ORIGINAL ARTICLE

Radiographic Outcome of Adolescent Idiopathic Scoliosis Surgical Correction with Posterior Spinal Fusion Using Pedicle Screw and Rods Fixation

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ABSTRACT

Objective

To evaluate the correction of deformity as measured by Cobb's angle with posterior spinal instrumentation and fusion (PSIF), by using rods and pedicle screw along with autologous bone graft in adolescent idiopathic scoliosis (AIS).

Study design

Descriptive case series.

Place & Duration of study

Department of Orthopaedics and Spine Surgery Postgraduate Medical Institute, Hayatabad Medical Complex Peshawar, from January 2007 to April 2011.

Methodology

Patients of aged more than 10 years of either sex were included in the study. All patients were managed by posterior spinal fusion using pedicular screws and rod and then evaluated by standing anteroposterior and lateral radiographs post operatively. The data was analysed with SPSS version 10.

Results

There were a total 18 patients with 14 (77.8%) females and 4 (22.2%) males. Mean age was 17 years (range 13-30 years) . The preoperative Cobb angle was 45^0 minimum, 120^0 maximum (average 70^0) which was corrected to 5^0 minimum, 65^0 maximum and 20^0 average postoperatively. Total correctness achieved was 25^0 minimum, 70^0 maximum and 50^0 average.

Conclusion

Pedicle screw construct can result in better correction and less frequent implant failures in idiopathic scoliosis.

Key words

Idiopathic scoliosis, Cobb's angle, Pedicle screw and rods.

INTRODUCTION:

Normally there is no curve in spine on anteroposterior view of radiograph at any level. Cervical and lumbar vertebrae have lordotic curves and thoracic and sacral vertebrae have kyphotic curves on lateral radiographic view.[1] Scoliosis is a complex three-dimensional deformity of the spine and ribcage, where individual vertebrae are translated laterally and rotated. [2] The standard method of assessing scoliosis curves is the Cobb's angle measurement from a standing posterior-anterior (PA) radiograph of the spine.[3]

Scoliosis causes cosmetic deformity as well as compressive effect on internal organs. Idiopathic scoliosis is a diagnosis of exclusion. Approximately 80% of curves are ultimately diagnosed as idiopathic.[4] The prevalence of adolescent idiopathic scoliosis is estimated at approximately two to three per cent of school going children. There is an overwhelming female preponderance for curves of larger magnitudes with a ratio of 9:1 in curves larger than 40°.[5,6]

There are three modes of treatment of AIS depending on age of onset, severity and skeletal maturity.[7] Treatment may be observational, bracing, or surgical.

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Surgical treatment is considered in patients with progressive curves greater than 40° that fail or cannot tolerate bracing and those with curves greater than 45° at skeletal maturity. [8,9]

The treatment of scoliosis in literature parallels the development in surgical techniques and the availability of implant systems along with mandatory preoperative imaging study of the patients.[10]. Surgical treatment of scoliosis has evolved over the last few decades. Instrumentation that uses the pedicle as a source of purchase for bone, screws from the posterior approach into the vertebral body, have become an increasingly popular form of spinal fixation.[8] The purpose of this study was to evaluate the correction of deformity in scoliosis with posterior instrumentation and fusion by using rods and pedicle screw fixation along with autologous bone graft in AIS.

METHODOLOGY:
This prospective hospital based study was conducted in the Department of Orthopaedics and Spine Surgery, Postgraduate Medical Institute, Hayatabad Medical Complex Peshawar, from January 2007 to April 2011. Patients of both sexes and age more than 10 years with diagnosis of AIS were included. Each patient had a progressive curve requiring surgical treatment. We generally follow the recommendations as described by Lenke's in deciding which curves are to be fused.[9]

Each patient underwent posterior spinal instrumentation and fusion by the same surgical team. Each patient had a complete set of radiographs. These included a preoperative standing anteroposterior (AP) and lateral views of the spine, a preoperative right and left maximum bend supine films and standing AP and lateral radiographs post operatively. Cobb angle measurements on these radiographs were done by the same examiner with the same accurate protractor. The median, standard deviation, and range of the Cobb angles and their respective changes were calculated. The study was analysed with SPSS version 10 and presented in the form of tables.

