented cases of MBF on balloon kyphoplasty which restores the...
height of the VB before cementing.\textsuperscript{6}

We present case series with type A3.1 unstable osteoporotic fractures of the thoracolumbar hinge, treated percutaneously with one level adjacent fixation with pedicular screws and third-generation kyphoplasty, cement (PMMA), and MBF.

\textbf{CASE SERIES}

Four women with a history of osteoporosis with a type A.3.1.2 fracture according to the Magerl/AO classification, without neurological symptoms (Table 1).

\textbf{TECHNIQUE}

After general anaesthesia, the patients were placed in prone decubitus position on 4 pads in prominent chest and pelvic areas of the body. A ‘C’ arm image intensifier was used to guide the entire surgery. Through 4 mm incisions using a trocar, a Kirshner type guide wire was introduced through the pedicle into the thickness of the fractured VB. After tapping and shaping the receiving area, two SpineJack\textsuperscript{®} augmentation implants (Vexim, Balma, France) were introduced.

Simultaneous and symmetrical expansion then took place until VB height was restored, and finally we inserted the cement-injection cannula with PMMA Cohesion\textsuperscript{®} (Vexim, Balma, France). After locating the levels adjacent to the cemented VB, a trocar was used for access through the pedicles, and the guide wires were placed. Then, previous tapping the polyaxial screws inserted through the pedicles. Finally, the rods were inserted percutaneously and locked to the screws. The patients were allowed to mobilise 6 hours after the operation. They were discharged home after 20-24 hours. Images were compared before the operation and one month after. The kyphotic angles were calculated by the Gardner method.\textsuperscript{7} In order to assess the restoration of VB height, the relative percentage heights of the anterior, medial and posterior VB were evaluated, for which the fractured VB was divided by the mean of the anterior, medial and posterior heights of the upper and lower VB. The parameters were described with mean and standard deviation (SD) (Table 2).

\textbf{RESULTS}

This is a preliminary study based on four cases, however, our results have been quite uniform and consistent (Table 2). We have obtained an improvement of the mean kyphotic angle of 11.3° (SD ±5.1) and a clear restoration of VB height. The height loss

\begin{table}[h]
\centering
\caption{Case characteristics} \label{tab:case_characteristics}

\begin{tabular}{llll}
\hline
Case & Age (yrs) & Pathophysiology & X-ray / CT \\
\hline
1 & 82 & Lumbar trauma after fall & L3 fracture, Type A.3.1.2 \\
2 & 84 & Mild lumbar trauma & L4 fracture, Type A.3.1.2 \\
3 & 75 & Lumbar trauma after fall & T12 fracture, Type A.3.1.2 \\
4 & 79 & Mild lumbar trauma & L1 fracture, Type A.3.1.2 \\
\hline
\end{tabular}
\end{table}

\begin{table}[h]
\centering
\caption{Radiographic data} \label{tab:radiographic_data}

\begin{tabular}{lllllllll}
\hline
 & Case 1 & & & Case 2 & & & Case 3 & & & Case 4 & & & Mean, (SD) \\
 & PRE\textsuperscript{5} & POST\textsuperscript{6} & PRE & POST & PRE & POST & PRE & POST & PRE & POST & PRE & POST & \\
\hline
Angle\textsuperscript{1} (α) & 15.80° & 11.57° & 21.11° & 9.48° & 16.70° & 3.60° & 30.91° & 10.34° & 11.3 (±5.1) \\
Height\textsuperscript{2} (%) & 72.5 & 98.8 & 73.5 & 97.4 & 92.8 & 95.2 & 46.2 & 97.3 & 25.9 (±19.9) \\
Height\textsuperscript{3} (%) & 43.4 & 89.9 & 73.3 & 98.1 & 45.3 & 92.8 & 50.4 & 91.4 & 39.9 (±10.4) \\
Height\textsuperscript{4} (%) & 85.1 & 99 & 71.4 & 94.5 & 95.7 & 99.2 & 93.6 & 94.6 & 10.3 (±10.5) \\
\hline
\end{tabular}
\end{table}

\textsuperscript{1}: Gardner angle; \textsuperscript{2}: restored height of anterior VB; \textsuperscript{3}: restored height of central VB; \textsuperscript{4}: restored height of posterior VB; \textsuperscript{5}: preoperation; \textsuperscript{6}: postoperation.
was 25.9% (SD ±19.9) anterior, 10.3% (SD ±10.5) posterior and 39.9% (SD ±10.4) central, the latter showing the greatest VB height loss.

