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Transpedicular wedge opening osteotomy (TWO, Meshtawy osteotomy) to wedged vertebrae (A novel technique)

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Abstract
Background: A transpedicular wedge opening osteotomy can be considered as part of the surgical treatment of symptomatic sagittal imbalance. The literature is limited to the prescription this technique by El meshtawy and no more.
Purpose: To evaluate our preliminary results of transpedicular wedge opening osteotomy as surgical treatment of chronic symptomatic post- traumatic kyphosis.
Study Design: Case series.
Methods: seventeen patients with symptomatic kyphotic deformity were treated with a transpedicular wedge opening osteotomy. The mean follow-up was 42.8 months (range 26–105). The clinical outcome, radiographic correction, and perioperative complications were analyzed.
Results: All patients were successfully managed with this procedure without major complications. All patients were instrumented with posterior-only fixation with two levels above and two levels below. The mean blood loss was 338.24 ± 99.26 mL (range, 150.0 – 500.0mL). Patients were followed for an average of 32 months (range, 6–70 mo.) postoperatively. Back pain was significantly improved to 1.41 ± 0.80 at the latest follow up and the Oswestry disability index (ODI) was also significantly improved to mean 8.12 ± 2.60. Average kyphotic angle was -0.59 ° ± 3.99° immediately after surgery and 0.57 ° ± 2.82 ° at final follow-up. Average of 1 ° of correction loss was documented and all patients obtained healing of the osteotomy site.
Conclusions: A transpedicular wedge opening osteotomy is a technically demanding but well tolerated operative procedure for the correction of post traumatic kyphosis. This technique results in satisfactory clinical results not only in the form of pain relief, kyphosis correction, but also in the form of reducing the risk of excessive bleeding and spinal cord injury with motion preservation of the spinal column.

Keywords: Wedge, Opening, Osteotomy, Transpedicular

Introduction

Spinal column fracture is common and approximately 150,000 to 160,000 will fracture their spinal column in the United States each year [1–3]. Post traumatic spinal deformity is possible complication either due to failed surgical or conservative treatment.

The presentation of the patient with post traumatic kyphosis is; pain, deformity or neurological deficit. [4-5]. pain is the most common presentation.it is explained by muscle fatigue due to mechanical disadvantage [6, 7]. Bridwell *et al*., [8, 9], Ahn *et al*. [10] and Kostuik and Matsusaki, [11], all of them stated that surgical correction of the deformity result in statistically significant improvement of pain.

The most common deformity after fracture spine is kyphosis. This kyphosis puts muscles at mechanical disadvantage and accelerates the rate of degeneration [13]. The sagittal index (30) (defined as the measurement of segmental kyphosis at the level of a given segment adjusted for the baseline sagittal contour at that level) express the absolute value of each segment. There evidence that surgical correction of sagittal index more than 15º result in improved outcomes [14].

Glassman *et al*. [15, 16] stated that there is a linear correlation between the kyphosis and the quality of life. The surgical approach to correct the post traumatic kyphosis is posterior alone, anterior or combined anterior and posterior. The most commonly used osteotomies are Smith-Petersen osteotomies (SPOs) and pedicle subtraction osteotomy (PSO) [5]. The SPO was first described in 1945 for the treatment of kyphotic deformity, [17] and has been modified by others since that time. [18-23]. The PSO was first described by Thomasen, [24]. Patients with major sagittal imbalance and sharp angular kyphosis will typically require a PSO in the lumbar spine or a vertebral column resection in the thoracic spine [25-27].

Anew technique was described by El-Meshtawy to correct post traumatic kyphosis. The aim of this study is asses the safety and efficacy of this new technique.

