THE ROLE OF POSTERIOR INSTRUMENTATION ON CANAL COMPROMISE IN THE TREATMENT OF BURST FRACTURES OF THORACOLUMBAR SPINE

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ABSTRACT:

Background: *Recent studies demonstrated the importance of the Posterior Longitudinal Ligament (PLL) and posterior annulus in the decompression of the medullary canal by reducing intracanal fragment.*

Aim: *Purpose of this study is to demonstrate the effects of canal compromise amount to the canal clearance by posterior distraction and ligamentotaxis.*

Material and Method: *There were 16 patients (7 women and 9 men) with average age of 37.2 years (range 15-56). All patients had preoperative and postoperative CT scans which revealed narrowing of the medullary canal less than 30% in 1; 30-50% in 4 and more than 50% in 11 cases preoperatively. Postoperative narrowing of the medullary canal revealed 0-15% in 6, 15-30% in 3 and more than 30% in 7 patients. The patients were operated with in 4 hours to 18 days (av. 1.8 days) of the injury. 9 patients underwent posterior, and 7 patients, combined anterior and posterior surgery. The average follow-up was 30.4 months. At follow-up examination 3 patinets Frankel A remained unchanged, 1 of 2 Frankel C patients remained unchanged and one improved to grade D, 2 of 6 grade D patients improved to grade E; 2 remained unchanged, and one deteriorated to grade C; 5 patients did not have neurological deficits postoperatively.*

Conclusion: *Our results demonstrated that ligamentotaxis achieved by distraction was successful in cases which medullary canal compromise was less than 35%, whereas in cases which medullary canal compromise was more than 35%, it was not successful and residual bone fragments still remained in the canal leading to various degrees of canal compromise. The possible cause for this may be that posterior longitudinal ligament 1 (PLL) and posterior annulus could have been ruptured in cases with more than 30% canal compromise.*

We think that preoperative MRI might be helpful to evaluate PLL and posterior annulus. If this is not possible, anterior surgery should be chosen.

Key Words: *Burst fractures, canal compromise*

INTRODUCTION

Today, one of the most controversial fracture in means of treatment is burst fracture (BF) of the spine. Most important difference of the burst fractures from compression or other vertebral fractures is the fracture of the middle column and 30 - 60 % of burst fractures at the thoracolumbar junction have an associated neurologic injury (7). Whitesides determined that the burst fracture is the most common cause of neural injury in the thoracolumbar spine (27). At present, there is wide acceptance, if not a consensus, towards surgical treatment of cases having neurological deficits. Timing and the choice of treatment seem to be important factors. Posterior instrumentation, mainly transpedicular fixation systems, depend on indirect reduction of the canal compromise (PLL) and posterior annulus in the decompression of the medullary canal by reducing intracanal fragment.

In this study, fracture characteristics of posterior reduction and those who need an anterior decompression have been investigated. Timing of surgery is not considered because of unbalanced groups (i.e. early vs. late surgery).

MATERIALS AND METHOD

20 thoracolumbar burst fractures who underwent operative treatment using Alıcı spinal system were identified. A retrospective study was designed including 16 of 20 patients who have had complete set of preoperative and postoperative X-ray and CT scans and a minimum of 6 months follow-up (mean follow-up was 30.4 months). There were 7 females and 9 males. Their mean age was 37.2 (minimum 15, maximum 56) years. Most common type of injury was fall from a height (9/16), followed by traffic accident (6/16) and work accident (1/16).

Vertebral height loss, sagittal index (SI) (15) were measured on lateral X-rays and canal compromise rel-

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ative to the mean diameter of one level above and one level below of affected vertebra was calculated. Burst fractures were classified according to Denis's classification (8) and Frankel scale was used to determine preoperative and postoperative neurologic status.

Indications for surgery were: 1. Neurologic findings, 2. instability (According to Denis), 3. More han 35% canal compromise with or without neurological findings. Anterior decompression and instrumentation is done whenever the canal clearance is not sufficient, presence or persistence of neurologic deficit.

Wilcoxon signed rank test and Wilcoxon rank sum test were used in statistical analysis.

RESULTS

Commonest level of injury was L1 (9/16), followed by T11 and L2 (2/16), T8, T12, L4 (1/16). There were three group A, 12 group B, one group D burst fractures. Additional fractures were observed in 6 patients (Calceneus fractures 3, Costal fractures 3, Acetabulum fracture 1).

9 patients underwent posterior reduction and instrumentation and 7 patients anterior decompression and instrumentation in addition to posterior instrumentation.

Preoperative vertebral height loss in sagittal plane was 51.7%. Postoperative measurement showed 13% of height loss, which was a significant recovery. (differences between preop and postop measurements in posterior instrumentation and posterior and anterior instrumentation groups were significant; p = 1.389E-03 and p = 5.188E-04 respectively)

Preoperative SI was 22.8° and postoperative SI was 8.9°. Both preoperative and postoperative values between groups were not significant (p = 0.215) and p = 0.469 respectively). However, preop. and postop. values within groups were significant (p = 9.87E-04 and p = 1.75E-03 respectively).

Mean preop. vertebral canal narrowing was 51.1% and postop. measurements revealed 29%. Table 1. Narrowing of the medullary canal was less than 30% in 1; 30-50% in 4 and more than 50% in 11 case preoperatively. Postoperative narrowing of the medullary canal revealed 0-15% in 6, 15-30% in 3 and more than 30% in 7 patients. Posterior instrumentation group showed 46.9% preop. and 16.8% postop. norrowing (p = 1.55E-03). Preop. and postop canal narrowing values in two staged operation group were 72.6% and 44.9% respectively (p = 8.63E-03).