**DISCUSSION**

This procedure gives similar results to those described by other authors: immediate stability; early mobilization; elimination of pain and protection of future deformations.

Compared to the above, the procedure significantly adds the plus of correcting the deformity. As demonstrated by most of the studies in the literature, the balloon kyphoplasty (BKP) is an effective and reliable technique in patient with spinal compression without neurological signs (AAOS guidelines). Comparative with BKP is the loss of VB height after deflating the balloon for cementing (Figs 1, 2).

The third-generation implants improve VB height restoration, and the SpineJack is the only one that delivers bidirectional expansion (cranium-caudal) instead of spherical. Force is applied only on the endplates, restoring VB height of bone fragments. In addition, it can be expanded and pulled back by means of a multi-function handle.

**CONCLUSION**

The combination of these percutaneous systems allows for the restoration of vertebral height while also offering sufficient stability to immobilize only one adjacent level with an early mobilization and discharge, reduced postoperative pain, lower blood loss in elderly patients. We believe that the minimal invasiveness of the combined system offers major advantages over the traditional methods of treatment. We suggest the need for more studies with a larger group of patients and long-term follow-up.

**REFERENCES**

1. Joaquim AF, Patel AA. Thoracolumbar spine trauma: evaluation and surgical decision-making. J Craniovertebral Junction Spine 2013;4(1):3-9.
2. Hitchon PW, He W, Viljoen S, et al. Predictors of outcome in the non-operative management of thoracolumbar and lumbar burst fractures. Br J Neurosurg 2014;28(5):653-7.
3. Gnanenthiran SR, Adie S, Harris IA. Nonoperative versus operative treatment for thoracolumbar burst fractures without neurologic deficit: a meta-analysis. Clin Orthop 2012;470(2):567-77.
4. Cheng LM, Wang JJ, Zeng ZL, et al. Pedicle screw fixation for traumatic fractures of the thoracic and lumbar spine. Cochrane Database Syst Rev 2013;(5):CD009073.
5. Liu S, Li H, Liang C, et al. Monosegmental transpedicular fixation for selected patients with thoracolumbar burst fractures. J Spinal Disord Tech 2009;22(1):38-44.

![Figure 1. Preoperative kyphotic angle.](image)
6. Rahamimov N, Mulla H, Shani A, et al. Percutaneous augmented instrumentation of unstable thoracolumbar burst fractures. Eur Spine J 2012;21(5):850-4.

7. Gardner VO, Armstrong GW. Long-term lumbar facet joint changes in spinal fracture patients treated with Harrington rods. Spine 1990;15(6):479-84.

8. Ortín-Barceló A. Kyphoplasty combined with monosegmental transpedicular percutaneous fixation in Type A3.1 osteoporotic compression fractures. In A Coruna, Spain; 2016.

9. Boonen S, Van Meirhaeghe J, Bastian L, et al. Balloon kyphoplasty for the treatment of acute vertebral compression fractures: 2-year results from a randomized trial. J Bone Miner Res 2011;26(7):1627-37.

10. Noriega DC, Ramajo RH, Lite IS, et al. Safety and clinical performance of kyphoplasty and Spine-Jack® procedures in the treatment of osteoporotic vertebral compression fractures: a pilot, monocentric, investigator-initiated study. Osteoporos Int 2016;27(6):2047-55.
Смежная одноуровневая комбинированная фиксация с использованием кифопластики и транскутанных транспедикулярных винтов при нестабильных позвоночных переломах типа A3 у больных пожилого возраста

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Мы представляем серию случаев нестабильных позвоночных переломов типа A3.1.2, транскутанных кифопластикой и моносегментной транспедикулярной фиксацией Precept® и аугментационной системой SpineJack® третьего поколения.

Традиционное лечение нестабильных позвоночных переломов связано с применением транспедикулярной фиксации на двух или более уровнях, прилегающих к перелому, что в значительной степени вызывает неподвижность. В последнее время идея мостовой фиксации, которая сочетает транспедикулярную фиксацию с одним сегментом, представляет собой более стабильную и менее инвазивную систему, которая обеспечивает большую мобильность при таком рода переломах. Комбинация кифопластики и мостовой фиксации может улучшить результаты по сравнению с другими системами фиксации при позвоночных переломах типа A3.