



## Results of surgical treatment for kyphotic deformity of the spine secondary to trauma or Scheuermann's disease

Teoman ATICI, Ufuk AYDINLI, Burak AKESEN, Rasim ŞERİFOĞLU

*From the University of Uludağ Faculty of Medicine, Bursa, Turkey*

The authors have performed a retrospective study of 20 patients who underwent surgical treatment for kyphosis secondary to trauma (10 patients) or Scheuermann's disease (10 patients) between 1992 and 2000. The mean follow-up was 60 months (range, 32-90) and 59.5 months (range, 24-109) respectively. Radiological evaluation of Scheuermann kyphosis included assessment of thoracic kyphosis angle (TKA), lumbar lordosis angle (LLA), scoliosis angle (SA) and sagittal vertical axis (SVA) ; radiological evaluation of post-traumatic kyphosis included the determination of local kyphosis angle (LKA) and SA, if present. A posterior approach was performed in 6 cases and a combined anterior and posterior approach was performed in 4 cases of SD whereas patients with post-trauma kyphosis were treated using an anterior approach in one case, a posterior approach in another and a combined anterior and posterior approach in 8 cases .

The mean TKA in Scheuermann cases was 71° (65°-80°) preoperatively and 41° (31°-52°) postoperatively. There was a mean loss of correction of 5°. No positive sagittal balance was present during follow-up. The mean TKA in post-trauma cases was 38° (25°-62°) pre-operatively and 14° (range -15°-28°) postoperatively. At the last visit, the mean loss of correction was 2°. Proximal junctional kyphosis developed in two cases with Scheuermann kyphosis (17° and 13°) and in one case with post-traumatic kyphosis (17°). These findings show that good results can be achieved in the treatment of kyphosis secondary to trauma or Scheuermann's disease, with appropriate selection of the surgical approach.

### INTRODUCTION

Sagittal plane deformities, especially kyphosis, are not only a cosmetic problem but may also result over time in low back pain and neurological impairment (8). Such deformities may be developmental, traumatic or iatrogenic. The treatment strategy differs with the severity, progression and aetiology of the deformity. Scheuermann disease (SD) is characterised by rigid and painful kyphosis in childhood (8). Post-traumatic kyphosis (PTK) is one of the complications of spinal trauma ; it usually affects adults and adolescents.

There have been conflicting views about the aetiology and prognostic criteria of these deformities. However, good results have been reported with surgical treatment (18, 23). The development of instrumentations which control the spine in all three planes have decreased the problems arising

---

■ Teoman Atici, MD, Orthopaedic surgeon.

*Department of Orthopaedic Surgery, S.S.K. Hospital, Bursa, Turkey.*

■ Ufuk Aydinli, MD, Professor.

■ Burak Akesen, MD, Orthopaedic registrar.

■ Rasim Şerifoğlu, MD, Orthopaedic registrar.

*Department of Orthopaedic Surgery, University of Uludağ Faculty of Medicine, Bursa, Turkey.*

Correspondence : Ufuk Aydinli, Department of Orthopaedic Surgery, University of Uludağ Faculty of Medicine, 16059, Görükle, Bursa, Turkey. E-mail : ufuk@uludag.edu.tr.

© 2004, Acta Orthopædica Belgica.

---

during surgical treatment of sagittal plane deformities (2, 4, 13, 14, 16).

The goal of treatment of thoracolumbar deformities is to relieve pain, and to prevent neurological failure or progression of neurological deficit. Anterior, posterior or combined procedures may be used; if the deformity is severe and rigid, osteotomies may be an appropriate solution (4, 7, 10, 13, 19, 22).

### PATIENTS AND METHODS

Two groups of patients, all operated between 1992 and 1999, were retrospectively studied. The first group included 10 patients (8 male, 2 female) with kyphosis secondary to Scheuermann's disease (SD), based on Sorenson's criteria. Their ages ranged from 14 to 23 years (mean: 18 years); they were followed up for a mean period of 60 months (range, 32-90 months). The other group included 10 patients (3 male, 7 female) with post-traumatic kyphosis (PTK). Their ages ranged from 13 to 45 years; they were followed up for a mean period of 59 months (range, 24-96 months). Patients in the first group were assessed for muscle strength (24); Frankel's classification was used to evaluate the neurological status in the second group (12). All the patients with PTK had previously been submitted to conservative treatment (8 cases) or surgical treatment (2 cases).

