การผ่าตัดโดยการใส่สกรูเสริมตำแหน่งกระดูกหัก ในผู้ป่วยกระดูกสันหลังหักช่วงอกและเอว

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Intermediate Pedicular Screws at The Fracture Level For Thoracolumbar Burst Fractures

Abstract

Surgical Treatment of thoracolumbar burst fracture with posterior short segment pedicle fixation could provide initial correction of kyphosis , but it has been associated with loss of reduction and instrument failure. This study evaluates the clinical relevance of short segment pedicle fixation with intermediate screws at fracture level. 21 patients were assessed in this retrospective study. All patients were followed for a minimum 36 months ($\overline{X}$= 38 ; SD 17). Preoperative mean Anterior vertebral height compression (AVHC) and local kyphosis angle (KA) were 40 % (SD 20 %)and 16° (SD 12°) ,respectively.

The mean correction of AVHC and kyphosis were 24% (SD 15%) and 14° (SD 8°) respectively. The mean loss of correction at the last follow up was 1.1 % (SD 3.2 %), and 2.2° (SD 2.8°) for AVHC and KA, respectively. The loss of correction of kyphosis was significant (p< .001) ,whereas of AVCH was not significant (p = 0.135). Despite there was significant loss of the correction of local kyphosis, the final KA at the latest follow up compared with the preoperative value was still significantly improved (p< .001). There was no evidence of instrument failure or neurologic deterioration in this series.

It is concluded that short segment pedicle fixation with intermediate screw at fracture level provides a significant correction of local kyphosis, The initial correction was well maintained and there was no serious complication.

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วารสารวิชาการแพทย์ เขต 11 Reg Med J 2015 ;29 : 95 - 100

Keywords : Fracture,spine,pedicular screw,intermediate

บทคัดย่อ

ศึกษาวิธีการผ่าตัดยึดตรึงกระดูกสันหลังส่วนอกและเอว ในผู้ป่วยกระดูกสันหลังหักรุนแรงด้วย short segment pedicular fixation with intermediate screw at fracture level ในผู้ป่วย 21 ราย ซึ่งได้ติดตามการรักษาเป็นเวลาอย่างน้อย 36 เดือน (ค่าเฉลี่ย 37 เดือน) โดยวัด Anterior vertebral height compression (AVHC) และ Kyphotic angle (KA) เทียบก่อนผ่าตัด หลังผ่าตัดทันที และ ช่วงติดตามการรักษา พบว่า ค่าเฉลี่ยก่อนผ่าตัดของ AVHC และ KA คือ

ร้อยละ 40 และ 16 องศาตามลำดับ หลังผ่าตัดทันทีค่าเฉลี่ยของการแก้ไข ของ AVHC และ KA คือ ร้อยละ 24 และ 14 องศาตามลำดับ การติดตามผลการรักษาครั้งสุดท้ายพบว่า ค่าเฉลี่ยของการสูญเสียการแก้ไข ของ AVHC และ KA คือ ร้อยละ 1.1 และ 2.2 องศาตามลำดับ วิธีการผ่าตัด short segment pedicular fixation with intermediate screw at fracture level สามารถแก้ไขและรักษามุม kyphosis และ AVHC ได้ดีโดยไม่มีภาวะแทรกซ้อนที่ร้ายแรงจากการผ่าตัด

คำหัส : กระดูกสันหลังหัก, การผ่าตัดยึดใส่สกรู

Original Articles นิพนธ์ต้นฉบับ

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Introduction

Unstable thoracolumbar burst fractures may be treated with anterior, posterior or combined approach. Regardless of approach, the goal of internal fixation is to minimize the number of vertebral levels to be fused by using short segment fixation. For this purpose the posterior approach, using transpedicular short segment fixation, became popular after its introduction by Roycamille and Dick[2]. This approach included pedicular screw placement in one vertebra above and one vertebra below the fracture site. It has several advantages[3,4] but may suffer from loss of reduction and failure of instrumentation. Achievement of a stiffer construction can be performed by several methods. These include cross linking, supplemental hook fixation ,vertebroplasty, kyphoplasty[10-13],and screw fixation at the fracture level(14-15). The purposes of this study are to evaluate the clinical efficacy of short segment pedicular screw fixation with intermediate screws at fracture level and the procedure's effectiveness in maintaining the initial correction of deformity.