Materials and methods

The radiographs and clinical course of 17 consecutive patients undergoing transpedicular wedge opening osteotomy for a kyphotic deformity were studied. All patients were operated on by the same surgeon in orthopedic department, assiut university hospital in the period between January 2011 and December 2013. Ten males (58.8%) and seven females (41.2%) with a mean age of 30.77+-7.81 years (range 20–50) were operated. The diagnosis was symptomatic post-traumatic kyphosis in all patients. The mean follow-up was 42.8(26–105) months. Complications were recorded for all patients.

Table 1: Preoperative demographic and injury data**.**

S. no	Age (year)	Sex	Mechanism of injury	Duration since primary trauma(month)	Level of Wedged vertebra
1	28.0	Female	FFH	12.0	L1
2	35.0	Male	MCA	5.0	D11
3	30.0	Female	MCA	12.0	L2
4	40.0	Male	FFH	12.0	D12
5	24.0	Female	FFH	12.0	L1
6	20.0	Male	FFH	5.0	D12
7	23.0	Female	FFH	36.0	L1
8	30.0	Male	FFH	4.0	D12
9	25.0	Male	FFH	4.0	L1
10	27.0	Male	FFH	36.0	D12
11	35.0	Female	FFH	4.0	L1
12	50.0	Male	FFH	3.0	L1
13	35.0	Male	FFH	11.0	D8
14	28.0	Male	FFH	22.0	L1
15	21.0	Female	FFH	36.0	L1
16	32.0	Female	FFH	60.0	L1
17	40.0	Male	MCA	5.0	L1

Surgical technique

A transpedicular wedge opening osteotomy was performed as previously described [El meshtawy]. In summary, the patient was placed prone on a radiolucent table and the spine was approached posterior. The osteotomy was planned at the level of the wedged vertebra. The pedicle screws were placed two levels proximal (long head screws) and two levels distal to the osteotomy site. The osteotomy trajectory is determined in the same way like the pedicular screw under C arm guidance, and then a 10 mm osteotome is passed in the same trajectory of the transpedicular screw followed by a lateral one and the last one which take the central part of the anterior circumference of the vertebral body. This last osteotome is done after the osteotome has passed the spinal canal in the lateral view. The spine was then reconstructed by securing rods to the distal pedicle screws. Subsequently, the osteotomy was opened holding the rods on both sides and applying it to the proximal screws, while tightening the osteotomy will open smoothly. In this way, opening of the osteotomy site was achieved with V shaped gap is formed. Postoperatively, all patients were mobilized without an orthosis in the same day. The suction left until 30 cc blood is present for two consecutive8 hours shifts.

Functional assessment: All patients were administered a subjective questionnaire preoperatively and at the time of the most recent follow-up by an orthopedic resident not involved in the Surgery. Both the preoperative and postoperative questionnaires included a visual analogue scale (VAS), rated on a scale from 1 to 10, for pain and impairment. In addition, The Oswestry Disability Index (ODI) score.

Radiographic analyses: Whole spine standing anteroposterior and lateral radiographs were made preoperatively and at last postoperative follow-up. Multislice CT was made pre operatively and at last follow up before metal removal. The preoperative radiographs were analyzed to measure local kyphotic angle, sagittal index and the lumbar lordosis, Also to measure the sagittal vertical axis (SVA). The pre-operative CT used for pre-operative planning the post-operative CT is used to judge the osteotomy site healing. The radiographs at the last follow-up were used to evaluate the achieved correction of the local kyphotic angle, sagittal index and complete osteotomy site healing. In addition, follow-up radiographs were evaluated for potential loss of correction with time, progression of the osteotomy site healing. After complete healing of the osteotomy site metal removal is done, and radiograph is done after one year to assess the local kyphotic angle, sagittal index and possible loss of correction. Statistics were calculated on the subjective and radiographic results for the entire group of 17 patients.

Statistical analyses: Preoperative and postoperative variables were analyzed for statistical significance with the Wilcoxon signed-rank test.