Radiological evaluation of patients with SD included measurement of thoracic kyphosis angle (TKA), lumbar lordosis (LLA), sagittal vertical axis (SA) and assessment of the reducibility of kyphosis by dynamic radiological study. The patients with SD were classified according to the apex vertebra of the deformity: 8 were classified as thoracic (type 1) and 2 as thoracolumbar (type 2) (9). On the other hand, patients with PTK were evaluated radiologically by measurement of the preoperative and postoperative local kyphosis angle (LKA). Post-traumatic kyphosis was located in the lumbar area in 7 patients and in the thoracic area in the other three. The indication for surgical treatment in SD cases was back pain unresponsive to conservative treatment or a curve greater than 65°. A posterior approach was used in 6 patients whose TKA was reduced below 50° on preoperative dynamic films. A combined anterior and posterior approach was performed in the same session in 4 patients whose TKA could not be reduced under 50°.

In post-traumatic kyphosis, the surgical indication was an unacceptable LKA (more than 30° in the thoracic area, 20° in the lumbar area) or neurological deficit. Two

patients underwent a single approach, one posterior and one anterior. A combined anterior and posterior approach was performed in 8 patients. Autograft was used to achieve fusion for all patients; supplemental allograft was also used in two cases. A Smith-Petersen osteotomy was performed in 4 patients with post-traumatic kyphosis. Only one patient with PTK used a thoracolumbosacral orthosis for three months postoperatively. Preoperative and postoperative radiographs were compared in both groups and loss of reduction was calculated at the last visit.

### RESULTS

The mean TKA in SD patients was 71° (range, 65° to 80°); it reduced to a mean value of 41° (range, 31° to 52°) postoperatively (fig 1a, b). The mean loss of correction was 5° (range, 2° to 8°) (table I) at the last follow-up. Six patients who underwent a posterior approach were compared with 4 others who underwent a combined anterior and posterior approach. The mean loss of correction was 5° for both groups.

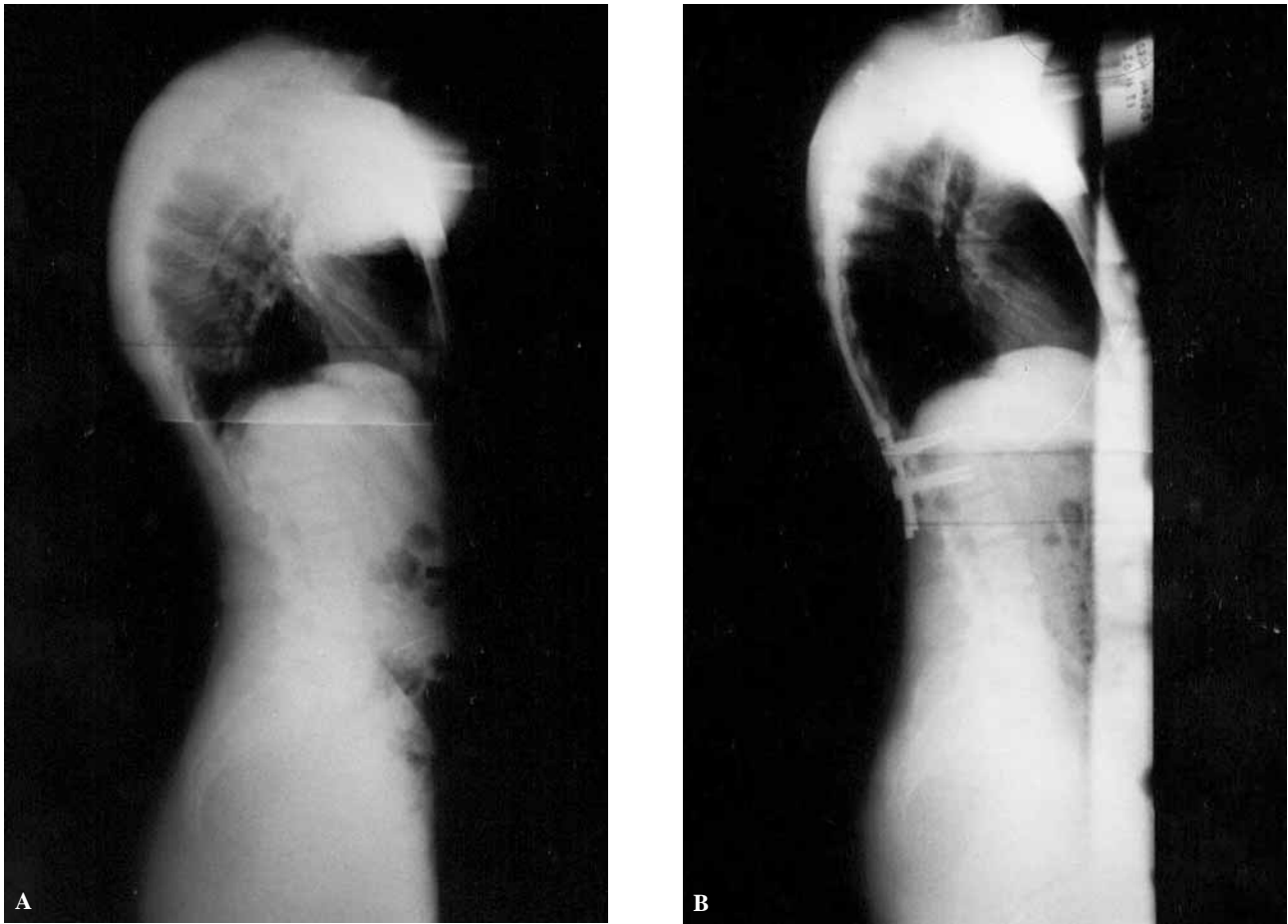
The mean preoperative LKA in cases with post-traumatic kyphosis was 38° (range, 25° to 62°) and the mean postoperative LKA was 14° (range, -15° to 28°). At the last visit, the mean local kyphosis angle was 16° (range, -9° to 31°) and there was a 2° loss of correction (fig 2a-d). Only one patient had more than 5° loss of correction (6°) (table II).

