Outcomes of Surgical Correction of Idiopathic Scoliosis by Rod Derotation and Translation Technique – An Experience in a Tertiary Medical College Hospital

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ABSTRACT

Background: Idiopathic scoliosis is a complex three-dimensional spinal deformity commonly affecting adolescents and often requires surgical correction in severe or progressive cases. Posterior spinal fusion using rod derotation and translation techniques has become an established method for achieving satisfactory deformity correction and spinal balance. However, limited data are available regarding the outcomes of these techniques in low-resource tertiary care settings. Aim of the study: To evaluate the radiological, functional, and clinical outcomes of surgical correction of idiopathic scoliosis using combined rod derotation and translation techniques in a tertiary medical college hospital. **Methods & Materials**: This prospective observational study was conducted in the Department of Orthopedic Surgery of Satkhira Medical College and Hospital and some Private Hospitals, Satkhira, Bangladesh in Bangladesh over 24 months. A total of 35 patients with idiopathic scoliosis who underwent posterior spinal deformity correction using combined rod derotation and translation techniques were included. Preoperative, operative, and postoperative clinical and radiological data were collected. Functional outcome was assessed using the Scoliosis Research Society-22 (SRS-22) questionnaire. Follow-up evaluations were performed at 3, 6, and 12 months. Statistical analysis was performed using SPSS version 26, with $p<0.05$ considered statistically significant. Result: The mean age of the patients was 17.9±4.6 years, and females constituted 71.43% of the study population. The mean major Cobb angle improved significantly from 61.4±11.2° preoperatively to 18.7±6.1° postoperatively and was maintained at 20.2±6.8° at 12 months ($p<0.001$). The mean correction rate at final follow-up was 66.9±9.1%. Significant improvement was also observed in thoracic kyphosis, coronal imbalance, and rib hump angle ($p<0.001$). The mean SRS-22 total score improved from 2.8±0.5 preoperatively to 4.1±0.4 at 12 months ($p<0.001$), with marked improvement in pain, self-image, and functional activity domains. Postoperative complications were absent in 71.43% of patients, while superficial surgical site infection was the most common complication (8.57%). Better surgical outcomes were significantly associated with younger age, smaller preoperative Cobb angle, early presentation, absence of complications, and shorter hospital stay. **Conclusion**: Surgical correction of idiopathic scoliosis using combined rod derotation and translation techniques providedsignificant radiological correction, improved sagittal and coronal balance, and enhanced functional outcomes with acceptable complication rates. These techniques appear to be safe and effective for managing idiopathic scoliosis in tertiary care settings of developing countries.

Keywords: *Idiopathic scoliosis, rod derotation, rod translation, posterior spinal fusion, Cobb angle, spinal deformity correction.*

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INTRODUCTION

Idiopathic scoliosis is a three-dimensional deformity of the spine with a lateral deformity and vertebral rotation of unknown etiology, and is most frequently seen in the adolescent growth spurt [1]. They may be caused by trauma, degenerative diseases, or congenital diseases and can lead to long-term pain, disability, and reduced quality of life [2]. The most common type is idiopathic, which occurs in children between the ages of 10 and 18 years, and is referred to as adolescent idiopathic scoliosis (AIS) and affects 2 to 3 % of this age group [3]. The incidence rate of idiopathic scoliosis in Southeast Asia is about 1.35% among children and adolescents [4]. Treatment for idiopathic scoliosis will vary depending on the degree of curvature, skeletal maturity, and the risk of progression. Treatment is conservative (observation or bracing) for mild curves, and surgical correction is indicated for severe and progressive curves [5]. Posterior spinal fusion with pedicle screw instrumentation has emerged as the preferred surgical technique because of the superior three-dimensional correction and superior stability of the spine [6]. The existing corrective techniques are rod derotation, rod translation, and other methods; of these, the rod derotation and translation techniques are widely used for correcting coronal and rotational deformities while preserving sagittal balance [7]. The rod derotation technique involves fixation of the pedicle screws to the vertebrae, and then a pre-contoured rod is rotated to correct the rotation and alignment of the spine over time [8]. The translation technique, on the other hand, repairs the deformity by gradually tightening the screws to pull the vertebrae towards the rod [9]. The goal of both methods is to realign the spine, decrease rib prominence, and enhance posture and functional outcomes [10]. Both methods try to restore the alignment of the spine, decrease the prominence of the ribs, and increase the function and posture [11]. Although scoliosis surgery has these benefits, it is a complex procedure and can still have some complications [12]. Neurologic injury is the most severe complication and is, therefore, the most feared. Other complications are dural tears, peripheral neuropathy, surgical site infection, implant problems, thromboembolic complications, visual loss, pseudarthrosis, Crankshaft phenomenon, flatback phenomenon, and mortality [13]. In addition, the differences in correction rates, duration of surgery, complications, and functional recovery between the two procedures (rod derotation and translation) remain controversial [14]. So, the choice of the best corrective procedure is still a significant issue among spine surgeons, especially in low-resource tertiary hospitals. Although rod translation and derotation are frequently employed to address idiopathic scoliosis, there is ongoing debate regarding their relative efficacy, functional results, and consequences [15]. There is little data