Results

All patients had symptomatic post-traumatic kyphosis. The primary etiology was fall from height in fourteen patients (82.4%) and motor car accident in three patients (17.6%). The time elapsed between the primary injury and surgical intervention for correction was16.41 ± 16.24monthes. The type of fracture cannot be identified because of long time before the presentation to us. All patients were neurologically free. 58.8 %(ten patients) had the primary pathology at L1, four patients (23.5%) at D12, one at L2, one at d11and another one at D8. Thirteen patients (76.5%) had no previous operation and four patients (23.5%) had failed previous surgery which was short segment transpedicular screw fixation and decompression. All osteotomies were performed at the level of the primary pathology (Table 1). The perioperative blood loss was 338.24 ± 99.26 (range 150.0 – 500.0) mL, and the operative time was 45.59 ± 9.98 (range 30.0 - 60.0) minutes. There were no major perioperative complications; in particular, no neurological deficits were encountered. In one patient, a superficial wound infection occurred which resolved after debridement.

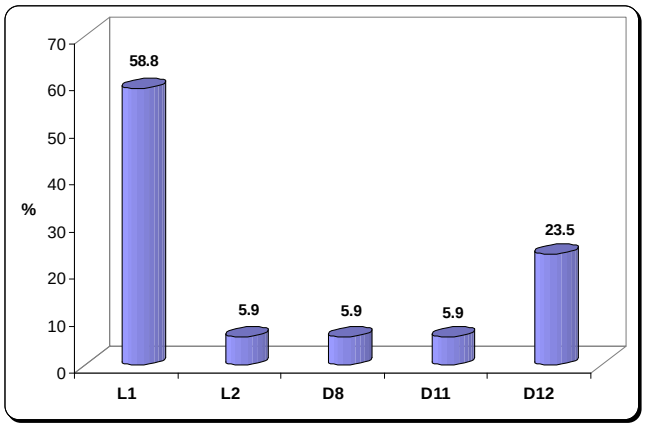

Fig 1: Patient distribution according to the level of pathology.

Radiographic analyses

In our group of patients, the osteotomy was performed at the level L1 in ten cases and at the level Th12 in four cases and once at the level Th8,11 and L2 (Table 1). In all cases the transpedicular screw fixation extended two levels above and two levels below the osteotomy.one patient had a broken screw at one pedicle above the wedged vertebra, this patient had an extra level of transpedicular screw fixation. Preoperatively for all patients the local kyphotic angle was measured at the level of the wedged vertebra. Also the sagittal index is measured. The local kyphotic angle figure improved from a preoperative mean of 25.12 ± 7.28 (range, 16.0 - 45.0) to a postoperative mean of-0.59 ± 3.99 (range,-6.0 - 8.0). The mean degree of correction was 25.71 ± 7.81 (range, 8.0 – 43.0). The mean degree loss of correction before metal removal was 1.13 – 1.71 (range, 2to4). And the mean degree loss of correction after metal removal was 0.14 ± 1.07. The sagittal index figure improved from a pre-operative mean of 27.24 ± 9.24 (range, 16 - 51) to a post-operative mean of -1.00 ± 3.24 (range-7 - 5). The mean degree of correction was 28.24 ± 9. 76 (range 14.0 – 54.0). The mean degree loss of correction before metal removal was 1.76 ±1.68. And the mean degree loss of correction after metal removal was 0.90 ± 1.97. The lumbar lordosis decreased from a preoperative mean60.94 ± 13.33 to a post-operative mean45.82 ± 7.69. All patients achieved healing of the osteotomy site at 12 month. no recorded perioperative complications except for one patient had superficial infection which respond to debridement.