Material and Methods

Twenty-one consecutive cases of unstable thoracolumbar burst fractures between 2007 and 2011 were studied. Data were drawn from medical records and phone interviews. The inclusion criteria were unstable burst fracture according to McAFee [16] (defined as anterior compression exceeding 50%, kyphosis exceeding 20°,associated posterior element injury, and associated neurological deficit treated with short segment pedicular fixation plus intermediate screws fixation at one level above and one level below the fracture site, as well as fixation at the level of fracture. The instruments used in these cases were a pedicular screw and rod system. After the operation, all patients had 2-3 days of bed rest and ten wore a hyperextension brace for 3 months. Pre-operative, post-operative and follow-up plain radiographs were evaluated. Analysis included measurement of AVHC and local KA.

The KA was the intersection between a line along the superior endplate of the vertebra just above the fractured vertebra and a line along the inferior endplate of the vertebra just below the fractured vertebra. AVHC was the percentage of anterior vertebral body compression with respect to the average intact vertebrae above and below the fractured vertebra[17]. Failure was defined as an increase of 10° or more in local KA in the latest follow-up radiograph compared to the initial postoperative radiograph and/or implant failure adopted by Alanay[18]. Clinical assessment of pain was determined by using Denis's pain scale [19], with the grading system as:

P1 No pain

P2 Occasional minimal pain with no need for medication

P3 Moderate pain with occasional medication but no interruption of work

P4 Moderate to severe pain with frequent medication and occasional absence from work or significant change in ADL

P5 Constant severe pain, chronic medication

Statistical Analysis

Statistical testing was done using student paired-t test,2 tail by SPSS. Any value of P smaller than 0.05 were considered significant. Using SPSS for analyzed all of data.

Results

The study included 21 patients mean age at time of injury was 38±18 years. The most common fracture site in this study was at L1 9 cases (43 %) and at T12 7 cases (33 %). Distribution of fracture level is shown in Table 1. All patients had complete clinical and radiographic follow-up. The average follow-up period was 38 months (SD: 17 ,range : 19 to 72 months).

Clinical Results

At the latest follow-up, 48% of patients had no pain, and 43 % had mild pain as shown in Table 2. No patients had neurological deterioration, infection or instrumental failure.

Table 1 Distribution of fracture level

Fracture level	Number of patients (%)
T12	7 (33 %)
L1	9 (43 %)
L2	2 (10%)
L3	3 (14 %)

Table 2 Pain scale at latest follow-up

Level of pain	N (%)
P1	10 (48%)
P2	9 (43%)
P3	2 (10%)
P4	0
P5	0

Radiographic result

All 21 patients with AVHC and local KA before surgery, after surgery, and at follow up are shown in Figure 1 and Figure 2. Mean and SD of preoperative AVHC and local KA were 40±20% and 16±12° respectively and early postoperative mean corrections of AVHC and local KA were 24±15% and 14±8° respectively demonstrate in table 3. These changes were statistically significant. Mean losses of correction of AVHC and local KA were 1.1±3.2% and 2.2±2.8° respectively. Loss of correction was significant for local KA (p<.001), but not for AVHC (p=.135). Despite the significant loss of correction for the local KA at the latest follow-up, it remained less than the preoperative value (p<.001). No patient had instrument failure or loss of local KA of 10° or more. Case undergoing posterior short segment pedicular fixationwith intermediate screws for unstable burst fracture (L2) is shown in **Figure 3.**

