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Cross-sectional Study

Rod derotation and translation techniques provide comparable functional outcomes for surgical correction of adolescent idiopathic scoliosis – A retrospective, cross-sectional study

Didik Librianto [a,*,1], Ifran Saleh [b], Fachrisal [a], Widyastuti Srie Utami [c], Witantra Dhamar Hutami [d]

[a] Consultant Orthopaedic Spine Surgeon, Department of Orthopaedic & Traumatology, Fatmawati Hospital, Jalan RS Fatmawati No. 4, Cilandak, Jakarta Selatan, Jakarta 12430, Indonesia
[b] Consultant Orthopaedic Spine Surgeon, Department of Orthopaedic & Traumatology, Cipto Mangunkusumo National Central Hospital and Faculty of Medicine, Universitas Indonesia, Jalan Diponegoro No. 71, Jakarta Pusat, Jakarta 10430, Indonesia
[c] Orthopaedic Spine Surgeon, Tarakan General Hospital, Jalan Kyai Caringin No.7, Cideng, Gambir, Jakarta Pusat, 10150, Indonesia
[d] Department of Orthopaedic & Traumatology, Cipto Mangunkusumo National Central Hospital and Faculty of Medicine, Universitas Indonesia, Jalan Diponegoro No. 71, Jakarta Pusat, Jakarta 10430, Indonesia

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ABSTRACT

Objectives: To compare the functional outcome of the two most commonly used methods of Adolescence Idiopathic Scoliosis (AIS) correction surgery using rod rotation and translation techniques from a single center in Indonesia.

Method: We performed retrospective, cross-sectional study of patients with AIS who underwent deformity correction surgery by either technique in Fatmawati General Hospital from January 2016 to March 2018. All patients were asked to complete scoliosis research society (SRS)-22 questionnaire.

Result: Both methods of surgical correction yielded similar functional outcome as recorded in SRS-22 score, 3.67 for rod derotation technique and 3.44 for translation technique ($p = 0.235$).

Conclusion: Both rod derotation and translation technique resulted in equally desirable quality of life for AIS patients, in line with what would be expected from the literatures. Neither technique can be judged superior to the other. Therefore, the decision to use rotation or translation technique, as well as to compliment it with additional correction methods, should be made by the surgeon according to personal preference, experience, and comfort.

1. Introduction

Adolescent idiopathic scoliosis (AIS) affects approximately 1.2% of the whole population and estimated 2.93% of the Indonesian children. Based on the previous data, there was a relatively significant proportion of the patients indicated for correction surgery. The deformity of the spine in scoliosis alters physical appearance and function, which has a negative impact on the patients' quality of life (QoL). Surgical correction of scoliotic deformity is aimed to address patient's dissatisfaction regarding their physical appearance and discomfort, beside other indications other than aesthetic reason [1–3].

There are some techniques of surgery that are used to achieve intraoperative correction of scoliosis, including simple rod rotation, simultaneous double rod rotation, direct vertebral rotation, segmental derotation, en-bloc derotation, translation, cantilever bending, in situ bending, and distraction-compression [2]. The two most commonly used techniques used in our center are rod de-rotational and rod translation techniques [2,4]. In rod derotation technique, a pre-molded rod put in concave side is rotated so that a predominantly coronal scoliotic deformity is converted into thoracic kyphosis or lumbar lordosis in sagittal axis [5]. In translation maneuver, the technique obtains most of its reduction by gradually translating the periapical vertebrae toward

* Corresponding author.
E-mail address: didikl.orthopaedic@yahoo.com (D. Librianto).
[1] Present/permanent address: Department of Orthopaedic & Traumatology, Fatmawati Hospital, Jalan RS Fatmawati No. 4, Cilandak, Jakarta Selatan, Jakarta 12430, Indonesia.

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the rod in the midline [6].

Based on previous study, the two instrumentation techniques were equally able to achieve a comparable and effective three-dimensional correction of the scoliotic deformities. The use of either a rod rotation maneuver or a translation technique during surgery does not result in any significant measurable difference in three-dimensional correction. However, the perceived patient's satisfaction was not measured [7,8]. The goal of our present study was to investigate whether one of the two operative procedures led to a better functional outcome for AIS. Our hypothesis was that both techniques of surgery could provide comparable functional outcomes for the patients.

