Comparison of Different Posterior Instrumentation Systems in Scheuermann’s Disease

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ABSTRACT
OBJECTIVE: Posterior surgical correction and instrumented fusion of Scheuermann’s Disease (SD) is an effective and safe treatment option in severe cases at adulthood.

MATERIALS and METHOD: Two groups of 15 patients each were treated with two different instrumented systems. The efficacy of different posterior instrumentation systems composed of laminar and pedicular hooks (=hybrid) in group 1 and all level-pedicle screw instrumentation in group 2 were compared retrospectively.

RESULTS: Mean preoperative thoracal kyphosis values in group 1 were reconstructed from 78.02 degrees to 45.067 degrees postoperatively and measured as 57.4 degrees at the final follow-up. Mean preoperative thoracal kyphosis values in group 2 were reconstructed from 80.46 degrees to 41.73 degrees postoperatively and measured as 45.53 degrees at the final follow-up. Lumbar curves resolved spontaneously in both groups. All level pedicular screw instrumentation was found to be slightly better than hybrid constructs in maintaining the initially corrected kyphotic deformity until the osseous fusion.

CONCLUSION: Regression from initial correction of sagittal balance might be seen in patients with SD who undergo posterior instrumented fusion with claws and hooks. We recommend meticulous follow-up of these patients in the postoperative period.

KEY WORDS: Kyphosis, Pedicle screw, Posterior spinal instrumentation, Scheuermann’s disease

INTRODUCTION

Scheuermann’s disease (SD) is the most common cause of kyphosis in adolescence. Vertebral alterations in SD are wedging of the thoracal vertebrae bodies and development of Schmorl’s nodes. (18) Kyphosis occurs gradually over several segments without acute angulation and called round back deformity. Conservative treatment with serial casting and bracing can be preferred in skeletally immature patients. (12) Surgical treatment is tailored individually and may be considered in patients whose back pain cannot be relieved with conservative methods and whose kyphosis increases progressively with cosmetic problems. (1)

Correction and maintaining of the reconstructed curvature are the main goals of the treatment. Surgical correction of kyphosis can be achieved by the anterior, posterior or combined approaches. (4) Use of posterior instrumentation systems are gaining popularity due to their technical improvements. (7)

Instrumented fusion with all level pedicle screws is being replaced by the hybrid hook instrumentation systems. We conducted a retrospective study to evaluate the differences in correction rates and maintenance of the deformity corrected with these two systems. After data collection from the charts, patients who were operated on
at the same institution sequentially were recalled for final follow-up.

**MATERIAL and METHODS**

After approval of the Institutional Review Board, patients who underwent posterior instrumented fusion due to Scheuermann's kyphosis at the same institution were evaluated retrospectively. A total of thirty patients reconstructed via posterior surgery only and with a minimum follow-up period of 24 months were included in the study group.

The decision for surgery was given by the same senior surgeon using the same evaluation objectives such as thoracal kyphosis exceeding 75 degrees with severe pain that decreased the quality of life.

All patients were recalled to a last follow-up visit and evaluated by physical exam and preoperative, postoperative and final orthoroentgenograms. Combined or complicated sagittal deformities related to other deformities and disorders like neurological and congenital diseases and patients who were lost to follow-up were excluded from the study.

The patients' age, gender, operation dates and follow-up periods, level of the apical vertebra, instrumented spinal levels, number of blood transfusions and operations were collected from preoperative, operative and postoperative charts and the clinical findings were reviewed. The patients were allocated into 2 groups according to their instrumentation type.

Hybrid spinal instrumentation systems with pedicle and laminar hooks were used in fifteen (group 1) of these 30 patients and pedicle screws were used in all levels in the consequent group (group 2). (Figure 1a-d).

The degree of sagittal plane curves was recorded in the chart in both groups as measured on orthoroentgenograms taken in the standing position in a chronological manner and the orthoroentgenograms were repeated at the final follow-up.

Fusion levels were determined according to the site of the apex of the deformity; the instrumentation was extended at least four levels above and four levels below the apical vertebra in both instrumentation types. In none of the patients was the instrumentation terminated at the thoracolumbar junction.

Statistical analyses including power analysis, t-test, Bonferroni measurements and Spearman's correlation test were performed with SPSS 16.0.

**RESULTS**

Thirty (25 male and 5 female) patients with Scheuermann's kyphosis and a mean age of 17.47 years that underwent correction and fusion with posterior spinal instrumentation between the years 2003-2007 were evaluated.

The patients' data were allocated to the groups presented in Table 1.

Posteriorly, fusion was started from the most cephalad level involved in the kyphosis using multiple fixation points with claw constructs in group 1 or screws in group 2. Fusion was performed to T2 in 10 patients, to T3 in 14 patients, and to T4 in 6 patients and extended to L1 in 12 patients, L2 in 8 patients and L3 in 10 patients at the lower ends.

According to statistical analyses, there was no significant difference between the preoperative values (age level of apical vertebra and Cobb's angle measurements) of both groups and they were accepted as comparable. The sagittal curve degrees were reduced a significant amount in both groups after the operation (P<0.05). There was also a significant difference between the postoperative values and follow-up values of group 1 and 2 (P<0.05) at the thoracal region, but the differences in lumbar lordosis measurements were not significant. Deterioration of reduced kyphosis angles at the thoracal region at the final follow–up were 21.48% in group 1 and 8.35% in group 2.