When canal compromise was less than 50%, postop. canal clearance was nearly complete (3.6% ± 5.4%; p = 5.41E-04). When canal compromise was greater than 50% (mean 69.7% ± 12.9) there was a significant (p = 1.94E-04) reduction in canal compromise (40.6% ± 18.6).

At follow-up examination 3 patients. Frankel a remained unchanged, 1 of 2 Frankel C patients remained unchanged and one improved to grade D, 2 of 6 grade D patients improved to grade E; 2 remained unchanged, and one deteriorated to grade C; 5 patients did not have neurological deficits postoperatively.

DISCUSSION

In the last two decades surgical treatment of burst fractures became increasingly important. However, conservative treatment for lumbar burst fractures. Kelly and Whitesides (22) considered burst fractures with retropulsed fragment to be unstable and believed that they should be treated by anterior decompression.

Argenson (1) demonstrated that the annulus fibrous and longitudinal ligaments are extremely important in the stability of the spine. Anterior longitudinal ligament, posterior longitudinal ligament, ligamentum flavum, articular capsules, annulus fibrosus, and nucleus pulposus are soft tissue components which can be injured in a BF. If posterior annulus or posterior

Table 1. Mean values of measurements are given

	Vertebral Height Loss		Sagittal Index		Canal Compromise	
Type of Instrumentation	preop (%)	postop (%)	preop (%)	postop (%)	preop (%)	postop (%)
Posterior Instrumentation	47.11 SD±25.7	14.22 SD±10.9	21.4 SD±6.5	9 SD±7.7	46.9 SD±19.1	16.8 SD±17.6
Posterior and anterior Instrumentation	57.6 SD±25.2	11.42 SD±13.1	24.7 SD±6.7	8.7 SD±6.7	72.6 SD±16	44.9 SD±21.2
Total	51.7	13	22.8	8.9	58.1	29

longitudinal ligaments are disrupted, an indirect reduction maneuver, so called ligamentotaxis could not be successful. Frederickson et al. (16) showed that there were important injury at the superior and inferior end plate of fractured vertebra, annulus fibrosus were disrupted from the both end plate. Sometimes PLL was ruptured, but sometimes it was intact. Annulus fibrosus was ruptured or injured in various degrees. They also showed that when PLL was ruptured alone, reduction could be achieved by distraction posteriorly, but when it was ruptured together with posterior annulus fibrosus it could not be achieved. Besides, posterior distraction techniques can have deleterious affect on neurologic status of the patient (16).

Controversies exist in literature concerning medullar canal compression and neurologic injury. Some authors indicate that there is a correlation between medullar canal compression and neurologic status (10, 11, 13, 25, 26), some authors don't (2, 7, 18, 20). There are patients with varying degrees of canal narrowing inconsistent with neurologic status. Besides, neurologic status depends on the level of injury, impact and severity at the time of injury. Postural reduction might occur in supine position, so observed canal narrowing do not necessarily reflect the reality (6). The fragment seen at CT minimally compressed to the spinal cord could compress totally the medulla spinalis at the instant of fracture, and retracted again. Sometimes, especially in lumbar region, when canal is compressed as high as 75 % there might not be any neurologic findings. Hashimato et al (19). indicate that the intracanal fragment is not always correlated with the neurologic status. But if the compression is about 35% at T11-12 level, 45 % at L1-2, and 55% at cauda equina level, the possibility of neurologic injury is very high. However, decompression constitutes an important issue in the treatment (3, 4, 9, 10, 17, 22, 24, 25). Studies by Edwards et al (12), Fidler (14), and Jhonsons et al (20) and others documented the occurrence of gradual resorption of such displaced fragments (12, 14, 21).

The criteria we use for determining whether surgical interventions that will be recommended are: kyphosis greater than 15° and/or spinal canal compromise more than 35% with or without a correlative neurological deficit (5, 7, 11). Despite of good functional results have been documented with nonoperative approaches, particularly in the absence of neurologic deficit, surgical intervention facilitates faster mobilization, better correction of deformity, and greater neurologic improvement. However, approaches to decompression and stabilization remain hotly debated.

Indirect decompression is accomplished by fracture reduction and restoration of sagittal contour with posterior instrumentation. This uses the ligamentotaxis effect by applying tension to the posterior longitudinal ligament and posterior annulus to restore vertebral body height and reduce displaced anterior fracture fragments while they are still loose. Frederickson et al (16) documented that posterior longitudinal ligament complex provides only a minor contribution in the reduction of the intracanal fragment in comparison to the posterior half of the annulus fibrosus. The annular complex, specifically the attachments of the intracanal fragment, appears to be the main contributor to the reduction of this fracture. If these structures are intact after injury, adequate reduction of the fracture should be possible using posterior instrumentation. This means that if these structures, especially posterior half of the annulus are ruptured at the instant of trauma, reduction of the intracanal fragment would not be possible by the posterior distraction. Actually, we observed worsening of neurologic status after distracting the fractured vertebra by posterior instrumentation. Retrospectively, we think that PLL and posterior annulus were ruptured in the cases. For this reasons, we strongly advocate that MRG must be routine in all burst fractures with intracanal fragment. In indirect reduction maneuver by posterior distraction, there is a neurologic risk, not only further compression of the intracanal fragment, but by the decreasing the blood flow to the neural elements due to stretched blood vessels. Another disadvantage of this technique is that it can be used within a 24 to 48 hours following trauma, since after this period, consolidation of the bone fragments will not permit indirect reduction.

As a result in the light of our results and literature, we advocate that surgical planning must be guided with magnetic resonance imaging. This may offer a means to asses the integrity of the posterior annular attachments to the intracanal fragments. If a magnetic resonance imaging of the patient is not possible, and it has been shown by CT that patient has intracanal fragment with canal compromise canal more than 35%, an anterior decompression technique must be chosen.

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