2. Method

This is a retrospective, cross-sectional study of patients with AIS who underwent correction surgery with either rod derotation or translation technique in Fatmawati General Hospital from January 2016 to March 2018. Ethical approval was obtained from institutional review board of local faculty and the participating hospital. Fatmawati General Hospital is an academic hospital, located in the capital city of Indonesia, Jakarta. Research registry was also obtained for retrospective study. The inclusion criteria for this study were established diagnosis of AIS, age of ten to 30 years, body mass index (BMI) 5th–95th percentiles for the age and posterior instrumentation with fusion of >6 levels, with minimum follow-up of one year. The exclusion criteria were patients with neuromuscular or any other known etiology of scoliosis, underwent minimal invasive technique, multi-staged procedure or loss to follow-up. Completion of scoliosis research society (SRS)-22 questionnaire was approached by phone and email. Medical records of those patients were also collected to determine whether rotation or translation method was performed during surgical correction. A flow chart of our study is presented in Fig. 1.

Data were imported from a Microsoft Excel spreadsheet into the IBM SPSS version 22 statistical software for data analysis. Independent T or Mann-Whitney tests were used to compare study groups for mean equality of preoperative characteristics and postoperative outcomes. Statistical testing was two-sided, with $p < 0.05$ was considered to be statistically significant. This study had been written according to STROCC guideline [9].

3. Intervention and consideration

3.1. Surgical technique

The surgeries were carried out at single institution by either two senior spine consultants with more than 10 years of experiences, using the two most common surgical technique either by rod rotation or translation technique, besides other supplemental maneuvers such as direct vertebral rotation or compression-distraction force. The choice of either technique was based in surgeon's preferences. The steps of surgery were as follow: incision and exposure of the fused levels, bilateral facetectomies, instrumentation of pedicle screws using free-hand technique, and followed by either technique of deformity correction. Intraoperative neuro monitoring (IONM) was carried out for all surgeries, and the final construct op the pedicle screws was confirmed using image intensifier.

In rod rotation technique, a pre-shaped rod was placed into the screws on the concave side of a curve, followed by locking the rod at the proximal and distal ends as points of fixation and rotating the rod apex in the direction of correction. In rod translation technique, the procedure was performed by fixing a rod in normal alignment at the rostral and caudal ends, followed by gradual alignment of the intermediate instrumented vertebrae toward the rod at the midline using a persuader [10]. Posterior elements were decorticated after performing final tightening of the rod-screw connections. In the end of the procedure, posterolateral fusion was performed by inserting the autologous bone grafts that were harvested during the course of the procedure.