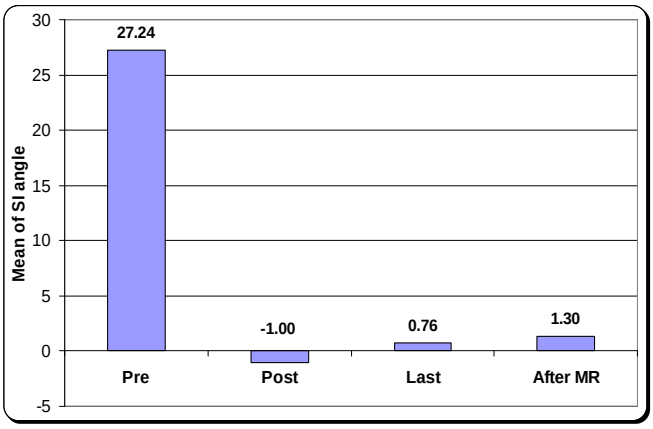

Fig 2: The mean sagittal index.

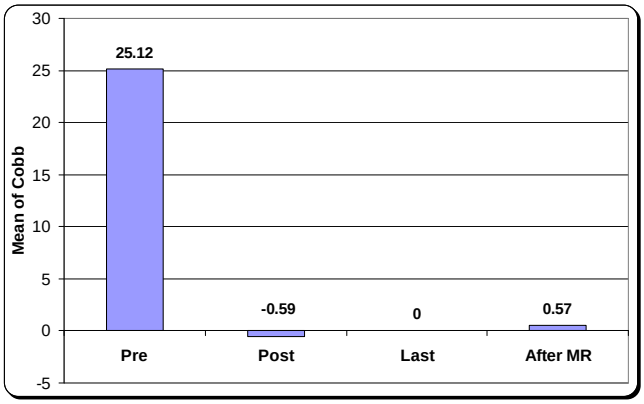

Fig 3: The mean value of cobb angle.

Functional assessment

Pain scores (visual analogue scale) improved significantly from 7.06 ± 0.75 preoperatively to 1.41 ± 0.80 at the latest follow up (p value0.000) (Fig. 2). Also for ODI improved significantly from 67.65% ± 9.55% to 8.12% ± 2.60% (p value0.000); All patients were very satisfied with the result and would choose surgical treatment again.

Cases	ODI (%)		VAS		Time (min)		SI angle				Cobb angle			
	Pre	Latest	Pre	Latest	Osteot.	Operative	Pre	Post	Latest	After MR	Pre	Post	Latest	After MR
1	54.0	10.0	7.0	3.0	20.0	45.0	22	3	5	5	24.0	6.0	7.0	6.0
2	62.0	6.0	6.0	1.0	15.0	35.0	22	2	5		27.0	2.0	0.0	
3	58.0	4.0	7.0	1.0	30.0	60.0	41	-1	4		23.0	-5.0	-3.0	
4	72.0	10.0	8.0	2.0	20.0	45.0	25	-2	-1	0	28.0	-6.0	-2.0	0.0
5	76.0	12.0	7.0	1.0	30.0	60.0	33	5	6	6	23.0	2.0	3.0	
6	80.0	6.0	7.0	1.0	25.0	35.0	31	-2	3	2	30.0	1.0	1.0	0.0
7	80.0	10.0	7.0	1.0	35.0	60.0	51	-3	-2	4	45.0	2.0	2.0	2.0
8	58.0	8.0	6.0	1.0	20.0	35.0	19	1	2	2	20.0	0.0	-1.0	0.0
9	72.0	8.0	6.0	1.0	20.0	30.0	17	-7	-4	-3	16.0	-3.0	-1.0	-1.0
10	74.0	4.0	8.0	3.0	25.0	40.0	33	0	1	1	23.0	-2.0	-1.0	-1.0
11	62.0	12.0	7.0	2.0	25.0	45.0	21	-3	-3	-3	24.0	-4.0	0.0	0.0
12	58.0	8.0	7.0	1.0	35.0	45.0	31	-1	0		31.0	1.0	0.0	0.0
13	56.0	8.0	8.0	2.0	20.0	40.0	16	2	2		16.0	8.0		
14	62.0	10.0	8.0	2.0	25.0	40.0	26	-4	-2		28.0	-2.0	0.0	0.0
15	66.0	4.0	6.0	0.0	30.0	45.0	23	-7	-3	-1	19.0	-6.0	-3.0	-3.0
16	80.0	8.0	7.0	1.0	25.0	60.0	33	0	0		33.0	0.0	1.0	1.0
17	80.0	10.0	8.0	1.0	20.0	55.0	19	0	0		17.0	-4.0	-3.0	-3.0