from tertiary institutions in settings with low resources; thus, assessment is necessary to determine the safest and most efficient method. The objective of the study was to compare the outcome of surgical correction of idiopathic scoliosis (IS) using the technique of derotation and translation of the rods with outcomes regarding deformity correction, functional outcome, operative parameters, and postoperative complications.

METHODS & MATERIALS

This prospective observational study was conducted in the Department of Orthopaedic Surgery of Satkhira Medical College and Hospital and some Private Hospitals, Satkhira, Bangladesh over a period of 24 months from January 2024 to December 2025. The study evaluated the clinical, radiological, and functional outcomes of surgical correction of idiopathic scoliosis using combined rod derotation and translation techniques. A total of 35 patients diagnosed with idiopathic scoliosis who underwent posterior spinal deformity correction were included in the study.

Inclusion Criteria:

- Diagnosed cases of idiopathic scoliosis
- Patients aged 10 years and above with progressive spinal curvature requiring surgical intervention
- Cobb angle greater than 40° or progressive deformity despite conservative management
- Patients fit for major spinal surgery

Exclusion Criteria:

- Congenital, neuromuscular, or syndromic scoliosis
- Previous spinal surgery
- Active spinal infection or malignancy

Ethical Considerations

Prior to commencement of the study, ethical clearance was obtained from the Ethical Review Committee. Written informed consent was obtained before inclusion in the study. Participation was entirely voluntary, and participants were allowed to withdraw from the study at any stage without affecting their treatment. Privacy and confidentiality of patient information were strictly maintained throughout the research process.

Surgical Procedure

All operations were performed under general anesthesia using a posterior-only approach. Pedicle screw instrumentation was applied segmentally according to curve characteristics. Deformity correction was achieved using combined rod derotation and translation maneuvers. Rod derotation was used to convert the scoliotic curvature into physiological sagittal alignment, while translation technique facilitated gradual movement of the vertebral column toward the contoured rod. Additional corrective maneuvers including compression, distraction, and in situ bending were used when necessary. Bone grafting and posterior spinal fusion were performed in all cases. Thoracoplasty was carried out selectively in patients with significant rib prominence.

Data Collection

Data were collected using a structured data collection sheet during the preoperative, operative, and postoperative periods. Before surgery, all patients underwent comprehensive clinical evaluation including detailed history taking, physical examination, neurological assessment, and evaluation of cosmetic deformity. Radiological assessment was performed to measure major Cobb angle, thoracic kyphosis, lumbar lordosis, coronal imbalance, and vertebral rotation. Rib hump deformity was assessed clinically by the Adams forward bend test. Pulmonary function tests and routine laboratory investigations were performed where indicated. Functional status and health-related quality of life were assessed preoperatively using the Scoliosis Research Society-22 (SRS-22) questionnaire.

Operative data including duration of surgery, number of fused levels, number of pedicle screws used, need for thoracoplasty, ICU requirement, and duration of hospital stay were recorded intraoperatively and during hospitalization. Postoperative follow-up evaluations were conducted at 3 months, 6 months, and 12 months after surgery. During each follow-up visit, clinical examination, neurological assessment, and radiological evaluation were repeated to assess spinal correction, coronal and sagittal balance, and maintenance of deformity correction. Functional outcomes were reassessed at the 12-month follow-up using the SRS-22 questionnaire. Postoperative complications were documented throughout the follow-up period. Good surgical outcome was defined as achieving ≥65% correction of the major Cobb angle at the 12-month follow-up.