Infection developed as a complication in two patients with Scheuermann kyphosis; they were treated with antibiotics and debridement. Proximal junctional kyphosis developed in both cases (13° and 17°). Infection persisted despite appropriate antibiotic therapy and debridement was performed with removal of the hardware. Solid fusion was not achieved in one case.

No neurological deficit developed postoperatively in either group. The neurological status progressed from Frankel C to D<sub>3</sub> in one patient with posttraumatic kyphosis.

### DISCUSSION

Scheuermann's disease, also referred to as juvenile kyphosis, osteochondritis deformans, round back or apophysitis of the spine, was described



**Fig. 1.** — Patient with Scheuermann's disease. (A) Preoperatively, the thoracic kyphosis angle was 72°. (B) This was reduced to 40° after operation.

**Table I.** — Mean thoracic kyphosis angles pre and post-operatively and mean loss of correction in cases with Scheuermann's disease

	Mean thoracic kyphosis angle
Preoperative	71° (65° to 80°)
Postoperative	41° (31° to 52°)
Mean change	30° (21° to 44°)
Mean change (%)	42.5% (29% to 55%)
Last visit	50° (37° to 75°)
Loss of correction*	5° (2° to 8°)

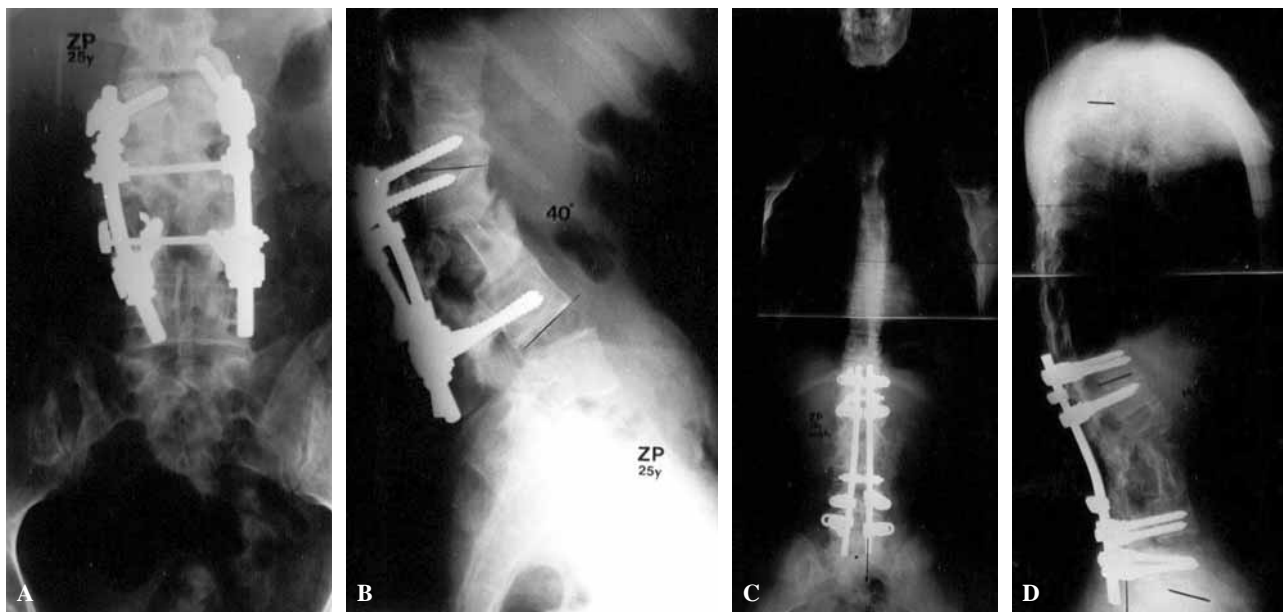
\* after excluding one case with 39° loss of correction due to absence of fusion at the time of hardware removal.

