THE RESULTS OF THE POSTERIOR INSTRUMENTATION OF THE THORACOLUMBAR BURST TYPE SPINE FRACTURES*

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ABSTRACT:

The surgical treatment of the thoracolumbar burst type spine fractures has been widely explored. The long term survival and the possibility of functional rehabilitation of patients with spinal cord injuries has led to increased interest in treatment of these patients.

Between 1992-1995, 87 patients with thoracolumbar burst type fractures were surgically treated by posterior instrumentation and fusion within five days from the injury. The applied instrumentation system were Alıcı for 45, Isola for 30, and AO fixatour interna (Dick) for 12 patients. After an average follow-up period of 2.4 years, the mean loss of correction in local kyphotic angle was 11°. The average improvement in the canal devience was found as 26%. The improper placement of the transpedicular screw fixation was 9.2% (to the fractured vertebra in 1, to the disc space in 7 patients). Although the postoperative pain on the thoracolumbar vertebral region was identified in 2.3, it was 31% on the posterior iliac allograft donor site. No screw or rod breakage, and nonunion was established. With respect to neurologic recovery, the average improvement was 1.17 Frankel grades. The mean post-operative infection rate was 4.6%, but in only one patient, the implant removal was needed.

As a result; the surgical treatment of the unstable burst type thoracolumbar vertebral fractures with a posterior instrumentation system is the proper method of fixation when the indications of the surgery and the approach type are well-decided.

Key words: *Thoracolumbar Vertabrae, Burst Fractures, Posterior İnstrumentation.*

INTRODUCTION

The optimal surgical approach for unstable thoracolumbar burst type fractures is controversial, and the decision of the operative or conservative treatment, operation time, and the need, type and time of surgical decompression remains unclear (7, 12, 19, 26). In this study, the efficacy of posterior instrumentation for treating thoracolumbar burst fractures to restore spinal alingment and indirectly reduce intracanal bone fragments was investigated.

METHODS

87 cases of thoracolumbar burst type fracture that were treated by posterior instrumentation and fusion in Ankara Numune Hospital, 3rd Department of Orthopaedics and Traumatology were rewieved. This group of patients included 51 men and 36 women with the mean age of 46.3 y (ranging 18-57 y). All patients were involved in steroid administration from the time of admission. All fractures were stabilized by posterior instrumentation and fusion within five days from the injury. They also used a thoracolumbosacral orthosis for 9 mounths postoperatively.

The applied posterior instrumentation system were Alıcı for 45 patients, Isola for 30 patients, and Dick (AO fixatour interna) for 12 patients. After the mean follow-up period of 2.4 years, all patients were evaluated with respect to local kyphotic angle, improvement in the canal deviance, neurologic recovery, transpedicular screw placement, postoperative implant failure, nonunion, pain and infection.

Neurological status was graded at the time of admission, postoperatively, and at a mean of 2.4 years postinjury. By using preoperative and postoperative radiographs and computed tomographic scans, the degree of spinal canal compromise, the loss of correction in local kyphotic angle and the placement of transpedicular screw fixation were quantified in the sagittal, coronal, and axial planes.

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The desicion-making criterias for posterior instrumentation were incomplete neurological deficit with a compression of more than 50% in vertebral body height, angulation of more than 20° in kyphotic angle, canal compromise between 30%-70% (11) and complete neurological deficit in order to achieve anatomic alignment, to reduce morbidity, and also the hospitalization time and costs (7). However these measurements for indication might change according to the fracture level as well as the type of fracture and the neurologic status (1, 7, 26).

RESULTS

Between 1992-1995, posterior instrumentation and fusion was applied in 87 patients with unstable burst type fractures. The distribution of the applied instrumentation system were Alıcı in 45, Isola in 30, Dick (AO fixatour interna) in 12 patients.

The level of the fractured vertebra in Alıcı group was thoracal in 8, T11 in 3, T12 in 15, L1 in 14, L2 in 5 patients. Preoperative neurological status in this group was presented with Frankel A in 16, B in 2, C in 4, D in 4, E in 19 patients. In this group, postoperative improvement in Frankel score was 1 grade in 17 patients, and the mean loss of correction in local kyphotic angle was 15° at follow-ups.

In Isola group, the level of the fracture was thorocal in 4, T11 in 3, T12 in 6, L1 in 11, L12 in 8 patients. 12 patients presented with Frankel A, 2(B), 3(C), 6(D), 9(E) preoperatively. In this group, 12 of 30 patients showed neurological improvement postoperatively, and 5° loss of correction in local kyphotic angle were noted at follow-ups.