Statistical Analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Continuous variables were expressed as mean ± standard deviation. Categorical variables were presented as frequency and percentage. Paired t-test was used to compare preoperative and postoperative continuous variables. Chi-square test was used to analyze associations between categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULT

The largest age group was 16-20 years (45.71%), followed by 10-15 years (28.57%), with a mean age of 17.9±4.6 years. Females constituted 71.43% of the group. Thoracic curves were the predominant deformity pattern (60.00%), while thoracolumbar and lumbar curves accounted for 25.71% and 14.29%, respectively. The mean duration of symptoms was 3.1±1.4 years, and a preoperative neurological deficit was observed in 5.71% of patients (*Table I*).

Table I
Baseline characteristics of study participants (*n*=35).

Variable	Frequency (n)	Percentage (%)
Age group (years)		
10–15	10	28.57
16–20	16	45.71
21–25	6	17.14
>25	3	8.57
Mean age ± SD	17.9 ± 4.6	
Sex		
Male	10	28.57
Female	25	71.43
Curve type		
Thoracic	21	60.00
Thoracolumbar	9	25.71
Lumbar	5	14.29

Mean duration of symptoms (years)	3.1 ± 1.4	
Preoperative neurological deficit	2	5.71

Demonstrates a mean major Cobb angle of 61.4±11.2°, thoracic kyphosis of 19.5±7.1°, and lumbar lordosis of 41.3±10.4°. Mean coronal imbalance and rib hump angle were 2.4±1.1 cm and 18.2±5.7°, respectively. Advanced apical vertebral rotation (grade III-IV) was present in 45.71% of cases, while pulmonary restriction on spirometry was identified in 22.86%. The mean preoperative SRS-22 score was 2.8±0.5 (*Table II*).

Table II
Preoperative clinical and radiological characteristics of the study population.

Variable	Mean ± SD
Major Cobb angle (°)	61.4 ± 11.2
Thoracic kyphosis (°)	19.5 ± 7.1
Lumbar lordosis (°)	41.3 ± 10.4
Coronal imbalance (cm)	2.4 ± 1.1
Rib hump angle (°)	18.2 ± 5.7
Apical vertebral rotation grade III–IV	16 (45.71)
Pulmonary restriction on spirometry	8 (22.86)
Preoperative SRS-22 score	2.8 ± 0.5

The mean operative duration was 248±39 minutes with 11.8±2.1 fused levels and 17.6±3.4 pedicle screws used per procedure. Thoracoplasty was required in 11.43% of patients, and ICU support was necessary in 14.29%. Mean hospital stay was 8.3±2.4 days (*Table III*).

Table III
Operative details of rod derotation and translation technique.

Variable	Mean ± SD
Operative time (minutes)	248 ± 39
Levels fused	11.8 ± 2.1
Pedicle screws used	17.6 ± 3.4
Thoracoplasty performed, n (%)	4 (11.43)
ICU stay required, n (%)	5 (14.29)
Mean hospital stay (days)	8.3 ± 2.4

The Cobb angle improved from 61.4±11.2° preoperatively to 18.7±6.1° postoperatively and remained stable at 20.2±6.8° at 12 months ($p < 0.001$). Correction rates were 69.5±8.7% postoperatively and 66.9±9.1% at follow-up. Thoracic kyphosis improved to 28.0±6.2°, while coronal imbalance decreased from 2.4±1.1 cm to 0.9±0.6 cm at 12 months ($p < 0.001$). Rib hump angle also decreased significantly from 18.2±5.7° to 8.8±3.4° (*Table IV*).

Table IV
Radiological outcomes among patients following surgical correction.

Parameter	Preoperative	Postoperative	12-Month Follow-up	p-value
Cobb angle (°)	61.4 ± 11.2	18.7 ± 6.1	20.2 ± 6.8	<0.001
Correction rate (%)	—	69.5 ± 8.7	66.9 ± 9.1	<0.001
Thoracic kyphosis (°)	19.5 ± 7.1	27.2 ± 5.9	28.0 ± 6.2	<0.001
Coronal imbalance (cm)	2.4 ± 1.1	0.8 ± 0.5	0.9 ± 0.6	<0.001
Rib hump angle (°)	18.2 ± 5.7	8.4 ± 3.1	8.8 ± 3.4	<0.001

Shows marked improvement, with the SRS-22 total score increasing from 2.8±0.5 to 4.1±0.4 ($p < 0.001$). Pain domain, self-image, and functional activity scores improved significantly, while patient satisfaction reached 4.5±0.4 at 12-month follow-up. All analyses were statistically significant (*Table V*).