radiologically by Scheuermann in 1920 (11, 20). This condition is the most common cause of kyphosis in adolescents (2, 17, 18, 23, 24).

**Table II.** — Mean local kyphosis angles pre and post-operatively and mean loss of correction in cases with post-traumatic kyphosis

	Local kyphosis angle
Preoperative	38° (25° to 62°)
Postoperative	14° (-15° to 28°)
Last visit	16° (-9° to 31°)
Loss of correction	2° (1° to 6°)

Good results following surgical treatment increased after the development of double rod multisegmental screw and hook systems in spinal surgery. Jonge *et al* (8) reported a 4° loss of correction in patients with Scheuermann kyphosis treated with the CD system. Our results were very similar.



**Fig. 2.** — 22-year-old female patient with posttraumatic kyphosis. Anteroposterior (A) and lateral (B) radiographs following surgical treatment of an L3 burst fracture. She underwent a closing wedge osteotomy and a Smith-Petersen osteotomy. Anterior (C) and lateral (D) radiographs 3.5 years after surgical treatment.

Ferreira *et al* (10) reported more effective correction in patients younger than 16 years: correction of the TKA was 47% in 4 adolescent patients, versus 39% in 6 adult patients. Loss of correction at the last visit was 6° for adolescents and 10° for adults.

Junctional kyphosis is one of the most important complications following surgical treatment of Scheuermann kyphosis (2, 17, 18, 21, 23). Proximal junctional kyphosis occurred in two of our cases because of a technical mistake, as fusion was stopped at the T<sub>4</sub> level.

Post-traumatic kyphosis develops after inappropriate treatment of vertebral fractures. The most common complication is pain, which is present in 40% to 90% of cases with posttraumatic kyphosis. A local kyphosis angle superior to 30° can cause chronic pain at the deformity site (5, 6). All the patients in this study suffered preoperatively from back pain that was localised at the site of the deformity.

The goal of surgical treatment for posttraumatic kyphosis cases must be the decompression of neural elements, correction of deformity and stabilisa-

tion. Böhm *et al* (3) performed a combined anterior and posterior approach in their study and did not report any significant loss of correction. On the contrary, Malcom *et al* (15) only performed an anterior approach and reported a 40% complication rate. Both authors recommend a combined approach for posttraumatic cases. Acaroğlu *et al* (1) performed a combined approach in 31 patients and reported that the sagittal index, which is the difference between the measured segmental kyphosis at the affected vertebra and the baseline sagittal curve at that level, ranged from 18° to 52° preoperatively and from -2° to 10° postoperatively. In our study the mean preoperative local kyphosis angle in patients who underwent a combined anterior and posterior approach was 46° (range, 31° to 62°) and 27° at the last visit. Our correction ratio after sixty months follow-up was 41%. This value may not seem to reflect a high level of correction, but the high preoperative values of the LKA and the high initial level of deformity stiffness may account for this. Based on these results, we believe that, in cases where the LKA is more than 30° and the reducibility less than 50%, anterior and posterior

osteotomies should be performed to achieve better results.

Spinal deformities in the sagittal plane (e.g. PTK and SD) may have different aetiologies. It is necessary to select good indications and to do proper preoperative planning to achieve a successful outcome following surgical treatment.