Discussion

Thoracolumbar spine fracture is common.in the United States nearly 150,000 to 160,000 people had spine fracture per year [1, 3]. The healing o the spine fracture is good, however the posttraumatic kyphosis occurs due to under estimation of fracture type with improper management by conservative treatment or inadequate surgical intervention [28]. In our study, only four patients are due to failed surgical intervention (23.5%) and thirteen patients are due to failed conservative treatment.

The mean age of incidence of these thoracolumbar fractures is 33 years [1, 3]. In our study the mean age of incidence is 30.77 ± 7.81 years. The post traumatic kyphosis with sagittal index more than 15º requires surgical intervention with improved results [14]. Bohlman *et al.* [12] reported good results with surgical intervention earlier than two years after the trauma history. In our study the mean pre-operative sagittal index was 27.24 ± 9.24º. The mean degree of correction of the sagittal index was 28.24 ± 9.76º. The mean degree loss of correction was 1.76 – 1.68º. Yong-Sang Kim *et al*. [29] achieved 29.6 ° degree of correction by modified pedicle subtraction osteotomy.

The data presented indicate that the clinical and radiographic results in these patients seem to correspond with the results in more traditional indications for a pedicle subtraction osteotomy. These are, however, preliminary results in a small group of patients with relatively short follow-up. We are nevertheless encouraged by the results obtained and believe it is Acceptable to continue to perform these pedicle subtraction osteotomies in patients with disabling thoracolumbar hyperkyphosis.

