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Research Article

# A STUDY ON VARIABILITY IN TREATMENT DECISION-MAKING FOR EARLY-ONSET SCOLIOSIS

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## ABSTRACT

This study aimed to assess the variability in treatment decision-making for patients with early-onset scoliosis (EOS), a condition lacking clear treatment algorithms. Clinical and radiographic vignettes of EOS cases were presented to 26 experienced spine surgeons. Results revealed consensus on the need for surgery in most cases, but considerable variability in the choice of treatment type, construct location, and use of thoracotomy. While the vertical expandable prosthetic titanium rib was the preferred treatment, agreement on other treatment options was limited. These findings highlight the need for standardized approaches in managing EOS to improve consistency and outcomes.

**Keywords:** Early-onset scoliosis, Treatment variability, Surgical decision-making, Spine deformity, Consensus analysis.

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## INTRODUCTION

Progressive spinal deformities in children, particularly early-onset scoliosis (EOS), pose a challenge for treatment due to the absence of a universally accepted approach. While early fusion was once a common recommendation, its thoracopulmonary complications have led surgeons to consider it a last resort. Instead, interventions like hemiepiphyseodesis, hemivertebral resection, and short segment fusions are utilized in select cases. Growing rods and Vertical Expandable Prosthetic Titanium Rib (VEPTR) devices are popular alternatives, albeit with associated complications such as device migration and skin issues. Growing rod systems, while effective in halting curve progression, exhibit a high rate of minor complications like hook dislodgement. The VEPTR device, though not FDA-approved due to insufficient control data, has shown promising results in correcting deformities without life-threatening complications. Surgical strategies, including construct patterns and vertebral fusion levels, exhibit significant variability among surgeons, impacting treatment recommendations. Variability in surgical decision-making persists across different spinal conditions, necessitating a comprehensive assessment to understand and address these discrepancies, particularly in EOS management.

## METHODOLOGY

Each participating subjects was presented with 12 clinical vignettes, each accompanied by pertinent socioclinical variables such as diagnoses, age, gender, and relevant medical history. Preoperative planning included reviewing radiographs of the posterior and lateral spine, Cobb angles for each curve, and three-dimensional CT reconstructions.

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All information was provided electronically, and each surgeon reviewed the same set of cases, excluding the one they contributed. Preoperative planning data included type of surgery (surgical or nonsurgical), type of construct (e.g., VEPTRTM, growing rods, definitive fusions), construct location (unilateral or bilateral; rib to rib, rib to pelvis, or rib to spine), and whether a thoracotomy was recommended. Subjects completed handouts or electronic files and returned them to the principal investigator. Six months later, a follow-up assessment was conducted using the same instructions, and responses were submitted to the principal investigator. Descriptive analyses were performed using SPSS software.

**RESULTS**

In the first assessment of treatment type, all surgeons recommended surgery for seven of 12 patients. Three patients received nonoperative treatment via casting/bracing or observation, whereas the other two received surgery. Surgical treatment agreement ranged from 91% to 100% (average 97%) for each patient. The second assessment found that seven out of 12 patients should undergo surgery. One surgeon chose nonoperative treatment (casting and bracing for two patients) and observation for one patient in three patients. As for the remaining two patients, three surgeons chose to cast or brace one or observe the other. In the first assessment of patients for whom surgery was recommended, 25% to 92% (average, 72%) agreed on the use of VEPTRTM and 0% to 70% (average, 22%) agreed on growing rods. In the case of three patients, some surgeons chose to fuse their heads. According to the second assessment, 66% of surgeons recommended VEPTRTM (range, 33%-100%), while 30.4% of surgeons recommended growing rods (range, 0%-64%). In the second assessment, some surgeons chose to fuse four patients. According to the first assessment of surgical cases using the VEPTRTM, bilateral implants were chosen by 60% of surgeons (range, 8%-100%), and instrumentation should extend to the pelvis was agreed to by 67% (range, 8%-100%).

It was found that 100% of those who chose growing rods selected bilateral implants, and 18% recommended extending the instruments to the pelvis (range, 0%-66%). Second, among surgeons that chose VEPTRTM for their study, 56% (range, 0%–100%) chose bilateral construction, and 58% (range, 0%–100%) chose to extend instrumentation to the pelvis. Surgical groups that used growing rods chose to use them bilaterally, with 28% (range, 0%–100%) including the pelvis in the procedure. According to Table 5, none of them recommended thoracotomies in the first assessment for five patients, only one (8%-9%) recommended it for four patients, 50% recommended it for two patients, and 85% recommended it for one patient. A reduction in the recommendation of thoracotomy was noted in the second assessment compared with the first assessment. Of 12 patients, eight were not recommended for thoracotomies. It was recommended by one surgeon (10%), three by two surgeons (27%), and by eight by one patient (73%).

