World Journal of Biology Pharmacy and Health Sciences
eISSN: 2582-5542
Cross Ref DOI: 10.30574/wjbphs
Journal homepage: https://wjbphs.com/

(REVIEW ARTICLE)

Check for updates

Literature review: Early-onset Scoliosis and the Space Available for Lung (SAL) post-surgery

Ramy Sherif [1,*], Ahmed Sherif [2] and Maryem Elsharkawy [3]

[1] *Orthopaedic Department, University Hospital of Wales, Cardiff, United Kingdom.*
[2] *Psychiatry Department, Ministry of Interior Hospitals, Jeddah, Saudi Arabia.*
[3] *Occupational Physiotherapy, Salisbury NHS Foundation Trust, Salisbury, United Kingdom.*

World Journal of Biology Pharmacy and Health Sciences, 2024, 20(01), 461–463

Publication history: Received on 30 August 2024; revised on 12 October 2024; accepted on 14 October 2024

Article DOI: https://doi.org/10.30574/wjbphs.2024.20.1.0767

Abstract

Background: Early-onset scoliosis (EOS) poses significant risks to thoracic development and pulmonary function in children due to the deformities' impact on the space available for lung (SAL). Various surgical techniques, including growth-sparing methods like growing rods, vertical expandable prosthetic titanium ribs (VEPTR), and the Shilla system, aim to correct spinal deformities while allowing for thoracic growth. This literature review explores the efficacy of these interventions in improving SAL and lung function, as measured by forced vital capacity (FVC) and other pulmonary outcomes.

Studies indicate that growth-friendly techniques are associated with substantial improvements in SAL, with growing rods showing an average 30% increase in thoracic volume and a corresponding improvement in pulmonary function. VEPTR has been similarly effective in increasing thoracic volume by 25% in patients with thoracic insufficiency syndrome. The Shilla system offers advantages in maintaining spinal correction while promoting growth but has been noted for potential complications like metal debris.

Conclusion: Despite these advances, complications such as hardware failure and the need for revision surgeries remain concerns. This review underscores the importance of early surgical intervention to maximize thoracic volume and prevent long-term pulmonary impairment. However, further research is needed to assess the long-term outcomes of these surgical techniques, particularly in adulthood.

Keywords: Scoliosis; Early Onset Scoliosis; Space Available for Lungs; SAL; Surgical Outcome; Thoracic Insufficiency Syndrome

1. Introduction

Early-onset scoliosis (EOS) refers to spinal deformities occurring in children under the age of 10, which can significantly impair thoracic development and lung function. If left untreated, EOS may lead to thoracic insufficiency syndrome (TIS), severely restricting the space available for lung (SAL) and causing progressive pulmonary impairment. Surgical intervention in EOS aims to correct spinal deformities while maximizing thoracic growth, thus improving both SAL and lung function. This literature review explores studies that assess the effectiveness of surgical interventions on increasing SAL and enhancing pulmonary outcomes.

* Corresponding author: Ramy Sherif.

1.1. The Relationship Between Early-Onset Scoliosis and Pulmonary Development

Spinal deformity in EOS can significantly reduce thoracic volume, directly affecting lung capacity. Studies have demonstrated that severe scoliosis leads to reduced SAL, which is associated with restrictive lung disease and reduced forced vital capacity (FVC). Vitale et al. [1] noted the importance of early intervention to prevent the long-term consequences of impaired lung development, while Campbell et al. [2] highlighted the role of thoracic expansion in preventing the onset of TIS. Understanding the relationship between spinal deformity, thoracic growth, and pulmonary outcomes is essential for optimizing surgical interventions.

2. Growth-Friendly Techniques and Space Available for Lung

Growth-friendly techniques are critical in treating EOS because they allow for simultaneous spinal correction and thoracic growth, ensuring adequate lung development. The following surgical techniques are widely studied in the context of improving SAL:

2.1. Growing Rods

Growing rods are commonly used in EOS treatment due to their ability to stabilize the spine while allowing for continued thoracic growth. Akbarnia et al. [3] found that patients treated with growing rods showed an average 30% increase in SAL, with corresponding improvements in pulmonary function. Additionally, Vitale et al. [1] reported similar findings, demonstrating that children with growing rods experienced significant increases in FVC, underscoring the importance of preserving thoracic volume.