References

1. Tay BKB, Eismont F. Cervical spine fractures and dislocations. In: Fardon DF, Garfin SR, Abitbol JJ, *et al.*, editors. Orthopaedic knowledge update: spine. Rosemont, IL: American Academy of Orthopaedic Surgeons. 2002; 2:247-62.
2. Vaccaro AR, Jacoby SM. Thoracolumbar fractures and dislocations. In: Fardon DF, Garfin SR, Abitbol JJ, *et al.*, editors. Orthopaedic knowledge update: spine. Rosemont, IL: American Academy of Orthopaedic Surgeons. 2002; 2:263–78.
3. NSCISC. Annual Report for the Model Spinal Cord Injury Care Systems, National Spinal Cord Injury Statistical Center at the University of Alabama at Birmingham. 2005.
4. Jacob Buchowski M *et al*. Management of Posttraumatic Kyphosis after Thoracolumbar Injuries. Semin Spine Surg. 2010; 22:92-102.
5. Jacob Buchowski M, Craig Kuhns A, Keith Bridwell H, Lawrence Lenke G. Surgical management of posttraumatic thoracolumbar kyphosis. The Spine Journal. 2008; 8:666-677.
6. Vaccaro AR, Silber JS. Post-traumatic spinal deformity. Spine. 2001; 26:S111- S118.
7. Bernhardt M, Bridwell KH. Segmental analysis of the sagittal plane alignment of the normal thoracic and lumbar spines and thoracolumbar junction. Spine. 1989; 14:717-721.
8. Bridwell KH, Lewis SJ, Edwards C *et al*. Complications and outcomes of pedicle subtraction osteotomies for fixed sagittal imbalance. Spine. 2003; 28:2093-2101.
9. Bridwell KH, Lewis SJ, Lenke LG *et al.* Pedicle subtraction osteotomy for the treatment of fixed sagittal imbalance. J Bone Joint Surg Am. 2003; 85-A:454-463.
10. Ahn UM, Ahn NU, Buchowski JM *et al.* Functional outcome and radiographic correction after spinal osteotomy. Spine. 2002; 27:1303-1311
11. Kostuik JP, Matsusaki H. Anterior stabilization, instrumentation, and decompression for post-traumatic kyphosis. Spine. 1989; 14:379-386.
12. Bohlman HH, Kirkpatrick JS, Delamarter RB *et al*. Anterior decompression for late pain and paralysis after fractures of the thoracolumbar spine. Clin Orthop Relat Res. 1994; 300:24-29.
13. Polly DWJ, Klemme WR, Shawen S. Management options for the treatment of posttraumatic thoracic kyphosis. Semin Spine Surg. 2000; 12:110-116
14. Farcy JP, Weidenbaum M, Glassman SD. Sagittal index in management of thoracolumbar burst fractures. Spine. 1990; 15:958-965.
15. Glassman SD, Berven S, Bridwell K *et al*. Correlation of radiographic parameters and clinical symptoms in adult scoliosis. Spine (Phila Pa 1976). 2005; 30:682e8.
16. Glassman SD, Bridwell K, Dimar JR *et al*. The impact of positive sagittal balance in adult spinal deformity. Spine (Phila Pa 1976). 2005; 30:2024e9.
17. Smith-Petersen MN, Larson CB, Aufranc OE. Osteotomy of the spine for correction of flexion deformity in rheumatoid arthritis. Clin Orthop Relat Res. 1969; 66:6-9.
18. Chang KW. Oligosegmental correction of post-traumatic thoracolumbar angular kyphosis. Spine. 1993; 18:1909-1915.
19. Herbert JJ, Vertebral osteotomy. Technique, indications and results. J Bone Joint Surg Am. 1948; 30A:680-689.
20. Kostuik JP, Maurais GR, Richardson WJ *et al.* Combined single stage anterior and posterior osteotomy for correction of iatrogenic lumbar kyphosis. Spine. 1988; 13:257-266.
21. Chapelle La EH. Osteotomy of the lumbar spine for correction of kyphosis in a case of ankylosing spondylarthritis. J Bone Joint Surg Am. 1946; 28:851-858.
22. Law WA. Osteotomy of the spine. Clin Orthop Relat Res. 1969; 66:70-76.
23. McMaster MJ, Coventry MB. Spinal osteotomy in akylosing spondylitis. Technique, complications, and long-term results. Mayo Clin Proc. 1973; 48:476-486.
24. Thomasen E. Vertebral osteotomy for correction of kyphosis in ankylosing spondylitis. Clin Orthop Relat Res. 1985; 194:142-152.
25. Kawahara N, Tomita K, Baba H *et al*. Closing-opening wedge osteotomy to correct angular kyphotic deformity by a single posterior approach. Spine. 2001; 26:391-402.
26. Suk SI, Chung ER, Lee SM *et al*. Posterior vertebral column resection in fixed lumbosacral deformity. Spine. 2005; 30:E703-E710.
27. Suk SI, Kim JH, Kim WJ *et al*. Posterior vertebral column resection for severe spinal deformities. Spine. 2002; 27:2374-2382,

28. Schoenfeld AJ, Wood KB, Fisher CF, Fehlings M, Oner FC, Bouchard K *et al*. Posttraumatic kyphosis: current state of diagnosis and treatment: results of a multinational survey of spine trauma surgeons. J Spinal Disord Tech. 2010; 23:e1–e8,
29. Dae-Jean Jo, Yong-Sang Kim, Sung-Min Kim, Ki-Tack Kim, Eun Min Seo. Clinical and radiological outcomes of modified posterior closing wedge osteotomy for the treatment of posttraumatic thoracolumbar kyphosis. J Neurosurg Spine. 2015, 3.
30. Farcy JP, Weidenbaum M, Glassman SD sagittal index in management of thoracolumbar burst fractures. Spine Boulay C, Tardieu C, Hecquet J *et al*. 1990; 15:958-965.