Table V
Functional and clinical outcomes among patients following surgical correction.

Outcome Variable	Preoperative	12-Month Follow-up	p-value
SRS-22 total score	2.8 ± 0.5	4.1 ± 0.4	<0.001
Pain domain score	3.0 ± 0.6	4.2 ± 0.5	<0.001
Self-image score	2.4 ± 0.7	4.3 ± 0.4	<0.001
Functional activity score	3.1 ± 0.5	4.0 ± 0.5	<0.001
Patient satisfaction score	—	4.5 ± 0.4	—

Postoperative complications were absent in 71.43% of patients. Superficial surgical site infection occurred in 8.57% of patients, while implant-related complications, proximal junctional kyphosis, and pulmonary complications were each observed in 5.71%. Deep wound infection, transient neurological deficit, and reoperation requirement were each reported in 2.86% of cases (*Table VI*).

Table VII
Postoperative Complications of the respondents (*n*=35).

Complication	Frequency (n)	Percentage (%)
Superficial surgical site infection	3	8.57
Deep wound infection	1	2.86
Implant-related complication	2	5.71
Transient neurological deficit	1	2.86
Proximal junctional kyphosis	2	5.71
Pulmonary complication	2	5.71
Reoperation required	1	2.86
No complication	25	71.43

A good surgical outcome was significantly associated with age <20 years (73.08%, p = 0.021), preoperative Cobb angle <70° (80.77%, p = 0.018), early presentation (57.69%, p = 0.042), absence of complications (80.77%, p = 0.006), and shorter hospital stay (7.4±1.8 days, p = 0.003) *Table VII*.

Table VII
Factors associated with good surgical outcome (≥65% Cobb Angle Correction).

Variable	Good Outcome (n=26)		Poor Outcome (n=9)		p-value
	n	%	n	%	
Age <20 years	19	73.08	3	33.33	0.021
Female sex	18	69.23	6	66.67	0.589
Preoperative Cobb angle <70°	21	80.77	4	44.44	0.018
Early presentation (<3 years symptoms)	15	57.69	3	33.33	0.042
Absence of complications	21	80.77	3	33.33	0.006
Mean hospital stay (days)	7.4 ± 1.8		10.1 ± 2.7		0.003