The extent of curve to be involved in fusion was determined pre operatively by carefully assessing the standing AP and Lateral radiographs. The distal level was determined by using the midsacral line and proximal level determined by dropping the plumb line from C7 vertebra. Spinal cord monitoring was done by Stagnara. Patient placed prone on Wilson's spine frame placed over the operation table, carefully padding of the pressure points during surgery. Skin incision made in a straight line from one to two vertebrae superior to the proposed fusion area to one vertebra inferior to it. After exposure, the basic steps were clearing the soft tissue, exposing the cancellous bone of the pedicle canal by decortication at the intersection of the base of the facet and the middle of the transverse process, probing the pedicle, verifying the four walls of the pedicle canal by probing or obtaining radiographic confirmation, tapping the pedicle, and placing the screw. Suitable length of rods were cut and contoured according to normal curves and snug into pedicle screw heads. Correction of deformity was achieved by derotation, translation, and compression and distraction up to its maximum possible level. Spinal cord integrity was verified by doing the wake up test. The surface of bone and the facets decorticated and bone graft taken from iliac crest placed over the decorticated bone, specifically over the facet joints. Wound washed thoroughly and after placing bone graft wound closed in layers under suction drains.

RESULTS:
There were total 18 patients with 14 (77.8%) females and 4 (22.2%) males. Minimum age was 13 years and maximum was 30 years with mean age 17 years (SD 4.25) as shown in table I. With Lenke's classification thoracic scoliosis were 8 (44.4%), lumbar 2 (11.1%), thoracolumbar 4 (22.2%), double thoracic 2 (11.1%), and double major 2 (11.1%). The minimum preoperative Cobb's angle was 45^0, maximum 120^0 and average 70^0 (Table II). The minimum postoperative Cobb's angle was 5^0, maximum 65^0 and average 20^0 (Table III). Total correctness of Cobb's angle achieved was minimum 25^0, maximum 70^0 and average 50^0 (Table IV). The radiographs of two patients are shown in figures I and II.

Pre instrumentation anterior release was done in 4 cases. Complications included infection in one case where bone graft substitute was used. It was treated with serial debridements and the wound healed. In one patient rod was broken after three months of operation. This was replaced with a new rod. In one case the upper end of the rod appeared prominent which was shortened at a later date.

DISCUSSION:
This study was done to quantify the magnitude and variability of the correction achieved in AIS. The results are variable due to the degree of normal and/or pathologic anatomic variations. Bahairy et al included eleven patient in their study in which there were 10 females and one male, with a mean age at the time of surgery of 14 years (range 12-16).[2] The median preoperative Cobb angle was 60°±14° (range 48-90°), which was corrected to a

Table I: Overall Data				
	Age of Patients	Pre Operative Angulation in degrees	Post Operative Angulation in degrees	Total Correctness in degrees
n	18	18	18	18
Mean	16.56	69.72	20.56	49.17
Std. Error of Mean	1.00	5.92	4.62	2.69
Median	16.00	65.00	15.00	45.00
Mode	16	50	5	45
Std. Deviation	4.25	25.12	19.62	11.41
Range	17	75	60	45
Minimum	13	45	5	25
Maximum	30	120	65	70

Table II: Pre operative Angulations in Degrees			
Cobb's Angle	Frequency	Percent	Cumulative Percent
45	2	11.1	11.1
50	5	27.8	38.9
55	1	5.6	44.4
65	4	22.2	66.7
80	2	11.1	77.8
90	1	5.6	83.3
115	2	11.1	94.4
120	1	5.6	100.0
Total	18	100.0	

