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An Unconventional Treatment: Kyphoplasty as an Indirect Decompression Technique for Posterior Wall Retropulsion of Fractured Vertebral Body Kyphoplasty as an Indirect Decompression Technique

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ABSTRACT

There is no clear consensus on how to manage burst fractures that involve retropulsion of bony fragments of the posterior wall of the vertebral body. Many surgeons consider kyphoplasty relatively contraindicated due to technical challenges, increased risk of epidural cement leakage, and potential for further displacement of fragments into the central canal, which could potentially worsen the neurologic condition. We present the case of a neurologically intact 45-year-old man with a burst fracture at the T8 level and ≈50% compromised spinal canal with RWR. Kyphoplasty was performed. There was no cement leakage during the procedure. Pain relief is achieved immediately after surgery (VAS decreased from 7 to 2), and no neurological deterioration occurred. He could go back to work without pain within one week. Significant postoperative correction of kyphosis (wedge angle decreased from 22.6 to 6.9) and restoration of vertebral height (Beck index increased from 37.84% to 72.62%) was observed and was not lost during follow-up for a year (wedge angle 9.4, Beck index 75.81%). Retropulsion decreased from 7.8 mm (46,43% canal compromise) to 5.57 mm (33.15% canal compromise). At 1-year follow-up, the posterior wall appeared intact and there was almost no retropulsed fragment. Kyphoplasty for burst fractures with PWR can be an effective option for selected patients.

Alışılmadık Bir Tedavi: Arka Duvar Retropülsiyonu Varlığında Dolaylı Dekompresyon Tekniği Olarak Kifoplasti
Dolaylı Dekompresyon Tekniği Olarak Kifoplasti

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ÖZET

Vertebra gövdesinin arka duvarında kırık kemik parçaların retropulsiyonu (PWR) bulunan patlama kırıklarının yönetimi konusunda kesin bir fikir birliği sağlanamamıştır. Teknik zorluk, epidural sement sızıntısı riski ve kemik fragmanlarının santral kanalda daha fazla yer değiştirerek nörolojik durumun kötüleşmesine yol açabilme riski nedeniyle birçok cerrah kifoplastiyi nispeten kontrendike olarak değerlendirmektedir. Bu yazıda, T8 seviyesinde burst kırığı olan ve spinal kanalda ≈%50 oranında RWR ile basısı bulunan, nörolojik olarak sağlam 45 yaşında erkek hasta sunuldu. Kifoplasti uygulandı ve işlem sırasında çimento sızıntısı olmadı. Ameliyattan hemen sonra ağrı azalması sağlandı (VAS 7'den 2'ye düştü) ve nörolojik bozulma meydana gelmedi. Hasta bir hafta içinde ağrısız bir şekilde işine dönebildi. Ameliyat sonrası kifozda belirgin düzelme (kama açısı 22.,6'dan 6,9'a düşmüştür) ve vertebra yüksekliğinde restorasyon (Beck indeksi %37,84'ten %72,62'ye yükselmiştir) gözlenmiş ve bir yıllık takip sırasında kaybolmamıştır (kama açısı 9,4, Beck indeksi %75,81). Retropulsiyon 7.8 mm'den (%46,43 kanal basısı) 5.57 mm'ye (%33,15 kanal basısı) düştü. Bir yıllık takipte, arka duvar sağlam görünüyordu ve neredeyse hiç retropulse fragman yoktu. PWR'li patlama kırıkları için kifoplasti, seçilmiş hastalar için etkili bir seçenek olabilir.

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Introduction

Burst fractures (BFs) occur when the anterior and middle columns collapse, caused by severe axial forces applied. Though common (17% of all spinal injuries), BFs present several important treatment challenges (1, 2). Middle column disruption may lead to retropulsion of bone into the spinal canal and compression of neural elements (3). There is no definitive consensus on managing BFs with posterior wall retropulsion (PWR) of the fractured vertebral body (4). Many surgeons consider kyphoplasty relatively contraindicated due to the technical challenges, high risk of leakage, and further displacement of bone fragments into the central canal, which could worsen the neurologic condition. Here, we report on our experience of a BF case with PWR, which was successfully treated by kyphoplasty as an alternative decompression technique.

Case

A thoracic burst fracture was diagnosed in a 45-year-old patient who presented with severe localized pain in his back that prevented movement after a fall from a height. The examination was neurologically intact. Computerized tomography showed involvement of the posterior wall of the fractured vertebral body and no fractures of facet joints. The spinal canal was 46.43% compromised with PWR at the T8 level (Figure-1). Edema of the bone on STIR sequence (fat suppression technique) of magnetic resonance imaging indicated a fresh fracture. Luckily, there was no intramedullary T2-hyperintense signal suggestive of acute cord edema. We discussed the risks and benefits of different treatment options with the patient and decided on kyphoplasty since he was neurologically intact, even with PWR.

