CLINICAL ARTICLE

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Anterior and Posterior Stabilization by One Stage Posterolateral Approach in the Unstable Fracture of Thoracolumbar and Lumbar Spine

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Objective : The purpose of this study is to investigate the clinical results of anterior and posterior stabilization by one stage posterolateral approach for the unstable fracture of thoracolumbar and lumbar spine.

Methods : By posterolateral approach with curved skin incision, unilateral facet and pedicle were removed. Through this route, corpectomy was performed, and then this space was replaced with mesh cage filled up with autologous bone graft. Both side pedicle screw fixation was followed to upper and lower levels.

Results : Six of seven patients of this study showed neurological improvement. The other one patient showed no neurological change. One patient had postoperative infection, another patient had postoperative kyphosis. The other patient had epidural hematoma on operation site after surgery. And all patinets on this study made to have spinal stability except one patient happened postoperative kyphosis.

Conclusion : In the unstable fracture of thoracolumbar and lumbar spine, one stage anterior and posterior stabilization and fusion by posterolateral approach seems to be an effective procedure, if we have more care and supplementation.

KEY WORDS : Thoracolumbar spine · Unstable fracture · One stage fusion · Posterolateral approach.

Introduction

In thoracolumbar and lumbar trauma, two basic principles that have evolved are the needs to ensure stability and to perform adequate neural decompression. Anterior approach provide adequate decompression of the spinal canal and restoration of ventral load bearing capacity through placement of a strut graft. Posterior approach allows for the application of constructs that restore the dorsal tension band. The benefits of these two separate procedure would be obtained by one stage posterolateral approach. It is the purpose of this report to discribe the operative technique of posterolateral approach with it's results.

Materials and Methods

All cases performed at the Masan Samsung Hospital, School of Medicine, Sungkyunkwan University using the posterolateral approach for anterior decompression and fusion with concomitant posterior instrumentation in the unstable fracture of thoracolumbar and lumbar spine are included in this study. Between September 2003 and April 2004, a total 7 patients met this criteria. The medical records were reviewed. Data were collected on their preoperative diagnosis, neurologic examination, intraoperaive course, and immediate postoperative course and change in neurologic status.

Surgical technique

Anterior and posterior stabilization of the unstable fracture of the thoracolumbar, lumbar spine by one stage posterior approach was already reported. After the introduction of general anesthesia, the patient was rolled into the prone position. It was important to free the abdomen of all compression to reduce blood loss. C-arm fluoroscope was used for preoperative localization of the lesion. A crescent-shaped skin incision was made, centered over the injury site(Fig. 1). A skin flap was raised

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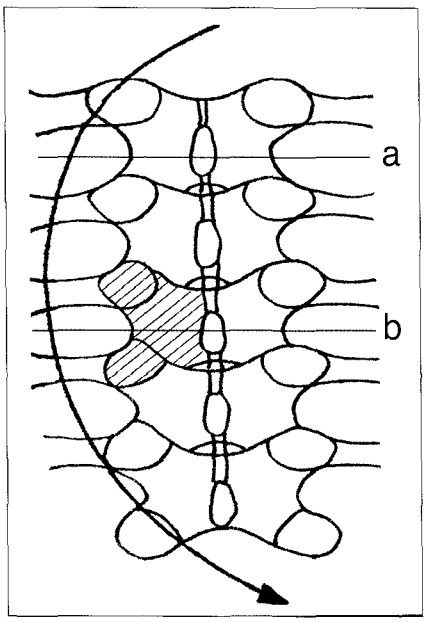

Fig. 1. This drawing shows crescent shaped skin incision, centered over the injury site(black arrow : incision line, deviant crease lines : injury site).

with the plane of dissection immediately above the plane of the thoracodorsal fascia. The fascial incision was made logitudinally. The erector spinae muscles were dissected from bony attachments and elevated from lateral to medial and retracted dorsally and medially. The transverse process and lamina were rongured back to its base on the pedicle. In the thoracic region, the costotransverse and costovertebral joint were disarticulated. The medial 6 to 8cm of one rib was dissected free and cut laterally. The rib was freed from the parietal pleura and removed from the operative field. The intercostal nerve was identified, tagged, and cut. The pedicle of the fractured vertebral body were removed, thus exposing the lateral and posterior aspect of dural sac(Fig. 2). Dissection ventromedially exposed the vertebral body and disc space. The fractured vertebrae was removed using a rongeur, osteotome, curette. The anterior and lateral cortex of vertebral body and posterior longitudinal ligament were preserved so it was possible to lend stability and reduce the blood loss and protect to the adjacent structures.

