

Rod derotation technique, a good option for correction of idiopathic kyphoscoliosis

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Abstract

Review of the radiological and clinical outcomes of the correction of idiopathic scoliosis by convex rod rotation were done in this prospective interventional study. Axial translation technique with pedicle screw-rod was used for correction of scoliosis. 35 patients (10 males, 25 females) were studied on the basis of clinical and radiological outcomes with a mean age of 14.8 years and follow-up a period of 32.5 months. Placement of screws was more on the concavity, around apical region and instrumentation at all levels were not mandatory. Radiological evaluation was done pre-operatively and at 1, 3, 6 and 12 months post-operatively by whole spine standing anteroposterior, lateral radiographs and yearly thereafter. Spinal balance was noted, measurement of Cobb's angles, SRS questionnaire for clinical evaluation and complications were documented. The study result shows three-dimensional deformity of spine can be corrected effectively with simple rod rotation with pedicle screw instrumentation by axial translation technique.

Introduction

Idiopathic scoliosis is a three dimensional deformity including lateral deviation in the coronal plane, kyphosis or lordosis in the sagittal plane with rotation in the transverse plane. Correcting system with optimal correction and rigid fixation with minimum fusion are considered ideal. Moreover, it should correct all three dimensions of the deformity.

Harrington instrumentation used hooks in the upper and lower stable vertebra and compression distraction forces is used for the correction. This system was used as a treatment of choice for scoliosis for many years. But, Harrington instrumentation is not helpful in correction of coronal plane and flat back deformity was also a major complication. Harrington instrumentation is no longer regarded as the treatment of choice for scoliosis surgery.¹

Rotational deformity and coronal angulations are better corrected by other techniques than the Harrington system. Rotation occurs mostly in the apical vertebrae, but also in other vertebrae. Both deformities can be corrected by pedicle screws.² Cotrel-Dubousset instrumentation has helped in adequate reduction in the frontal plane as well as in the sagittal and transverse planes. This instrumentation system has been accepted by most surgeons.³ With the experience of Cotrel-Dubousset system, universal spine system⁴ was developed where the

instability of Cotrel-Dubousset system occurring above and below the construct was balanced by the frame created by rods and screws fixed at the cranial and caudal end. Translation of anchor points of intervening segments into the construct was done using axial translation technique. This system also allows active derotation in each segment, correction of thoracic kyphosis and convex rib deformity.

This study shows that rod derotation technique using universal spine system with axial translation technique is a good option for the correction of idiopathic kyphoscoliosis.

Materials and Methods

Posterior correction of scoliosis with pedicle screw construct by the rod derotation technique was performed in 35 patients (10 males and 25 females) from January 2012 to December 2017. The average age was 14.8 years (range 11 to 24 years). The indication for surgery was Cobb's angle of 40° or more but less than 90°. Data sheets and investigations including X-ray, magnetic resonance imaging (MRI), computer tomography (CT) scan and lung spirometry were done. The average follow-up period was 32.5 months (range 10 to 48 months). Standing antero-posterior and lateral views with supine right and left bending antero-posterior views and traction films X-ray were done pre-



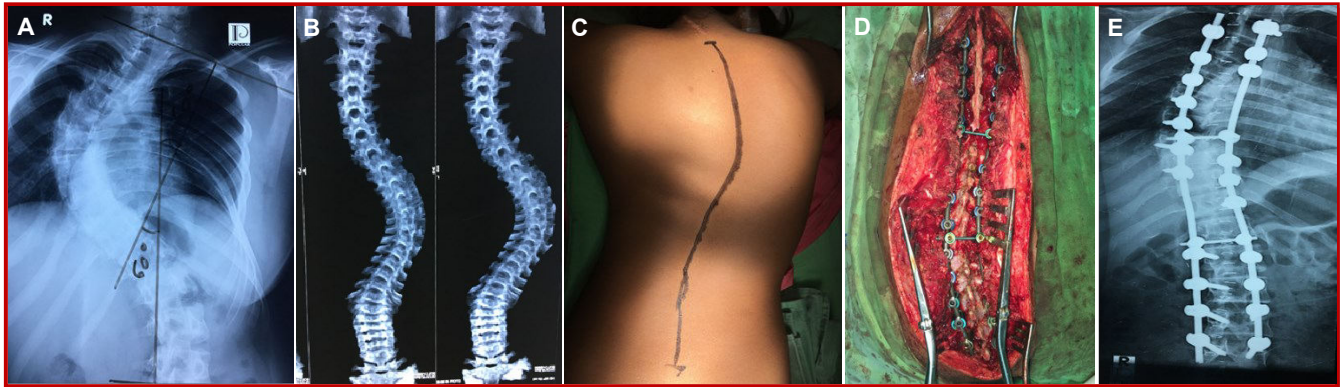


Figure 1: (A) Pre-operative X-ray whole spine anteroposterior view shows the cobb's angle (60 degree) as well as apex vertebra; (B) Pre-operative CT scan of whole spine coronal section shows the position of pedicle; (C) Per-operative skin marking over the spinous process of desired incision; (D) Per-operative image shows screw and rod placement with deformity correction; (E) Post-operative X-ray whole spine anteroposterior view shows the pedicle screw and rod with degree of correction of cobb's angle

operatively. During post-operative follow-up period, the whole spine standing antero-posterior and lateral view X-ray were taken and at 6 and 12 months then annually. Cobb's angle, thoracic sagittal profile- T5-T12, C7 plumb line, apical vertebral translation and apical vertebral rotation (Nash-Moe grading) were recorded. The upper and lower levels of instrumentation and levels of instrumentation were recorded. Signs of fusion, instrumentation failure and pseudoarthrosis were noted in the post-operative radiographs.