Documented complications were hemothorax in 1 patient (group 2) and superficial wound infection in 2 (1 patient in group 1 and 1 patient in group 2) and junctional kyphosis in 2 patients (both in group 2).

**DISCUSSION**

Scheuermann's disease is defined as thoracic kyphosis greater than 45° with greater than 5° of anterior wedging in 3 consecutive vertebrae. (8) The prevalence of SD in the literature varies from 1% to 8%. (18) During the adolescent period, 50% percent of patients present with pain (14) and progression of curves more than 45°. (11) A growth spurt has been demonstrated and the disease continues to increase after the age of 30. Bradford et al.
have reported a higher incidence of disabling thoracic and lumbar back pain in untreated adults. (1)

According to a report on the natural history of untreated Scheuermann disease, these patients were more likely to have thoracic pain, had higher pain intensity, were more likely to work in sedentary jobs, and were more likely to be unmarried. (9) Conservative treatment is the first choice of treatment in immature patients (11,12).

Surgical treatment modalities in SD were initially posterior fusion with Harrington and Luque rods. (4,10,15,16,17) Anterior or combined anterior surgeries were recommended for rigid and sharp kyphotic curves. Harrere-Sotoetalreportedthatvideo-assistedthoracoscopic release and fusion followed by posterior instrumented fusion for severe Scheuermann’s deformity was superior to reported posterior fusion alone and equally as successful as thoracotomy and posterior fusion in achieving stable

<table>
<thead>
<tr>
<th>Table 1: Patients’ data</th>
<th>Group 1</th>
<th>Group 2</th>
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<tbody>
<tr>
<td>Gender</td>
<td>Hybrid Spinal Instrumentation</td>
<td>All levels screwed Spinal Instrumentation</td>
</tr>
<tr>
<td>Mean age (year)</td>
<td>16.8</td>
<td>18.13</td>
</tr>
<tr>
<td>Mean follow-up (months)</td>
<td>75.07</td>
<td>49.4</td>
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<tr>
<td>Preoperative thoracal kyphosis (degrees)</td>
<td>78.02</td>
<td>80.46</td>
</tr>
<tr>
<td>Postoperative thoracal kyphosis (degrees)</td>
<td>45.067</td>
<td>41.73</td>
</tr>
<tr>
<td>Thoracal kyphosis At final follow-up (degree)</td>
<td>57.4</td>
<td>45.53</td>
</tr>
<tr>
<td>Preoperative lumbar lordosis (degrees)</td>
<td>53.8</td>
<td>52</td>
</tr>
<tr>
<td>Postoperative lumbar lordosis (degrees)</td>
<td>36.53</td>
<td>37.53</td>
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<tr>
<td>Lumbar lordosis at final follow-up (degree)</td>
<td>37.27</td>
<td>39.4</td>
</tr>
<tr>
<td>Blood transfusion (units)</td>
<td>3.8</td>
<td>4.2</td>
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correction. (5) Anterior release performed by open or videothoracoscopic techniques has the advantage of fusing shorter segments than only posteriorly instrumented fusions. (6) Posterior multisegment instrumentation was found to be a safe and effective treatment of SD. (7) However, additional procedures such as reconstructive osteotomies were also recommended as alternatives. (13) Aggressive osteotomies like wedge osteotomies or pedicle subtraction osteotomies performed via a posterior approach also increase the correction rates of kyphotic deformities. (3)

The availability of thoracal screw systems in our country has resulted in the change of implant choices from hook to screw systems. The availability of implant systems was the determinant of the type of instrumentation in the initial operations.

Distal junctional kyphosis was found in two patients of group 1 and the instrumentation was extended to two levels. Cho et al. defined the sagittal stable vertebra concept regarding the decision for distal fusion level. (2) The initial instrumentation length was inadequate in these two revised patients according to their concept. In the present series, the decision regarding the lower end of instrumentation was made according to the first lordotic disc. However, we detected the development of junctional kyphosis in two patients from group 1. L1 was the lower end of instrumentation in both these patients and they were revised by inferior extension of the instrumentation two more levels. There are few articles published on the treatment of SD with posterior instrumented fusion and the number of patients in these studies is also limited. The exact correction of the kyphosis is controversial due to presence of the natural kyphotic contour. The instrumented fusion was successful in all patients of both groups and pain relief was obtained. Despite the patients' perception with correction of sagittal balance and relief of pain, the radiographic data support better results in group 2. Hybrid constructs have weaker anchorage capacity to the spine. They are therefore not strong enough and can lose the initial correction degrees of kyphosis. This finding may also be related to the shorter follow-up duration of group 2.

The status and severity of Schmorl's nodes were also considered in reported studies. The fusion of 10 patients had to be extended to L3 vertebra in the present series. The effect of preserving only limited vertebral mobility is not a well-studied aspect in SD. Surgeons have to weigh the benefits and risks individually.

The clinical and radiological results in this report demonstrate that posterior instrumented fusion was successful. Although early postoperative measurements were identical in both groups, all screw instruments were found to maintain the correction angles until osseous fusion. Meticulous follow-up of patients with less rigid systems may be required.

REFERENCES


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