Surgical technique

The procedure was performed with sedo-analgesia in the prone position. The C arm was skewed at an appropriate angle so that vertebral endplates appeared parallel to each other. A bilateral transpedicular approach was used and the balloons were inserted and placed in the anterior one-third of the vertebral body in lateral view. The balloons were slowly and carefully inflated to avoid further displacement of bone fragments in the central canal. The inflation was stopped when the pressure of the balloons reached approximately 200 psi, then deflated and removed. PMMA (Polymethylmethacrylate) was injected under high viscosity and low pressure. We performed intermittent C-arm X-ray monitoring during the entire gradual injection process. We stopped immediately when PMMA neared the posterior wall. There was no cement leakage during the procedure.

Follow-up

We evaluated clinical and radiological data pre-operatively, post-operatively, and at first-year follow-up. Pain intensity was assessed using the visual analog scale (VAS). VAS score decreased from 7 to 2 immediately after surgery. No neurological deterioration occurred. He went back to work painlessly within one week. Post-operative correction of

kyphosis (adjacent bisegmental angle decreased from 23.1 to 18.0; calculated using the Cobb method) (5), wedge angle of fractured vertebra (decreased from 22.6 to 6.9) and restoration of vertebral height (Beck index (6) increased from 37.84% to 72.62%) was observed and was not lost during follow-up for a year (local kyphotic angle 18.5, wedge angle 9.4, Beck index 75.81%) (Figure-2). Retropulsion decreased from 7.8 mm to 5.57 mm and canal canal-occupying ratio of the fragment decreased from 46.43% to 33.15% postoperatively. After one year of surgery, the posterior wall remained intact and there was almost no retropulsed fragment (Figure-3).

Discussion

In this case, we introduce kyphoplasty as a safe and easy indirect decompression technique for BFs with PWR of bone fragments. According to current guidelines, treatment for burst fractures with PWR but without neurological impairment remains controversial. Some authors advocate for a conservative treatment approach in patients who have no neurological deficits, claiming possible spontaneous remodeling of the posterior wall, while others propose a range of surgical techniques, including decompressive laminectomy and stabilization with instrumentation. Whereas; discharging patients with canal compression for bed rest or performing major surgery are at the extreme points of the spectrum. Furthermore, many surgeons consider kyphoplasty relatively contraindicated due to technical challenges, the high risk of cement leakage, and the potential for further displacement of bone fragments into the central canal (7, 8). Kyphoplasty can achieve the desired mechanical stability in the anterior column by filling the vertebral body with cement (9). Therefore, following the three-column theory by Louis, we tried to fill the anterior two-thirds of the vertebra almost with cement to achieve good mechanical stability.

When we scrutinize kyphoplasty as an indirect decompression technique for BFs, it is crucial to attain partial height restoration and spontaneous reduction of the posterior fragment via ligamentotaxis (3, 7). Retropulsed fragments in the spinal canal are pushed back into their previous place partly by the posterior longitudinal ligament (PLL). As in distraction with the rod and pedicle screw in the instrumented ligamentotaxis, in the indirect decompression performed by kyphoplasty, PLL is distracted by the restored height of vertebrae, this continuous longitudinal force brings fracture fragments more closely together. As in our case, remaining bone fragments can also be resorbed gradually by a remodeling process by cerebrospinal fluid pulsations. Some studies have indicated that there was no notable difference in cement leakage between patients with fractures involving the posterior wall and those without such involvement (10). It is important to wait until the cement becomes highly viscous to avoid leakage. The viscosity we mention can be described as follows: it could stand at the tip of the cement inserter. Another essential trick is the slow injection of cement at low pressure. In current studies, no significant difference has been

shown between the unilateral and bilateral transpedicular approaches in terms of height restoration and cement leakage complications (11). We preferred to inflate the balloon cavity in a balanced way on both sides with two small 10 ml balloons. Thus, we thought we would be more controlled in fragment retropulsion.

Conclusion

The balloon inflation can distend the vertebral body to restore its height partially, and this distention can make the ligaments tense to retract protruded bone fragments. Kyphoplasty for BFs with PWR can be a safe and effective treatment option. Further large-scale prospective studies are required.

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Concept: S.B, I.E.S.
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Critical Review: S.B.

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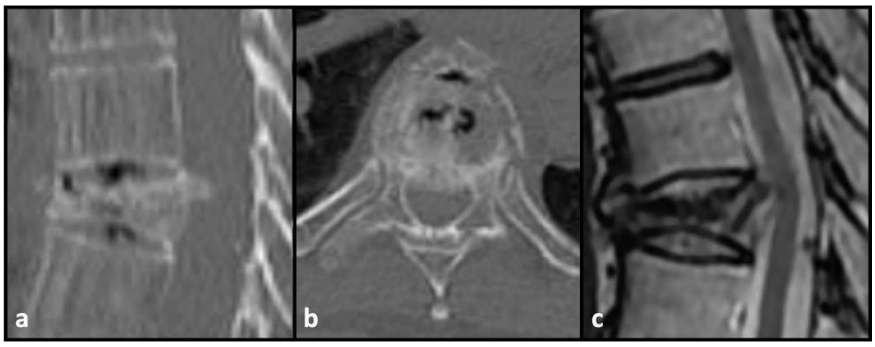

Figure 1. Preoperative CT and MRI findings: Burst fracture with posterior wall retropulsion with bone fragments and canal compression at the T8 level a. on midsagittal CT sequence and b. on the axial CT sequence, c. despite canal compression, there was no presence of an intramedullary T2-hyperintense signal suggestive of acute cord edema on MRI sagittal sequences.