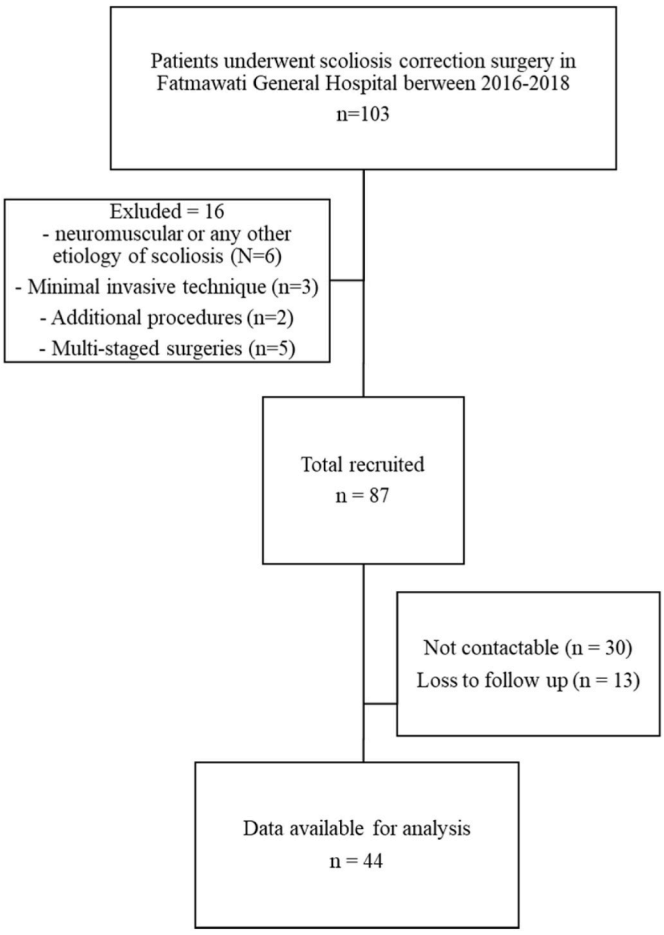

Fig. 1. Flowchart describing the inclusion and exclusion of patients.

3.2. Postoperative care

Surgical drain was left in place for 2–3 days postoperatively. Post operatively the patients were encouraged to ambulate as early as tolerated without external support. Daily activities were gradually increased with restriction to sports for at least 6 months after surgery.

3.3. Functional outcomes

The functional outcome was assessed using SRS-22 questionnaires. The assessment was carried out by single author not involved in patient's care. The SRS-22 questionnaires were scored and were categorized into five domains: function, pain, self-image, mental health, and satisfaction. The score gives a total score, that encompasses all domains, and a subscore for each domain. All scores range from 1 (worst) to 5 (best). The first 4 domains give total maximum score of 100. With the addition of 5th domain (satisfaction), gives the maximum total score of 110.

4. Results

A total of 103 patients underwent scoliosis correction surgery in our institution. Eighty seven of the patients were AIS patients were corrected by either rod derotation or translation technique from 2016 to 2018. The minimum follow up was one year. Fifty-seven patients were contactable and from those numbers, 44 completed SRS-22 questionnaires for QoL assessment. Thirteen patients were lost to follow up. (Fig. 1).

Derotation technique was performed in 25 patients (56%) while translation surgery was performed in 19 patients (44%). Mean age at the time of surgery were 19.6 ± 4.28 years and 21.7 ± 4.79 years for derotation and translation technique, respectively. The average follow-up duration were 15.83 ± 8.88 months in rod derotation technique and 12.3 ± 6.10 months in translation technique. Twenty-five female patients were included in rod derotation group while 17 females and 2 males were in translation group. Mean body weight were 43.17 ± 6.79 kgs in rod derotation group and 42.7 ± 5.57 in translation group. Fusion level was also described in our study with 13.7 ± 2.29 and 13.7 ± 1.37 levels in derotation and translation technique, respectively. Patient's baseline characteristics were described in Table 1.

Summary of SRS-22 scores for rod derotation and translation technique was depicted in Table 2. Each domain of SRS-22 questionnaire was compared using either Independent T-test or Mann-Whitney test. There was no significant difference between rod derotation and translation technique in terms of function (P = 0.008), pain (P = 0.072), self-perceived image (P = 0.464), mental health (P = 0.005), and satisfaction (P = 0.111). There was no statistically significant difference between SRS-22 scores in both groups of technique (Total score with P = 0.099). The clinical outcome comparison was shown in Fig. 2.

5. Discussion

Scoliosis is a three-dimensional structural deformity of the spine. Scoliosis is a complex rotational deformity which may manifest with a thoracic or lumbar prominence, shoulder imbalance, coronal shift and infrequently pain [11]. According to the Scoliosis Research Society (SRS), idiopathic scoliosis (IS) is a curvature of more than 10° Cobb angle. It affects 2–3% of pediatric population [12]. Adolescent idiopathic scoliosis (AIS) is the group of idiopathic scoliosis that acquired between 10 and 18 years of age and is the most common type of scoliosis. Although AIS is frequently a painless deformity and the patients have no weakness or movement problems, the cosmetic aspect of scoliosis often become a major concern of the patient, especially female patients [13].