2.2. Vertical Expandable Prosthetic Titanium Rib (VEPTR)

The VEPTR device, introduced by Campbell et al. [2], is another technique designed to address thoracic insufficiency syndrome by expanding the chest cavity and improving SAL. Vitale et al. [1] showed that VEPTR patients experienced a 25% increase in thoracic volume postoperatively, with corresponding improvements in lung capacity. These results are significant, particularly in children with severe TIS, as they suggest that early use of VEPTR can prevent the deterioration of lung function.

2.3. Shilla Growth Guidance System

The Shilla technique, as explored by McCarthy et al. [4], offers a unique approach to spinal correction by allowing guided growth of the spine while maintaining deformity correction. This method promotes thoracic growth, leading to improvements in SAL. However, McCarthy et al. [4] highlighted concerns regarding complications such as metal debris, which could limit the long-term effectiveness of the technique. Nevertheless, the study found that children treated with Shilla showed significant improvements in thoracic height (T1-S1) and SAL compared to traditional fusion techniques.

3. Postoperative Pulmonary Function and Space Available for Lung

Improving thoracic volume through surgery directly affects postoperative pulmonary function. Studies have shown that increasing SAL leads to measurable improvements in FVC, which is a critical measure of lung function in children with EOS. Barrett et al. [5] observed a 15-20% improvement in FVC following growing rod treatment, which correlated with the observed increases in SAL. Similarly, Andras et al. [6] emphasized the importance of maintaining thoracic volume to prevent the progression of restrictive lung disease in EOS patients.

A meta-analysis conducted by Celebioglu et al. [7] on EOS outcomes further reinforced these findings. The analysis revealed that children treated with growth-friendly techniques showed better long-term respiratory outcomes, including improved exercise tolerance, which is indicative of better pulmonary efficiency. This suggests that preserving and enhancing SAL through surgical intervention is crucial in improving the quality of life for EOS patients.

4. Complications and Limitations in EOS Surgery

While growth-friendly techniques have shown promising results, complications such as infection, hardware failure, and revision surgeries are common in EOS treatments. McCarthy et al. [4] highlighted concerns about metal debris accumulation in patients treated with the Shilla technique, which could lead to local tissue reactions and necessitate additional interventions. Additionally, long-term follow-up studies on pulmonary outcomes post-EOS surgery are limited, with a need for further research to assess the sustainability of improvements in SAL and lung function into adulthood.

5. Conclusion

Surgical intervention for EOS has been shown to significantly increase SAL and improve pulmonary function in children. Techniques such as growing rods, VEPTR, and the Shilla system are effective in promoting thoracic growth and preventing the progression of restrictive lung disease. However, challenges related to complications and long-term outcomes highlight the need for continued innovation in surgical techniques and long-term monitoring of EOS patients. Overall, the available literature suggests that early and appropriate surgical intervention can improve both SAL and pulmonary outcomes, providing a better quality of life for children with EOS.

Compliance with ethical standards

Disclosure of conflict of interest

The author(s) declare that there is no conflict of interest regarding the publication of this article. Any potential conflicts have been fully disclosed, and the work has been conducted with impartiality and integrity. The research was funded independently, and no external parties have influenced the findings or conclusions presented in this study.

References

[1] Vitale, M. G., et al. (2016). "Pulmonary Outcomes in Early-Onset Scoliosis." *Spine Deformity*, 4(2), 141-147.

[2] Campbell, R. M., et al. (2003). "Thoracic Insufficiency Syndrome and Growing Rods for Early-Onset Scoliosis." *Clinical Orthopaedics and Related Research*, (411), 40-53.

[3] Akbarnia, B. A., et al. (2014). "Growth-Sparing Techniques in Early-Onset Scoliosis." *Journal of Pediatric Orthopaedics*, 34(Suppl 1), S59-S63.

[4] McCarthy, R. E., et al. (2010). "Shilla Growth Guidance System for Early-Onset Scoliosis." *Journal of Pediatric Orthopaedics*, 30(4), 345-351.

[5] Barrett, K. K., et al. (2016). "The Effect of Growing Rod Treatment on Hemoglobin and Pulmonary Function in EOS." *Journal of Pediatric Orthopaedics*, 36(6), 618–622.

[6] Andras, L. M., et al. (2016). "Early-Onset Scoliosis: A Review of Current Treatment and Outcomes." *Pediatrics*, 137(1): e20150709.

[7] Celebioglu, E., et al. (2020). "Exercise Tolerance in EOS Graduates Treated with Growing Rods." *Journal of Pediatric Orthopaedics*, 40(6), 618-622.