After ventral decompression and reduction of deformity, this space was replaced with mesh cage filled up with autologous bone graft which was harvested from fractured vertebral body. We had enough space to insert cage by only a little retraction of nerve roots. So, we didn't need to cut the nerve root. The dorsal aspects of the appropriate vertebral bodies were exposed, and transpedicular screw fixation was performed. Especially, at the opposite side, transpedicular screw fixation was performed with longitudinal fascial dissection and muscle splitting (Fig. 3). The wound was closed after irrigation, checking for pleural leak. A layered closure was performed with hemovac insertion.

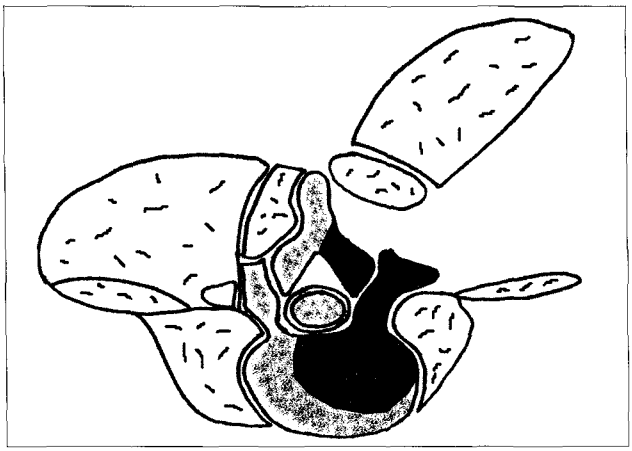

Fig. 2. On the level b of Fig. 1, after retraction of fascia and muscle, fractured vertebral body were removed(black area).

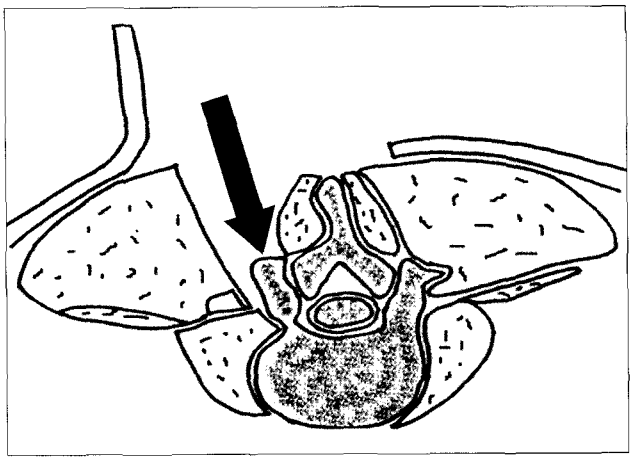

Fig. 3. On the level a of Fig. 1, after crescentric-shape skin incision, skin flap raised and fascial incision was made longitudinally(Black arrow : approach direction of screw).

Results

The study population was comprised of 7 patients(4 men and 3 women) with an average age of 55.4 years(range : 33 to 75 years). Follow up duration averaged 19.3 months (range : 14 to 24 months). All patients were underwent surgery between september 2003 and July 2004(Table 1).

Diagnosis at the time of surgery included burst fracture(6 patients), fracture and dislocation(1 patient). 5 patients had

Table 1. Clinical parameters

Case	Age/sex	Diagnosis	Level	Frankel grade*	Bony fusion	Posterior fixation
1	33/M	Fx&dislocation	L3-4	B	L2-4	L1,2,4,5
2	63/F	burst Fx	T11	A	T10-12	T9,10,12,L1
3	75/M	burst Fx	T12	C	T11-L1	T11,L1
4	52/M	burst Fx	L1	B	T12-L2	T12,L2
5	64/F	burst Fx	L1	D	T12-L2	T12,L2
6	45/M	burst Fx	L3	C	L2-4	L2,4
7	56/F	burst Fx	T12	C	T11-L1	T10,11,L1,2

* Frankel grade. A : complete motor and sensory paralysis below lesion, B : complete motor paralysis but some residual sensory perception below lesion, C : residual motor function but of nopractical use, D : useful but subnormal motor function below lesion, E : normal

Table 2. Changes in Frankel grade

Case	Frankel grade
1	B --> E
2	A --> D
3	C --> E
4	B --> D
*5	D --> A--> D
6	C --> E
7	C --> D