There are three modalities for the treatment of AIS, including observation, bracing, and surgical correction of deformity. Large curves, defined as Cobbs agle of more than 45–50°, are generally indication for surgery as it increase the risk of health problems such as cardiorespiratory issues, disability and pain [13,14]. Scoliosis surgery is one of the most challenging procedures in spine surgery [15]. The surgical correction can be performed by posterior approach for all type of curves or anterior approach for selected curves [13]. Correction manoeuvres in scoliosis surgery are as important as other factors such as hardware selection, fusion, graft options and osteotomy techniques [16]. Various techniques could be used to correct spinal deformities in scoliosis including compression-distraction force, cantilever bending, in-situ bending, rod derotation or direct vertebral rotation (DVR), and rod translation [10,15,16]. Derotation technique provides posterior force opposite to the deformity in each vertebrae to maximize axial derotational force [4]. Translation technique is used for obtaining reduction rather than a rotation manoeuvre. The instrumented vertebrae are gradually translated towards the rod with specialized instrument [15].

The primary aims of deformity correction surgery for AIS patient are to prevent future deterioration of the curve by achieving a solid fusion, achieve a permanent deformity correction, improve physical appearance and improve perceived functional outcomes of cosmetic appearance, physical and psychosocial health. Other purposes are to reduce low back pain development, degenerative changes, functional impairment and cardiopulmonary compromise in adulthood. Thus, an improvement in quality of life is expected in long term outcome [13,17]. Quality of life according to World Health Organization (WHO) is an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, personal beliefs, social relationships and their relationship to salient features of their environment. Health Related Quality of Life (HRQoL) is concerned specifically with health aspects while also accounting for general QoL components [18].

Aiming on the improvement of patient's QoL, instead of merely treating the radiograph parameters, offers a holistic approach in treating AIS patients which present with their spectrum of problem consisting not only physical but also physiological problems regarding the deformity [13]. Furthermore, although immediate improvement of QoL cannot be expected in short-term or mid-term outcome, evaluation of QoL can offer an early detection for possible negative adverse event for any correction methods. In such a way, interpretation of good QoL after surgery means that there were no serious adverse events after surgery. A review of thirteen existing literature by Danielsson revealed that spinal deformity correction for AIS does not significantly impact QoL in short and mid-term follow up. However, the clinical implications are unclear due to clinically important differences for SRS-22/24 have not been established [19]. Our study compared the clinical outcomes in an average follow-up duration of 15.83 ± 8.88 months in derotation correction and 12.3 ± 6.10 months in translation method.

The Scoliosis Research Society-22 (SRS-22) questionnaire is published by SRS in the late 1990s as a valid, reliable instrument to evaluate

Table 1
Patients' characteristics in derotation and translation technique of surgery.

	Derotation (n = 25)	Translation (n = 19)
Age (yo)	19.6 ± 4.28	21.7 ± 4.79
Sex (M/F)	0/25	2/19
Body weight (kg)	43.17 ± 6.79	42.7 ± 5.57
Fusion level	13.7 ± 2.29	13.7 ± 1.37
Duration of follow-up (months)	15.83 ± 8.88	12.3 ± 6.10

Table 2
Summary of derotation and translation correction surgery SRS-22 scores.

SRS-22	Derotation (n = 25)	Translation (n = 19)	P value
Function	3.3 ± 0.67	3.8 ± 0.76	0.008[a]
Pain	3.9 ± 0.68	4.2 ± 0.73	0.072[b]
Self image	3.8 ± 0.65	3.8 ± 0.76	0.464[a]
Mental health	3.6 ± 0.72	4.1 ± 0.79	0.005[b]
Satisfaction	4.2 ± 0.40	4.5 ± 0.49	0.111[b]
Total score	3.7 ± 0.53	4.0 ± 0.52	0.099[b]

[a] Independent T test.
[b] Mann-Whitney test.