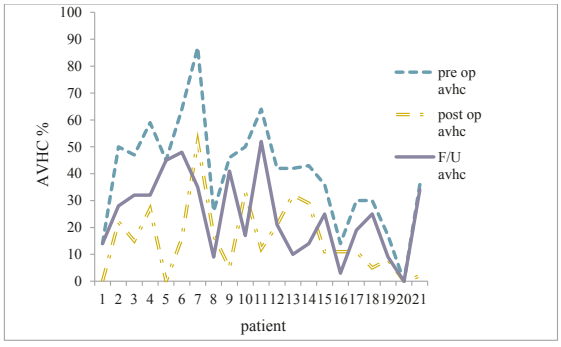

Figure 1 AVHC pre- operative, post- operative and at follow up period

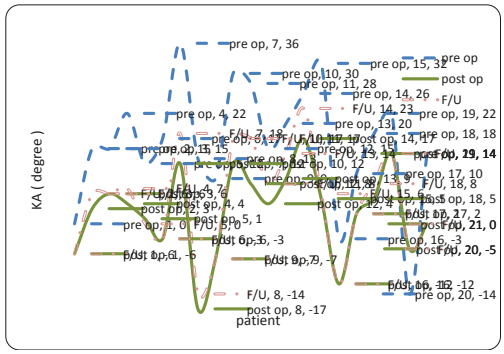

Figure 2 KA pre-operative, post-operative and follow up period

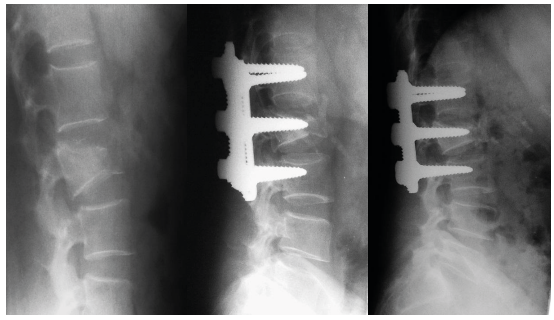

Figure 3 Radiographic study of unstable L3 burst fracture pre-operative, post-operative undergoing posterior short segment pedicular fixationwith intermediate screws and follow up images .

patients	anterior vertebral height compression (AVHC)		Kyphosis angle (KA)	
	Mean+SD	p value	Mean+SD	p value
Preoperative	40% ± 20%	p < 0.001	16 ° ± 12 °	p < 0.001
Postoperative	24% ± 15%	p = 0.135	14° ± 8°	p < 0.001
Follow-Up	1.1% ± 3.2%	p < 0.001	2.2 ° ± 2.8°	p < 0.001

Table 3. AVHC pre-operative,early post-operative and F/U period. Significant difference between the values measured preoperatively and those measured postoperatively (p < 0.001). The loss of correction of vertebral height at F/U period was not significant (p= 0.135). KA pre-operative,early post-operative and F/U period. Significant difference between the values measured preoperatively and those measured postoperatively (p < 0.001). The loss of correction KA at F/U period was also significant (p < 0.001).

Discussion

Surgical treatment of thoracolumbar burst fractures should correct vertebral body height loss and sagittal kyphosis, and also maintain these corrections until bony healing. Short segment pedicular fixation with fusion one level above and one level below the fractured vertebra using a posterior approach usually preserves the most spinal motion. However, only slight screw misplacement can lead to loss of correction and subsequent instability[19]. Deformity of fractured vertebra can be indirectly reduced, but the procedure for augmenting and strengthening the anterior column of the vertebral body is usually limited. This may result in a higher risk of instrumental failure and loss of correction [4, 18]. Screw insertion at the fractured vertebra is essential to overcome potential problems with posterior short segment pedicular fixation.

Anekstein [14] et al. evaluated the mechanical effect of adding screws at the intermediate level on

the stiffness of short segment constructs. In this study, an unstable burst fracture of pig's spine was created by dropped mass technique plus multiple drilling. Mechanical testing showed a significant decrease in the flexibility of the spinal segment in all axes of rotation when intermediate screws were added to the short segment construct.

Mahar [15] et al.performed a biomechanical study on cadaveric lumbar burst fractures of segmental constructs using screws at fracture sites versus non-segmental constructs. Axial torsion was significantly higher for segmental constructs, but there were no significant differences in flexion, extension, or lateral bending. Intervertebral disc pressure fluctuation during flexion-extension was significantly higher with segmental constructs than non-segmental constructs, reflecting the counteracting force of fractured vertebra which was fixed by the pedicular screw. The study showed the clinical results of 9 patients with lumbar burst fractures treated with segmental constructs and a \mean follow-up time of 4.4 month. The mean kyphotic deformity was 9° and the mean kyphotic correction was 15° after surgery. Follow-up radiography showed 5° KA loss. Mean anterior vertebral body height was 58% of normal before surgery. After surgery this height became 89% of normal and 78% at final follow-up.

This study confirmed the findings of Mahar et al. and Anekstein et al. concerning the clinical relevance of adding an intermediate screw at fracture level to short segment pedicular fixation. There was no instrumentation failure in this study, short segment pedicular fixation with intermediate screw at fracture level construction provided significant correction of spinal deformity, and it maintained its correction throughout the follow-up period. The patients had no neurological deterioration after the operation. The advantages of adding intermediate screws at fracture level were stiffer construction by method of three-point fixation and stronger pull-out resistive fixation. This procedure is also less invasive than anterior approach reconstruction. The disadvantages include a slightly longer operation time and higher expense.

Conclusions

Short segment pedicular fixation with intermediate screws at fracture level is safe and effective in the surgical treatment of thoracolumbar burst fractures. It provides significant correction of vertebral body height and local kyphosis, and maintains the correction.

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