In Dick group, the fracture level was noted as thoracal (1), T12 (4), L1 (5), L2 (2) and preoperative Frankel scale was A in 2, B (1), C (2), D (2), E (5) patients. Postoperatively, neurological improvement was noted in two patients presenting with Frankel C and D and the mean loss of correction in local kyphotic angle was 10° at follow-ups.

After a mean follow-up period of 2.4 years, the average neurologic improvement was 1.17 Frankel grades, the mean loss of correction in local kyphotic angle was 11°. The average improvement in the canal deviance was found 26%.

The improper placement of the transpedicular screw fixation was 9.2%. It was to the fractured vertebra in 1, to the disc space in 7 patients. With respect to the implant failure, no screw or rod breakage were noted, but rod buckling was established in 2 patients (2 Alıcı, 1 Dick). In one patient that was applied Alıcı for T6 vertebral fracture, otonomic hypereflex syndrom occured postoperatively.

Although postoperative pain on the operation site was 2.3%, 31% patients suffered from the pain on the posterior iliac allograft donor site. Postoperative infection rate was 4.6%, and in one patient who was applied Alıcı, the removal of the implant was needed for infection control.

CONCLUSIONS

Surgical treatment restores the spinal alingment, facilitates the rehabilitation time, reduces the hospitalization time and the complications such as pneumonia, decubitis, and thromboemboli. The goals of the surgery are to provide maximal neurological recovery, to reduce the fractured fragments, to obtain a stable and painless spinal column and to stabilize the least number of spinal segments (26). Surgical indication depends on the type and level of the fracture and the degree of the neurological injury, and varies widely (26). In this study, the surgery indications were correlated with Montesaro et al as mentioned above (7).

In unstable burst-type fractures, loss of vertebral body height, kyphotic angulation, and retropulsion of bone fragments into the spinal canal are restored by posterior instrumentation via distraction forces. Contouring the rods according to the normal spinal column is essential and corrects the kyphotic deformity (7).

The potential for recovery after incomplete spinal cord injury is dependent on the initial injury severity. Although some neurologic recovery and canal space remodelling will occur in patients with incomplete spinal cord injuries regardless of treatment, recent studies suggest more significant improvement using surgical methods that result in fracture reduction, canal decompression, and stabilization (7). In this study the average neurologic improvement was 1.17 Frankel grades. Sasso et al found that no patient in any group sustained an increase in neurologic deficit by posterior instrumentation (23). Alıcı reported the neurologic improvement in 22 injured patients of thoracolumbar fractures postoperatively. While 4 patients with Frankel D improving to E grade, 2 patients with Frankel A improved to D grade. 16

patients showed no neurological improvement (4). Dinçer et al reported the neurological improvement as 1.2 Frankel grade in neurologically injured patients by AO fixatour interna (10). Güngör et al found that 2 of 3 Frankel D patient improved to E grade (14). Akseki et al reported neurological improvement by applying Alıcı (2). Dick implied that satisfactory reduction of kyphosis and neurologic recovery occured in 52% of patient with a Frankel score of A through C. All patients with Frankel D had at least partial recovery (9). Few complications and similarly good results were found by Aebi et al and Mozes et al (7, 26). Grootboom et al noted that all partial neurological deficit improved in their study and surgery was only indicated in cases with partial neurological deficit and spinal canal compromise or significant instability (15).

Stability of the spinal column is described in different criterians. According to Holdsworth, the injury is accepted as stable if the ligamentous structures are intact (16). However, Denis accepts all vertebral fractures except compression ones as unstable (8). Mc Afee believes in that if the components of the posterior column are integrent, the injury is thought as stable (20). According to Farcy-Weidenbaum criterias, the injuries greater than or equal to Grade 3 are unstable (26). The stability criterias for this study were adjacent to Montesaro's (7).

The techniques of posterior instrumentation for thoracolumbar burst fractures have studied extensively (7). Indirect spinal canal decompression is thought to be achieved by the posterior longitudinal ligament that has been termed ligamentotaxis. Frederickson et al demonstrated that the posterior longitudinal ligament had little effect in vitro, but rather the tension created by the annulus fibrosus of the disk as a result of the distruction reduced retropulsed bone fragments (13). Harrington et al found that no tension was present in PLL structure at between 0% and 30% canal occlusion, confirming the results of Frederickson et al. These in vitro studies are consistent with clinical studies documenting incomplete reductions of the spinal canal by posterior instrumentation. Crutcher et al found posterior distruction instrumentation to reduce canal compromise by only 50% of the initial occlusion, leaving an average of 32% canal compromise (7).