DISCUSSION

Surgical correction of idiopathic scoliosis using rod derotation and translation techniques has emerged as an effective method for achieving three-dimensional spinal deformity correction with satisfactory radiological, functional, and cosmetic outcomes in affected patients [10]. Our study participants were predominantly female (71.43%) with a mean age of 17.9±4.6 years, reflecting the known female predominance and adolescent presentation of idiopathic scoliosis. This aligns with the findings of Kim, who reported a similar mean age of 16.4 years and a female distribution of 78% in their analysis of posterior spinal fusion [16]. Thoracic curves constituted 60% of cases, which is comparable to the pattern described by a similar study, where thoracic deformities represented the most frequent curve type requiring operative correction [10]. Our mean symptom duration (3.1±1.4) is longer than the 1.2 years reported by a similar study, suggesting a delay in surgical referral in our demographic [17]. The preoperative radiological severity in our study was substantial, with a mean Cobb angle of 61.4°, rib hump angle of 18.2°, and apical vertebral rotation grade III-IV in 45.71% of patients. These findings are comparable to those reported by Sun et al., who evaluated severe Lenke type 1 idiopathic scoliosis and observed similarly marked rotational deformities before surgery. Their study emphasized that modern derotation-based corrective strategies can effectively address three-dimensional spinal deformity while maintaining sagittal alignment [18]. A similar study found the Cobb angle to be less than 35 degrees, suggesting our group may have had better-preserved thoracic volumes [19]. Our mean Preoperative SRS-22 score (2.8) is lower than the 3.4 reported, indicating a lower baseline quality of life, possibly due to social stigma regarding spinal deformity [20]. Our mean of 11.8 levels fused is consistent with Suk et al. for posterior-only approaches in multi-curve patterns [21]. Our 14.29% ICU admission rate aligns with the 12-15% reported for complex spinal reconstructions [22]. Our mean operative time was 248±39 minutes, which is significantly longer than that of those who reported 185 min. This may reflect the complexity of "translation" maneuvers compared to simple distraction [23]. The Cobb angle improved from 61.4° preoperatively to 18.7° immediately after surgery, with maintenance of correction at 12 months (20.2°), corresponding to an initial correction rate of 69.5%. Similarly, Sun et al. reported correction rates ranging from 78% to 85% using advanced vertebral derotation techniques, confirming that rotational corrective maneuvers are highly effective in coronal deformity reduction [18]. This is highly comparable to the study by Suk et al., which reported a 70% correction rate using pedicle screw fixation and rod derotation. The effectiveness of the translation technique in our study is further evidenced by the improvement in coronal imbalance from 2.4 cm to 0.8 cm [21]. Similar findings were observed by another study, where rod translation was found to be superior in restoring thoracic kyphosis compared to simple distraction/compression. In our cohort, thoracic kyphosis improved from 19.5 ° to 27.2 °, a crucial factor in avoiding "flat-back" syndrome [7]. Functional assessment via the SRS-22 score showed a dramatic increase from a mean of 2.8 to 4.1 at the 12-month follow-up. The most significant improvement was noted in the self-image domain (2.4 to 4.3), highlighting the psychological impact of deformity correction. These results are consistent with Newton et al., who observed that postoperative self-image and satisfaction domains showed the greatest improvement among AIS patients undergoing posterior fusion [24]. Similarly, another study validated that SRS-22 score improvement of >1.0 is clinically significant, a threshold comfortably met by our study population [25]. The mean SRS-22 total score improved significantly from 2.8 preoperatively to 4.1 at 12 months, with notable improvement in pain, self-image, and functional activity domains. Patient satisfaction reached a high postoperative score of 4.5, indicating excellent perceived surgical benefit. These findings closely parallel those reported by Librianto et al., who found that both derotation and translation techniques yielded favorable SRS-22 outcomes without significant differences between techniques [10]. Our complication rate was 28.57%, with superficial surgical site infection (8.57%)

being the most common. This is slightly higher than the 5.2% reported in a large multicenter study, though our rate of deep wound infection (2.86%) was comparable to international benchmarks [26]. Furthermore, our incidence of Proximal Junctional Kyphosis (PJK) at 5.71% is consistent with the findings of Yagi et al., who reported a PJK rate of 3% vs. 25% in patients where the upper instrumented vertebra was selected based on the stable vertebra rule [27]. Younger age <20 years, smaller preoperative Cobb angles <70°, and early presentation (<3 years of symptoms) in our study showed as significant predictors of a "good" surgical outcome. This reinforces the conclusions of Upasani et al., who emphasized that spinal flexibility-often lost with age and increasing curve magnitude-is the primary determinant of surgical correctability [28]. Our findings also showed that the absence of complications was strongly correlated with better correction ($p = 0.006$), a sentiment echoed by a study that noted that intraoperative adverse events often lead to more conservative correction strategies to ensure neurological safety [29].

LIMITATIONS

- Selection bias may have been present due to non-randomized patient inclusion.
- Functional outcomes were assessed mainly using the SRS-22 questionnaire, which may be influenced by subjective patient perceptions.
- Advanced imaging modalities and intraoperative neuromonitoring facilities were limited due to resource constraints.

CONCLUSION & RECOMMENDATIONS

Surgical correction of idiopathic scoliosis using combined rod derotation and translation techniques demonstrated satisfactory radiological and functional outcomes in this study. Significant correction of Cobb angle, improvement in spinal balance, reduction of rib hump deformity, and enhanced quality of life were achieved with acceptable postoperative complication rates. Younger patients, earlier presentation, smaller preoperative curve magnitude, and absence of postoperative complications were associated with better surgical outcomes. The findings suggest that combined rod derotation and translation techniques are effective and feasible options for the management of idiopathic scoliosis in tertiary medical college hospitals in Bangladesh and other resource-limited settings. Further multicenter studies with larger sample sizes and longer follow-up periods are recommended to validate these findings and assess long-term outcomes.

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CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

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