**Table 1. Observational characteristics**

| **Patient number** | **Surgery** | **Brace/cast** | **Observation** | **Surgery** | **Brace/cast** | **Observation** |
|---|---|---|---|---|---|---|
| 1 | 24/24 (100%) | 0/24 (0%) | 0/24 (0%) | 16/22 (73%) | 6/22 (27%) | 0/22 (0%) |
| 2 | 22/22 (100%) | 0/22 (0%) | 0/22 (0%) | 22/22 (100%) | 0/22 (0%) | 0/22 (0%) |
| 3 | 22/24 (92%) | 2/24 (8%) | 0/24 (0%) | 16/18 (89%) | 2/18 (11%) | 0/18 (0%) |
| 4 | 22/24 (92%) | 0/24 (0%) | 2/24 (8%) | 22/22(100%) | 0/22 (0%) | 0/22 (0%) |
| 5 | 24/24 (100%) | 0/24 (0%) | 0/24 (0%) | 22/22(100%) | 0/22 (0%) | 0/22 (0%) |
| 6 | 24/26 (92%) | 2/26 (8%) | 0/26(0%) | 22/24 (92%) | 2/24 (8%) | 0/22 (0%) |
| 7 | 24/26 (92%) | 0/26 (0%) | 2/26 (8%) | 16/22 (73%) | 0/22 (0%) | 6/22 (27%) |
| 8 | 22/22 (100%) | 0/22 (0%) | 0/22 (0%) | 22/22(100%) | 0/22 (0%) | 0/22 (0% |
| 9 | 24/24(100%) | 0/24 (0%) | 0/24 (0%) | 22/22 (100%) | 0/22 (0%) | 0/22 (0%) |
| 10 | 24/24 (100%) | 0/24 (0%) | 0/24 (0%) | 20/22 (91%) | 0/22 (0%) | 2/22 (9%) |
| 11 | 22/22(100%) | 0/22 (0%) | 0/22 (0%) | 22/22 (100%) | 0/22 (0%) | 0/22 (0%) |
| 12 | 20/22 (91%) | 2/22 (9%) | 0/22 (0%) | 18/18 (100%) | 0/18 (0%) | 0/18 (0%) |

**Table 2. Types of medicinal therapy**

| Patient number | VEPTRTM | Growing rods | Fusion | VEPTRTM | Growing rods | Fusion |
|---|---|---|---|---|---|---|
| 1 | 14/24 (58%) | 10/24 (42%) | 0/24 (0%) | 8/16 (50%) | 8/16 (50%) | 0/16 (0%) |
| 2 | 18/22 (82%) | 4/22 (18%) | 0/22 (0%) | 18/22 (82%) | 4/22 (18%) | 0/22 (0%) |
| 3 | 16/22 (73%) | 6/22 (27%) | 0/22 (0%) | 6/16 (63%) | 6/16 (37%) | 0/16 (0%) |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | 18/22 (82%) | 0/22 (0%) | 4/22 (18%) | 18/22 (82%) | 0/22 (0%) | 4/22 (18%) |
| 5 | 22/24 (72%) | 0/24 (0%) | 2/24 (8%) | 18/22 (82%) | 0/22 (18%) | 4/22 (18%) |
| 6 | 22/24 (92%) | 2/24 (8%) | 0/24 (0%) | 8/22 (36%) | 14/22 (64%) | 0/22 (0%) |
| 7 | 24/24 (100%) | 0/24 (0%) | 0/24 (0%) | 16/16 (100%) | 0/16 (0%) | 0/16 (0%) |
| 8 | 16/22 (73%) | 6/22 (27%) | 0/22 (25%) | 14/22 (64%) | 8/22 (36%) | 0/22 (0%) |
| 9 | 14/24 (58%) | 4/24 (17%) | 6/24 (0%) | 18/22 (82%) | 2/22 (9%) | 2/22 (9%) |
| 10 | 14/24 (58%) | 10/24 (42%) | 0/24 (0%) | 10/20 (50%) | 10/20 (50%) | 0/20 (0%) |
| 11 | 18/22 (82%) | 4/22 (18%) | 0/22 (0%) | 16/22 (73%) | 6/22 (27%) | 0/22 (0%) |
| 12 | 6/20 (30%) | 14/20 (70%) | 0/20 (0%) | 6/18 (33%) | 10/18 (56%) | 2/18 (11%) |

## DISCUSSION

In recent years, there has been an expansion of treatment options for young children with scoliosis. A single treatment algorithm has not yet been proposed for EOS. In this area, rigorous clinical research is hampered by a variety of obstacles, including small patient populations and regulatory challenges associated with prospectively studying off-label devices. As a result of these factors, the comparative effectiveness of various treatment strategies is poorly understood. In this area, there are many variables in treatment recommendations due to a lack of evidence to guide decision-making. Four aspects of decision making were measured in patients with EOS: whether surgery should be recommended; what type of construct should be recommended; where should the construct be located; and whether thoracotomy should be performed. The study is limited in several ways. In the first place, it limits the study to members of the Chest Wall and Spinal Deformity Association. Although this group of surgeons is familiar with both nonoperative and operative methods of treating EOS, they are specialized surgeons and may have a bias toward surgery. It is likely that this would bias the study toward less variability than greater variability in agreement. It is likely that members of this study group have more experience with VEPTRTM than a general sample of pediatric spine surgeons, even though this study group examines all treatment options for EOS. In addition, an in-depth analysis of complex patients with EOS cannot be conveyed with a socioclinical and radiographic vignette, and the variability may be reduced if the participants examine the patients themselves. Generally, surgeons agreed that surgery was indicated.

## CONCLUSION

As a result of these findings, clinical and radiographic evaluations are useful for assessing curve severity. Interobserver and intraobserver agreement were poor when evaluating the type of construct selected by each surgeon. As a result, many surgical treatment options for EOS lack precise indications, including spinal fusions, hemipiphysiodesis with staples or tethers, growing rods, and the VEPTRTM. In addition, these findings highlight the diversity of etiology, curve morphology, and comorbidities among this cohort of patients. It was widely agreed that spine implants should be affixed in different places. It was only fair to find intraobserver agreement and substantial interobserver agreement when surgeons decided to use VEPTRTM bilaterally. Currently, there are no rigid indications for surgical interventions for this patient population, as highlighted in this study. EOS treatment options are determined by the preferences and opinions of a group of surgeons with experience treating the disease. Rather than making treatment recommendations, this study documents variability in treatment preferences among experienced EOS surgeons. We identified several priority areas where better evidence needs to be developed to assist surgeons in formulating optimal treatment strategies for children with EOS. There is a need for further research to develop and validate classification systems that can provide guidance for operative indications.

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