Results

The average pre-operative and post-operative Scoliosis Research Society (SRS) scores are shown in Table I. Self image and satisfaction domain were improved, which had most impact after surgical intervention. Increment in the SRS score from 3.4 to 4.1 showed significant improvement where it got better from 68.6 to 82.2%. The most frequent pattern of involvement was King type III (62.5%) followed by King type II (59.9%). Radiographic measurements were taken pre-operative, immediate post-

operative and the last follow-up Cobb's angle. The pre-operative, post-operative and final follow-up Cobb's angle are also shown in Table I where the mean pre-operative Cobb's angle was 61.8 degree, immediate post-operative Cobb's angle was 16.7 and the final follow-up 18.9. The loss of correction ranged from 1 to 3 degree with mean correction of 69.9%. One patient had superficial infection and 15 pedicle screws were malpositioned in three of the cases. Out of these three cases, two had implant failure who later underwent revision surgery. The study results showing the distribution according to King classification of scoliosis and pre-operative, post-operative, Cobb's angle at final follow-up along with SRS score are shown in Table I.

Complications

Superficial infection was noted in one case and was managed with the regular dressings and antibiotics. Among the 630 screws, 15 screws were malpositioned and two of the cases had implant failure who later underwent revision surgery (Table II). Neurological deterioration was not observed in any of our cases. Long-term complication was not found.

Table I

Cases according to the King's classification of AIS with preoperative, immediate postoperative and final follow-up Cobb angle and SRS score

King	No. of cases	Pre-operative Cobb	Post-operative Cobb	Final follow-up	Correction	SRS pre-operative	SRS final follow-up
I	1	54	14	16	70.4	3.2	4.2
II	8	59.9	15.3	17.5	71	3.3	4.1
III	22	62.5	17.4	19.5	68.9	3.4	4.1
IV	3	64	18	20	71.8	3.5	4
V	1	62	12	14	77.4	3.2	4.1
Average	n= 35	61.8	16.7	18.9	69.9	3.4	4.1

Table II

Number of cases of complication of surgery	
Complications	Cases
Superficial infection	1
Malplaced screws	3 (15 screws)
Implant failure	2
Neurological	0

Discussion

Adult idiopathic scoliosis being the most common subtype consists of deformity in three planes i.e., coronal, sagittal and axial planes. Lateral deviation occurring in coronal plane, kyphosis or lordosis on sagittal plane and rotation of vertebra on axial plane. The coupling deformities of these planes signifying that deformity in any one of the planes does not occur in isolation.^{5,6} Clinical assessment was done using the SRS score. 30 outcomes questionnaire which included 5 domains- pain, function, self-image, satisfaction and mental health. Major changes were noted in the domains of self-image and satisfaction and the other three domains did not show much change post-operatively and at the final follow-up. Our series showed improvement of SRS scores with average of 13.6% at last follow-up which is better to the 7.1% quoted in the series of Lehmann et al. (2008).⁷ Comparative analysis between the pedicle screw and hybrid instrumentation published by Kim et al. (2006) showed that the hybrid group was 56 and 70% average major curve correction in the screw group and which is similar to our study which is 69.9%.⁸ We did not use hybrid construct with hooks and pedicle screws were not kept in all levels. Moreover, screws were placed more in the concavity and in the periapical region. The correction of the curve approximately matched those found by other authors. Other recent techniques of curve correction are direct vertebral rotation and vertebral coplanar alignment.

Correction of 79.6% showed in the study by Suk et al. (2005)⁹ using the technique of direct vertebral rotation. In that study, pedicle screws are put in the concavity of vertebral deformity and a contoured rod is fitted into them followed by standard counter-clockwise derotation technique. 73% curve correction as showed by Vellespir et al. (2008)¹⁰ with the technique of vertebral coplanar alignment. In our study, we were able to achieve a correction of 69.9% which shows similar results compared to these two recent techniques. Probability of pedicle screw malpositioning is high in scoliosis correction surgery than other surgeries. Misplaced screw were 1.7% in 311 screws in Di Silvestre et al. (2007)¹¹ and Kuklo et al., (2002)¹² could show an accuracy of

96.3%. Three cases (15 screws) had malpositioned screws which is 2.4% and is comparable to the above study.

Conclusion

Spinal instrumentation systems, using the axial translation technique by pedicle screw and rod, achieved good clinical and radiological outcome for the patients of adolescent idiopathic scoliosis.

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