In this study, the mean reduction rate of canal compromise was 26%. In an experimental study of Shono et al, reduction rate of canal compromise was 18.5% for Dick (24). Zou et al found that canal comprimise was reduced from 27.5% to 16.7% by using AO fixator intern (27). Cain et al noted the increase in canal size with distruction instrumentation as 11.7% in twenty-four freshly frozen dairy calf spines (6). Albayrak et al reported the canal restoration after the operation by Alıcı as 33% in 43 patients including 32 burst fractures (3). Kutluay et al noted 55% canal restoration by posterior instrumentation by Alıcı (18). Esses concluded that, although anterior surgery results in a more complete and reliable decompression of the canal, posterior distruction instrumentation can effectively decompress the canal and correct kyphosis in burst-type injuries (13).

In this study, the mean loss of correction is found 15° in Alıcı, 5° in Isola, 10° in Dick group and averagely 11° in all patients. Aebi et al, Dick and Gertzbein et al noted the the preoperative kyphosis and late kyphosis by using Dick as follows: Aebi (4→7°), Dick (5→10°), Gertzbein (6→15°) (12). Sasso et al found that 6.3° improvement in kyphosis by Harrington, and 13° by Luque postoperatively. But they concluded that no statistically significant differance was found between preoperative and after 1 year of the operation results (23). Dinçer et al reported the mean loss of correction as 3.7° by using AO internal fixateur (10). Albayrak et al reported a change of 5.9° in local kyphosis angle postoperatively by performing Alıcı (3). Özbarlas et al applied Alıcı in 7 burst fracture and noted preoperatively 19° and postoperatively 6.4° vertebral wedging (21). Güngör et al found 24% improvement in local kyphosis angle by using Alıcı in burst and other types of fractures (14). Kutluay et al found loss of correction in kyphotic angle as 11.2° by in using Alıcı (18). Altınmakas et al rewieved 44 thoracolumbar fractures that were applied Dick (8), Alıcı (12), TSRH (24). They reported 7° improvement in sagittal index postoperatively and concluded that Dick and Alıcı instrumentation systems showed no significant differance with respect to maintain reduction and stability (5). Most authors established 5-15° progressive kyphosis and gradul loss of vertebral height after surgery in lumbar spine (12).

No implant breakage and nonunion occured in this study. Sasso et al found 4 hook dislodgement and 1 pseudarhtrosis in Harrington group of 24 patients, 1 rod breakage and 1 pseudarthrosis in each Luque

group of 23 patients, and in PSP group of 33 patients (23). In literature, nonunion rate is 2% in upper lumbar, and 8% in lumbosacral region (12). Grootboom et al 15 noted the postoperative back pain as 10% which was higher than 2.3% in this study.

The mean infection rate in this study was 4.6% in performence of Alıcı, Isola and Dick. In the study of Sasso et al, postoperative infection rate was found 26% in Luque group, 9% in Harrington group, and 4% in AO pedicle screws and plates (23). Roy-Camille and Thalgott reported the infection rate as 6% in their series (22, 25). Altınmakas et al noted 6.8% screw breakage, 6.8% back pain, 2.3% infection rate (5). Kutluay et al reported the superficial infection rate as 1.2% (18). Dinçer et al reported 1 painful root lesion and 4.8% postoperative infection rate by Dick (10). Güngör et al noted 2 superficial infection, 1 back pain and 1 implant loosining by Alıcı (14). Akseki et al noted 3 infection, 2 screw and 1 rod breakage in 62 patients treated with Alıcı (2).

Early surgical reduction, stabilization, and decompression is safe and improves neurologic recovery in comparison to historical controls treated by postural reduction or late surgical intervention (17).

The posterior reduction and stabilization with posterior instrumentation provided effective restoration of the sagittal alignment, but the optimal type of posterior instrumentation for reconsructing the spinal canal is unclear (24). Anterior procedures have not shown any significant advantages over posterior procedures. Also, anterior implant systems are presently in a state of development and investigation (7). Failure of neurologic recovery and persistent anterior compression is an indication for a second - stage anterior decompression and fusion (7, 12, 19, 25).