* : case 5 : She had experienced immediate post operative paraplegia. And after removing epidural hematoma on operative site, her motor gradually recovered

Table 3. Summary of clinical results

Case	Bony fusion	Posterior fixation	OP. time (hrs)	Blood loss (cc)	ICU time (hrs)
1	L2-4	L1,2,4,5	3.25	2500	21.5
2	T10-12	T9,10,12,L1	3.8	2000	429
3	T11-L1	T11,L1	2.75	1000	0
4	T12-L2	T12,L2	3.1	4200	29
5	T12-L2	T12,L2	4.42	7000	355.5
6	L2-4	L2,4	2.9	1800	13
7	T11-L1	T10,11,L1,2	3.3	2300	15

surgery in the thoracolumbar junction(T11 to L2), and 2 in the lumbar spine.

Preoperative neurologic status was evaluated using Frankel's classification; 3 patients were classified as grade C, 2 patients as grade B, 1 patient as grade A(Table 2).

Surgical time averaged 3.3 hours(range : 2.75 to 4.42 hours). blood loss averaged 2.98 liter(range 1 to 7 liter). Cell saver was not routinely used. Postoperative intensive care unit stay averaged 123 hours(range : 0 to 355.5 hours). 4 patients were extubated at the end of the surgical procedure(Table 3).

All patients had a one-level corpectomy. 4 patients had only one level instrumented above and below(Fig. 4) and 3 patients had two levels instrumented above and below(Fig. 5). No patients required chest tube placement at the end of the surgical procedure.

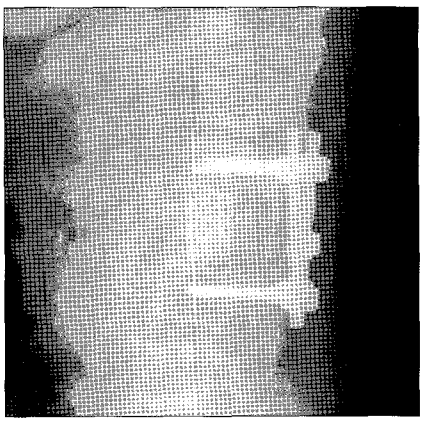

Fig. 4. This thoracolumbar lateral radiograph shows one level corpectomy and only one level instrumentation above and below.

There was one intraoperative complication, involving one patient. That was an intraoperative coagulopathy. In this case, blood loss was 7 liter intraoperatively, and postoperatively epidural hematoma at the operation site was developed. With reoperation and physiotherapy, this patient's Frankel grade was improved from grade A to grade D.

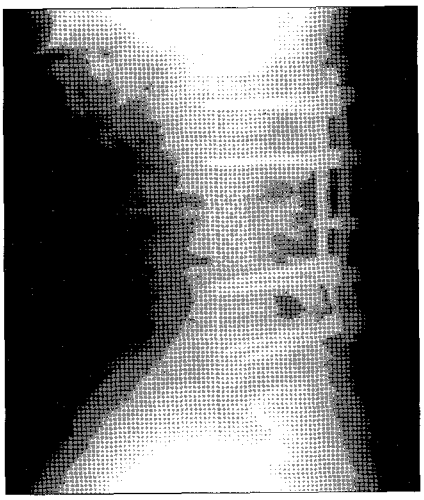

Fig. 5. This lateral lumbar radiograph shows one level corpectomy and two levels of instrumentation above and below.

There were three postoperative complication, involving three patients. One patient(Fig. 6) had been developed an infection on the operation site. This case required surgical exploration and debridement. And irrigation line was applied for 1 week. In this case, instrumentation was left in place. One patient, who had one level instrumented above and below, had been developed loosening of MESH cage and kyphosis(Fig. 7). This patient refused reoperation. Now, this patients suffers moderate back pain without any neurological deficits. Another patiant had been developed epidural hematoma at the operation site, described at above. Postoperatively, this patient showed instance of neurological worsening. Motor power came to grade I. This patient had been underwent reoperation immediately. Motor power was restored to grade IV. Hardware malposition was not found in all patients. Hemothorax or pleural effusion, which required tube thoracostomy, didn't occur in any patients, and there was no mortality.

Discussion

The ideal treatment of thoracolumbar and lumbar burst fractures or fracture-dislocation remains controversal. Various surgical treatments are proposed by surgeons to offer the benefit of canal decompression, correction of spinal deformity, immediate stabilization and improved fusion rate[2,6].