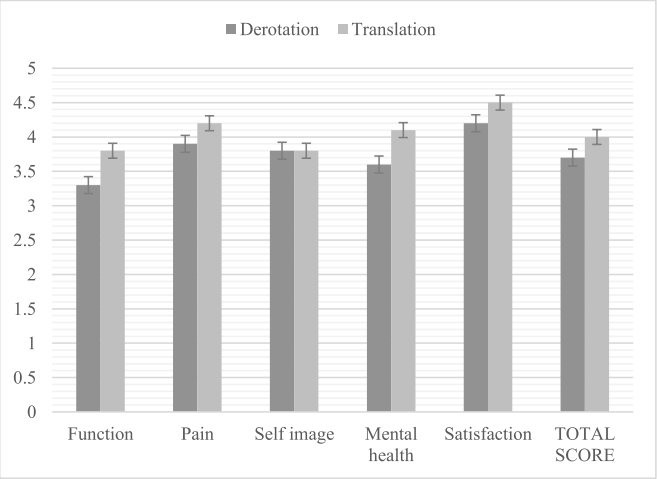

Fig. 2. SRS-22 comparison of both groups.

health-related quality of life (HRQOL) in idiopathic scoliosis. However, the use still limited in an active ambulatory population and has not been validated for other cause of scoliosis such in non-ambulatory patient, congenital or neuromuscular scoliosis [12]. The SRS-22 questionnaire is a simple, patient-based, and practical disease-specific instrument. Therefore, it is widely used as a clinical outcome instruments in AIS patients [20] SRS-22 emphasises on patient-centered care. Patient's satisfaction domain in this instrument allows for description of treatment effectiveness yet still focuses on primary goals of scoliosis correction [20].

Our study only conduct post-operative assessment. Translation technique had a higher overall SRS-22 scores of 4.0 ± 0.52 compared to that of 3.7 ± 0.53 in rod derotation correction. However, there was no statistically significant difference between SRS-22 scores in both of our study groups ($P = 0.099$). In a previous study by Lee et al. the improvement in QoL of a single method was assessed and comparison of two different methods only focused on radiological outcomes (curve changes). In his study, thirty-eight AIS patients were treated either by direct vertebral rotation or simple rod derotation. Segmental pedicle screw fixation with DVR showed better rotational and coronal correction in radiographic examination than simple rod derotation [4]. Other prospective nonrandomized study by Crandall and Revella on 126 AIS patients, showed better deformity correction by translation than rod derotation technique. However, no significant difference was found between both groups in Owestry disability index measured [21]. Both rotation and translation technique resulted in equally desirable quality of life for AIS patients, in line with what would be expected from the literature.

The benefits of the surgery towards improving the post-operative quality of life despite the method of correction will provide assurance to patients and guardians. Therefore, author strongly suggest for surgeons to take this QOL assessment into consideration instead of solely improve the radiographic parameters for treatment evaluation.

6. Study limitation

Our study was held in one institutional center thus limiting a larger number of participants. Due to retrospective design of the current study, patients were not randomized to different method of reduction. Lastly, our study didn't include the pre operative assessment comparing the post operative QoL assessment of both corrections.

7. Conclusion

Both rotation and translation technique resulted in significant and similarly effective correction in AIS. Neither technique can be judged superior to the other. Therefore, the decision to use rotation or translation technique, as well as to compliment it with additional correction methods, should be made by the surgeon according to personal preference, experience, and comfort.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Conflicts of interest

The authors declare that there is no conflict of interest.

Sources of funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Ethical approval

Ethical approval was obtained from institutional review board of local faculty and the participating hospital.

Consent

Informed consent had been obtained by the patient.

Author contribution

Didik Librianto: study concept, data collection, data interpretation, and writing the paper. Ifran Saleh: data collection, data interpretation and writing the paper. Fachrisal: data collection, data interpretation and writing the paper. Widyastuti Srie Utami: data collection, data interpretation and writing the paper. Witantra Dhamar Hutami: data collection, data interpretation and writing the paper.

Registration of research studies

1. Name of the registry: ANZCTR.
2. Unique Identifying number or registration ID: 381064.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): http://www.anzctr.org.au/Trial/Registration/TrialReview.aspx?id=381064&isClinicalTrial=False.

Guarantor

Didik Librianto.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2021.103188.

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