Table III: Post operative Angulations in Degrees			
Cobb's Angle	Frequency	Percent	Cumulative Percent
5	5	27.8	27.8
10	3	16.7	44.4
15	3	16.7	61.1
20	3	16.7	77.8
30	1	5.6	83.3
50	1	5.6	88.9
65	2	11.1	100.0
Total	18	100.0	

median of 26°±22° (10-80°) on preoperative supine right bend film. The postoperative angle was 40°±14° (9-56°). Pre-instrumentation release contributed a median 42%±25% to the overall correction. [11]

Luk KD et al[12] studied idiopathic thoracic scoliosis in which they pointed out that the Cobb's angle was decreased from 34° to 21° postoperatively with total correctness of 13° (average) in 45 patients and remained unchanged in 28 patients, while in our

Table IV: Total Correctness in Degrees			
Cobb's Angle	**Frequency**	**Percent**	**Cumulative Percent**
25	1	5.6	5.6
30	1	5.6	11.1
45	8	44.4	55.6
50	2	11.1	66.7
55	2	11.1	77.8
60	1	5.6	83.3
65	2	11.1	94.4
70	1	5.6	100.0
Total	18	100.0	

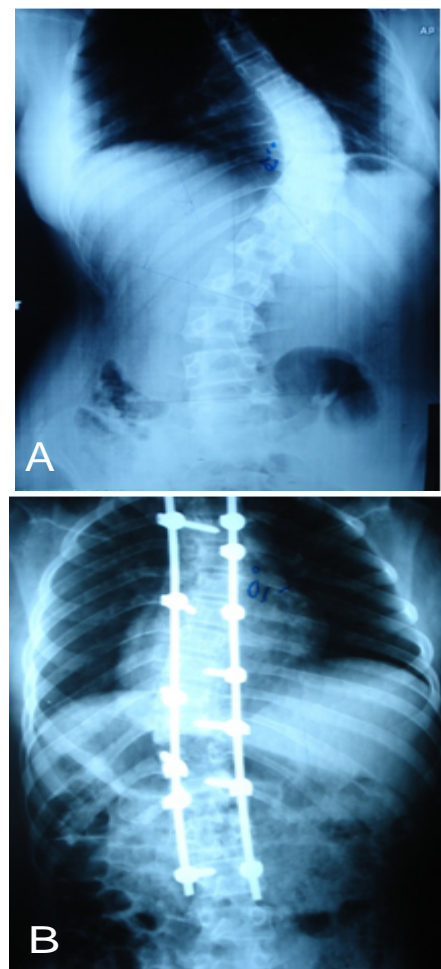Figure I: Radiographs of a 14 years old male with AIS, A: before surgery, B: after surgery

Figure II: Radiographs of a 13 year old girl with AIS, A: before surgery, B: after surgery.

study the Cobb's angle was decreased from 70° to 21° postoperative with total correctness of 50° (average). In his review article Yalda et al analyzed the data of 3299 patients.[13] In this study the average major curve correction was 26.6° (for 2188 patients).

The mean total Oswestry Disability Index (ODI) was 41.2 (for 1289 patients), and the mean postoperative reduction in ODI was 15.7 (for 911 patients). The mean SRS-30 equivalent score was 97.1 (for 1700 patients) with a mean postoperative decrease of

23.1 (for 999 patients).[13]

In Quan GM et al[14] study the preoperative main thoracic curve of 60.0° +13.4° was corrected to 17.4° + 6.9° (69.9% correction) on the postoperative radiographs. The preoperative thoracic kyphosis of 20.0° + 10.2° decreased to 11.6° + 4.9° after surgery. There was a significant correlation between decrease in sagittal kyphosis and magnitude of coronal Cobb angle correction (P 0.002).

All the above studies are comparable to the present study which showed that the treatment of adolescent idiopathic scoliosis with posterior instrumentation by using rods and pedicle screw fixation along with autologous bone graft is the most effective method for treating AIS.

CONCLUSIONS:
Posterior fusion with instrumentation for the surgical treatment for scoliosis with pedicle screw constructs can result in better correction and less frequent implant failures in thoracic idiopathic scoliosis, however, this can be at the expense of sagittal contour.

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