Anterior and lateral approaches(transthoracic, thoracoabdominal, extrapleural thoracotomy) are widely recommended for acute burst fractures with significant canal compromise in the presence of neurological deficit[5,8,12].

Esses and associates concluded that anterior decompression was indicated for fresh injuries with major deficit and canal compromise, and for injuries presenting late with major kyphosis[8]. Anterior procedures also spare the paraspinal muscles, replace fragmented disc with bone graft[11]. With these approaches, one can obtain access to the lateral and anterior thecal sac. Valid objections to anterior technique address the potential

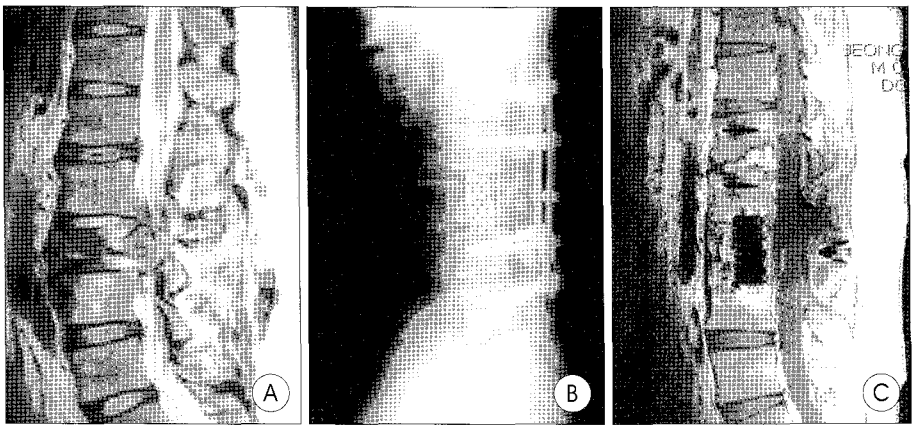

Fig. 6. Pre-operative magnetic resonace(MR) imaging(A) and post-operative 7 days lateral view of lumbar spine(B) and post-operative 3 months MR imaging(C) of 33-year old man. Note spondylitis and diskitis implying post-operative infection.

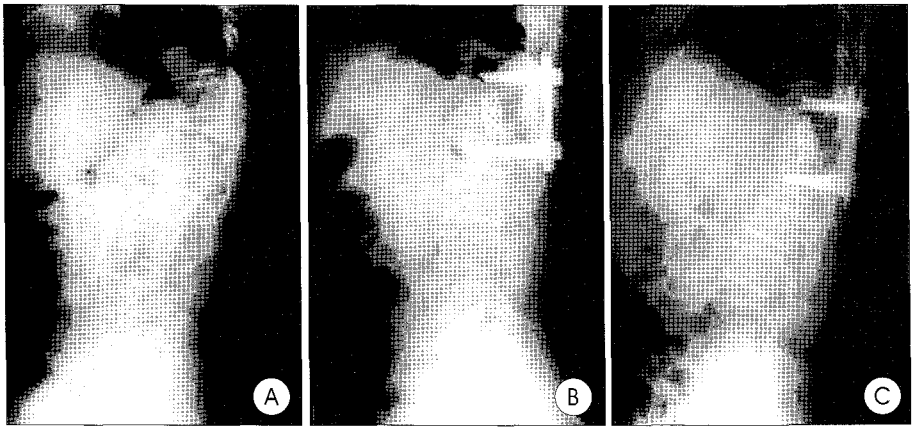

Fig. 7. Lateral view of thoracolumbar spine in 75-year old man showing T12 burst fracture(A). Post-operative 7-day(B) and post-operative 1 month lateral radiograph(C) shows postoperative kyphosis.

morbidity of intrapleural, diaphragmatic, and retroperitoneal dissection, with attendant bleeding and visceral retraction. And patients are expected to have longer hospital stay due to pneumothorax, ileus, blood loss, and pain[17]. Posterior spinal surgery has long been a popular method of restoring spinal stability. The advantages include familiarity to most surgeons and ease of multilevel decompression and long segment fusions with screw, hook, and rod configurations are routinely performed through posterior exposures[1].

Purely posterior surgery can improve canal dimensions by direct and indirect methods[10]. Although some reduction may occur, improvement in the canal dimension is never complete, and may be inadequate[9]. This lack of complete canal restoration in the neurologically injured patient is critical, because adequate decompression may optimize the ultimate neurologic outcome[15,18]. Another problem inheritant to isolated posterior surgery alone is the failure to address three-column instability[6]. The posterior approach does not fully reconstruct the anterior or middle columns.