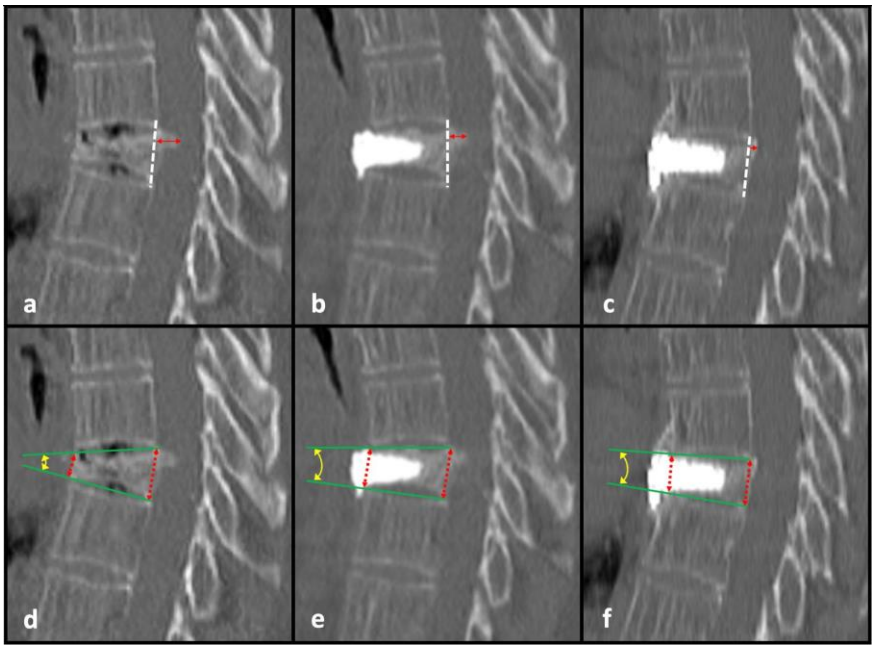

Figure 2. A straight line was drawn on the midsagittal sequence, extending from the posterior-inferior corner of the upper adjacent vertebral body to the posterior-superior corner of the lower adjacent vertebral body, to determine the normal position of the posterior wall at the target level before fracture is seen in the first row of pictures (white dashed lines). The PWR was subsequently measured perpendicularly from this line (red arrows), as seen in the first row of images. a. Preoperative PWR was 7.8 mm (with 46.43% canal compromise). b. Early postoperative PWR was 5.57 mm (with 33.15% canal compromise) c. At 1-year follow-up, the posterior wall appeared intact and there was almost no retropulsed fragment. The wedge angle (marked in yellow) measurement of the collapsed vertebra, along with the reference lines (green lines), can be seen in the second row of images. Beck index was calculated by dividing the anterior edge height by the posterior edge height (red dashed lines). Wedge angle and Beck index were found as follows, respectively: d. Preoperative 22.6 and 37.84%, e. Early postoperative 6.9 and 72.62%, f. Correction of kyphosis was not lost during follow-up for a year; 9.4 and 75.81%.

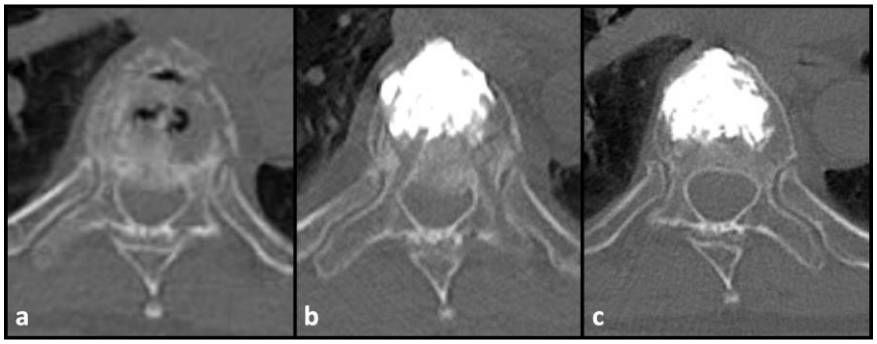

Figure 3. a. Burst fracture with posterior wall retropulsion with bone fragments and canal compression at the T8 level can be seen in the preoperative axial CT sequence. b. Early postoperative axial CT sequence shows spontaneous partial reduction of posterior fragment via ligamentotaxis. c. At the 1-year follow-up, the posterior wall appears to be almost intact, and the bone fragment has been resorbed, potentially through a process of remodeling facilitated by cerebrospinal fluid pulsations.