## REFERENCES

1. **Acaroglu ER, Schwab FJ, Farcy JP.** Simultaneous anterior and posterior approaches for correction of late deformity due to thoracolumbar fractures. *Eur Spine J* 1996 ; 5 : 56-62.
2. **Ahçı E, Berk H, Akçalı Ö, Gül BÖ.** Juvenile kyphosis (Scheuermann disease). *J Turk Spinal Surg* 1992 ; 4 : 1-7.
3. **Böhm H, Harms J, Donk R, Zielke K.** Correction and stabilization of angular kyphosis. *Clin Orthop* 1990 ; 258 : 56-61.
4. **Bradford DS, Ahmed KB, Moe JH, Winter RB, Lonstein JE.** The surgical management of patients with Scheuermann's disease : a review of twenty-four cases managed by combined anterior and posterior spine fusion. *J Bone Joint Surg* 1980 ; 62-A : 705-712.
5. **Canikoglu M, Mirzanlı C, Karamehmetoglu M, Güngör HR, Gülhan H.** Posterior wedge osteotomy in treatment of localised kyphosis. *J Turk Spinal Surg* 1992 ; 1 : 20-22.
6. **Chang KW.** Oligosegmental correction of post-traumatic thoracolumbar angular kyphosis. *Spine* 1993 ; 13 : 1909-1915.
7. **Danisa OA, Turner D, Richardson WJ.** Surgical correction of lumbar kyphotic deformity : Posterior reduction "eggshell osteotomy". *J Neurosurg* 2000 ; 92 : 50-56.
8. **De Jonge T, Illes T, Bellyei A.** Surgical correction of Scheuermann kyphosis. *Int Orthop* 2001 ; 25 : 70-73.
9. **Domaniç Ü, Dikici F, Hamzaoglu A, Talu U, Şar C.** Posterior total wedge resection osteotomy for surgical correction of kyphosis. 7<sup>th</sup> International meeting on Advanced Spine Techniques (IMAST) 2000 ; poster no : 65.
10. **Ferriera-Alves A, Resina J, Palma-Rodrigues R.** Scheuermann's kyphosis *J Bone Joint Surg* 1995 ; 68-B : 189-193.
11. **Gertzbein SD, Harris MB.** Wedge osteotomy for the correction of post-traumatic kyphosis. *Spine* 1992 ; 3 : 374-379.
12. **Kirchmier RS, Denis F.** Surgical corrections of post-traumatic spinal deformity. In : Cotler JM, Simpson, An HS, Silveri CP (eds). *Surgery of Spinal Trauma*. Lippincott, Williams&Wilkins, Philadelphia. 2000, pp 317-332.
13. **Lowe T, Karsten M.** An analysis of sagittal curves after Cotrel-Dubousset Instrumentation for kyphosis secondary to Scheuermann's disease : A review of 32 patients. *Spine* 1994 ; 19 : 1680-1685.
14. **Lowe T.** Scheuermann kyphosis. Current concepts review. *J Bone Joint Surg* 1990 ; 72-A : 940-945.
15. **Malcom BW, Bradford DS, Winter RB, Chou SN.** Posttraumatic kyphosis. *J Bone Joint Surg* 1981 ; 63-A : 891-898.
16. **Murray PM, Weinstein SL, Spratt KF.** The natural history and long-term follow up of Scheuermann kyphosis. *J Bone Joint Surg* 1993 ; 75-A : 236-248.
17. **Otsuka NY, Hall JE, Mah JY.** Posterior fusion for Scheuermann kyphosis. *Clin Orthop* 1990 ; 251 : 134-139.
18. **Papagelopoulos PJ, Klassen RA, Peterson HA, Dekutoksi MB.** Surgical treatment of Scheuermann's disease with segmental compression instrumentation. *Clin Orthop* 2001 ; 386 : 139-149.
19. **Sachs B, Bradford DS, Winter RB, Lonstein JE, Moe JH, Wilson S.** Scheuermann's kyphosis. *J Bone Joint Surg* 1987 ; 69-A : 50-57.
20. **Scheuermann HW.** Kyphosis Dorsalis Juvenilis (The Classic Article). *Clin Orthop* 1997 ; 128 : 5-7.
21. **Se-II-Suk.** Anterior-posterior surgery vs. posterior eggshell decompression in post-traumatic kyphosis with neurologic compromised osteoporotic fracture. 7<sup>th</sup> International meeting on Advanced Spine Techniques (IMAST) 2000.
22. **Strum PF, Dobson JC, Armstrong GWD.** The surgical management of Scheuermann's disease. *Spine* 1993 ; 18 : 685-691.
23. **Vaccaro AR, Silber J.** Post-traumatic spinal deformity. *Spine* 2001 ; 245 : 111-118.
24. **Weinstein JN, Collato P, Lehman TR.** Thoracolumbar "burst" fractures treated conservatively. A long-term follow up. *Spine* 1988 ; 13 : 33-38.