Dimar and associates[7] have shown that anterior decompression, strut autografting, and posterior instrumented autogenous fusion, either as a combined or staged procedure, is a safe surigical option for thoracolumbar burst fractures. It allows complete canal visualization, thorough decompression, anterior and middle column reconstruction, and immediate postoperative spinal stability. But they report some disadvantages. Those are longer operating time(mean 5 hours 42 minutes) and increased blood loss(mean 1,455mL).

The posterolateral approach to the spine was developed by Capener for the treatment of tuberculous spondylitis and was subsequently used for the management of thoracolumbar fractures[3,13]. The posterolateral approach to the thoracolumbar and lumbar spine provides a simultaneous ventral, lateral, and dorsal aspects of the spinal canal at any level of thoracic and lumbar spine[4]. This allows for a single stage decompression, fusion, and fixation of the spine in many patients who otherwise may require two separate procedures[16]. And this approach has advantages related to the avoidance of thoracotomy and its attendant risks[14]. The posterolateral approach is, however, technically demanding, time-consuming, and associated with a certain intrinsic morbidity.

The decision to use the posterolateral approach is opposed to staged ventral/dorsal procedures for the treatment of acute thoracolumbar or lumbar spine trauma. Even though, the avoidance of a second incision and a second anesthetic serve to lower overall patient morbidity, the decision to use the posterolateral approach should be based on a clear understanding of the anatomic constraints of the region, the biomechanical properties of the completed reconstruction, and the morbidity associated with each approach[16].

Transpedicular screws grip vertebra with a long level arm, creating a strong distractive force, and provide three column fixation. Usually, transpedicular screws may be limited to one level above and below unstable segments[17]. But, in our cases, loosening of MESH cage and post-operative kyphosis developed in 1 of 4 patients, who had one level instrumented above and below. After that case, we thought that two level instrumentation

above and below in unstable fracture, especially in fracture and dislocation, of thoracolumbar and lumbar spine would be better. So, the decision whether to fix one level or two levels should be done carefully by case by case.

In our case, we also experinced postoperative epidural hematoma. We suspect that that result was happened due to bleeding of segmental artery or vein. Therefore, it was thought to be important to ligate these vessels. Careful dissection between lateral wall of vertebral body and it's surrounding tissue, were also thought to be important things especially in the emergent cases.

Conclusion

In the unstable fracture of thoracolumbar and lumbar spine, one stage anterior and posterior stabilization by posterolateral approach provide simultaneous ventral lateral and dorsal aspects of the spinal canal at thoracolumbar spine and allows for a single stage decompression, fusion, fixation of the spine in many patients who otherwise may require two separate procedures.

In this study, there were some complication. But one stage anterior and posterior stabilization by posterolateral approach have many benefits of short operation time, more easier approach and one stage stabilization.

So, this technique seems to be an effective procedure if we have more care and supplementation.

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Commentary

I read with great interest the article and the authors well present that the effectiveness of one stage posterolateral approach in the unstable fracture of thoracolumbar and lumbar spine. I fully support their remarks and applaud their work. I have experienced 22 cases of posterolateral approach and reported series of posterolateral approach and stabilizations for thoracolumbar lesion; 6 tumor cases, 7 thoracic disc herniation cases and 9 fracture cases.[1] As the authors recommended, the posterolateral approaches to the spine is an effective method for the neural decompression and the spinal stabilization. The advantage of this technique is that it allows removal of the paramedian fragments without the anterior approach, which will require transpleural and transdiaphragmatic dissection, the surgeons can perform both decompression and stabilization in one setting. So, They do not require violation of the pleural space, manipulation of the mediastinal structure and this technique allows patient early ambulation and shorten the hospital day than other staged approaches[2].

But, this technique has some disadvantages. The removal of lamina and pedicle at the injured segments that may adversely affect long-term stability and the bone fragments that is causing the anterior compression "blindly," since the dura and neural elements obstruct direct visualization.

To determine the appropriate method of management of a thoracolumbar fracture, many variables must be assessed, including fracture type, stability, and neurologic deficit. For patients undergoing surgery, the approach, instrumentation, levels fused, associated injuries, and comorbidities also affect treatment decisions.

In selected patients, the one stage posterolateral approach to thoracic or lumbar lesion involving both the anterior and posterior columns is a safe and efficacious technique.

Anyway, thanks again and congratulation for their good experience.

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