REFERENCES

1. Aebi M, Etter C, Kehl T, et al: Stabilization of the Lower Thorasic and Lumbar Spine with the Internal Skeletal Fixation System: Indications, Techniques, and First Results of Treatment. Spine 12: 544, 1987.
2. Akseki D, Tiner M: Alıcı Spinal Instrumentation in the treatment of thoracolumbar Vertebral Fractures. Congress Book of 13rd National Orthopaedics and Traumatology, p. 466, 1994.
3. Albayrak F, Tolgay M: Early Results in the Thoracal and Lumbar Vertebral Instrumentation by Alıcı, Congress Book of 13rd Orthopaedics and Traumatology, 536, 1994.
4. Alıcı E: The Early Results of the 372 Patients That were Treated by Alıcı Spinal System, Congress Book of 12nd Orthopaedics and Traumatology. 523, 1991.
5. Altınmakas N, Aydoğan A, Şehirlioğlu C: The Surgical Treatment of the Unstable Vertebral Fractures. Congress Book of 13rd National Orthopaedics and Traumatology, 488, May 1994.
6. Cain CJE, DeJong MJT: Pathomechanical Analysis of Thoracolumbar Burst Fracture Reduction. Spine. 18, 1647, 1993.
7. Chapman JR, Anderson PA: Thoracolumbar spine fractures with neurological deficit. Orthop. Clin. North. Am. Oct: 595, 1994.
8. Denis F: The Three Column Concept and It's Significance in the Classification of Acute Thoracolumbar Spinal Injuries. Spine 8: 817, 1983.
9. Dick W: The "fixateur interne" as a Versatile implant for Spine Surgery. Spine 12: 882, 1987.
10. Dinçer D, Us K, Yıldız Y: Application of AO Fixatour Interna in Thoracolumbar Vertebral Fractures. Congress Book of 12nd National Orthopaedics and Traumatology; 506, 1991.
11. Doerr TE, Montesano PX, Burhus JK, Benson DR: Spinal Canal Decompression in Traumatic Thoracolumbar Burst Fractures: Posterior Disctruction Rods versus Transpedicular Screw Fixation. J. Orthop. Trauma 5(4), 1991.
12. Edwards C.C., Levine AM: Fractures of the Lumbar Spine. In Surgery of the Musculoskeletal System. Evarts CMC (ed), vol 3, 2237, Churchill Livingstone Inc. New York, 1990.
13. Esses SI, Botsford DJ, Kostuik JP: Evaluation of Surgical Treatment for Burst Fractures. Spine 15: 667, 1990.
14. Güngör S, Sepici B, Kulekci S: The Application of Alıcı Posterior Instrumentation System in Thoracolumbar or Vertebral Fractures. Congress Book of 13rd National Orthopaedics and Traumatology, 457, 1994.
15. Grootboom MJ, Govender S: Acute Injuries of the Upper Dorsal Spine. Injury, 24, 389, 1993.
16. Holdsworth S: Rewiew Article: Fractures, Dislocations and Fracture-Dislocations of the Spine. J. Bone Joint Surg. 52A: 1534, 1970.
17. Krengel WF 3d, Anderson PA, Henley MB: Early Stabilization and Decompression for Incomplete Paraplegia due to a Thorasic-level Spinal Cord Injury. Spine. 15, 18, 2080, 1993.
18. Kutluay E, Ege C, Erel N: Alıcı Spinal Instrumentation in Lumbar Burst Fractures. Congress Book of 13rd National Orthopaedics and Traumatology. 470, 1994.

19. Montesaro PX, Benson DR, Fractures and Dislocations of the Spine. In Fractures. Rockwood CA, Wilkins KE, King RE (ed), vol 2, 1309, J.B. Lippincott Company, Philadelphia, 1991.
20. Mc Afee PC, Yuan HA, Frederickson BE, et al: The Value of Computed Tomography in Thoracolumbar Fractures. J. Bone Joint Surg. 65A: 461, 1983.
21. Özbarlas S, Korkmaz M, Özkan İ: Application and Early Results of the Alıcı Instrumentation in Vertebral Fractures. Congress Book of 12nd National Orthopaedics and Traumatology. 532, 1991.
22. Roy-Camille R, Saillant G, Mazel C: Internal Fixation of the Lumbar Spine with Pedicle Screw Plating. Clin. Orthop. 203: 7, 1986.
23. Sasso RC, Howard BC: Posterior Instrumentation and Fusion for Unstable Fractures and Fracture-Dislocations of the Thorasic and Lumbar Spine. Spine, 18, 450, 1993.
24. Shono Y, Mc Afee PC, Cunningham BW: Experimental Study of Thoracolumbar Burst Fractures. A Radiographic and Biomechanical Analysis of Anterior and Posterior Instrumentation Systems. Spine. 19, 1711, 1994.
25. Thalgott J, La Rocca H, Aebi M: Reconstruction of the Lumbar Spine Using AODC Plate Internal Fixation. Spine. 14: 91, 1989.
26. Weidenbaum M, Farcy JPC: Surgical Management of Thorasic and Lumbar Burst Fractures. In Spinal Surgery. Bridwell KH, DeWald RL (ed) vol. 2, 911-57, J.B. Lippincott Company, Philadelphia, 1991.
27. Zou D, Yoo JU: Mechanics of Anatomic Reduction of Thoracolumbar Burst Fractures. Spine. 18, 195, 1993.