

# Comparative Outcomes of Single-Stage and Double-Stage Laryngotracheal Reconstruction for Pediatric Subglottic Stenosis: A Systematic Review

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## Background

- Single Stage Laryngotracheal Reconstruction (ssLTR) allows for immediate decannulation, but higher risk of reintubation and complications post-surgery<sup>1</sup>.
- Double Stage Laryngotracheal Reconstruction (dsLTR) is often preferred for patients with severe stenosis or high-risk comorbidities with lower immediate risk but requiring prolonged tracheostomy care<sup>2</sup>.
- Overall, decannulation rates are higher in ssLTR than dsLTR in most studies; however, many do not stratify the results by stenosis grade, which may influence the success of dsLTR procedures<sup>3</sup>.
- This study aimed to perform an expanded systematic review comparing decannulation rates following ssLTR and dsLTR procedures in children with subglottic stenosis, stratifying outcomes by subglottic stenosis grade.

## Hypothesis

We hypothesized that, consistent with previous studies, ssLTR would demonstrate higher decannulation rates than dsLTR, and that this difference would persist across stenosis grades.

## Methods

- A systematic search of PubMed, Embase, and Web of Science was conducted in September 2024.
- Two reviewers (HS, PS) independently screened abstracts and full texts using Covidence.
- Studies were included if they reported outcomes of ssLTR, dsLTR, or both in patients under 18 with subglottic stenosis.
- Data from 46 studies were extracted, stratified by Cotton-Meyer stenosis grade, and analyzed.
- Meta-analysis was performed using Python code in Google Colab

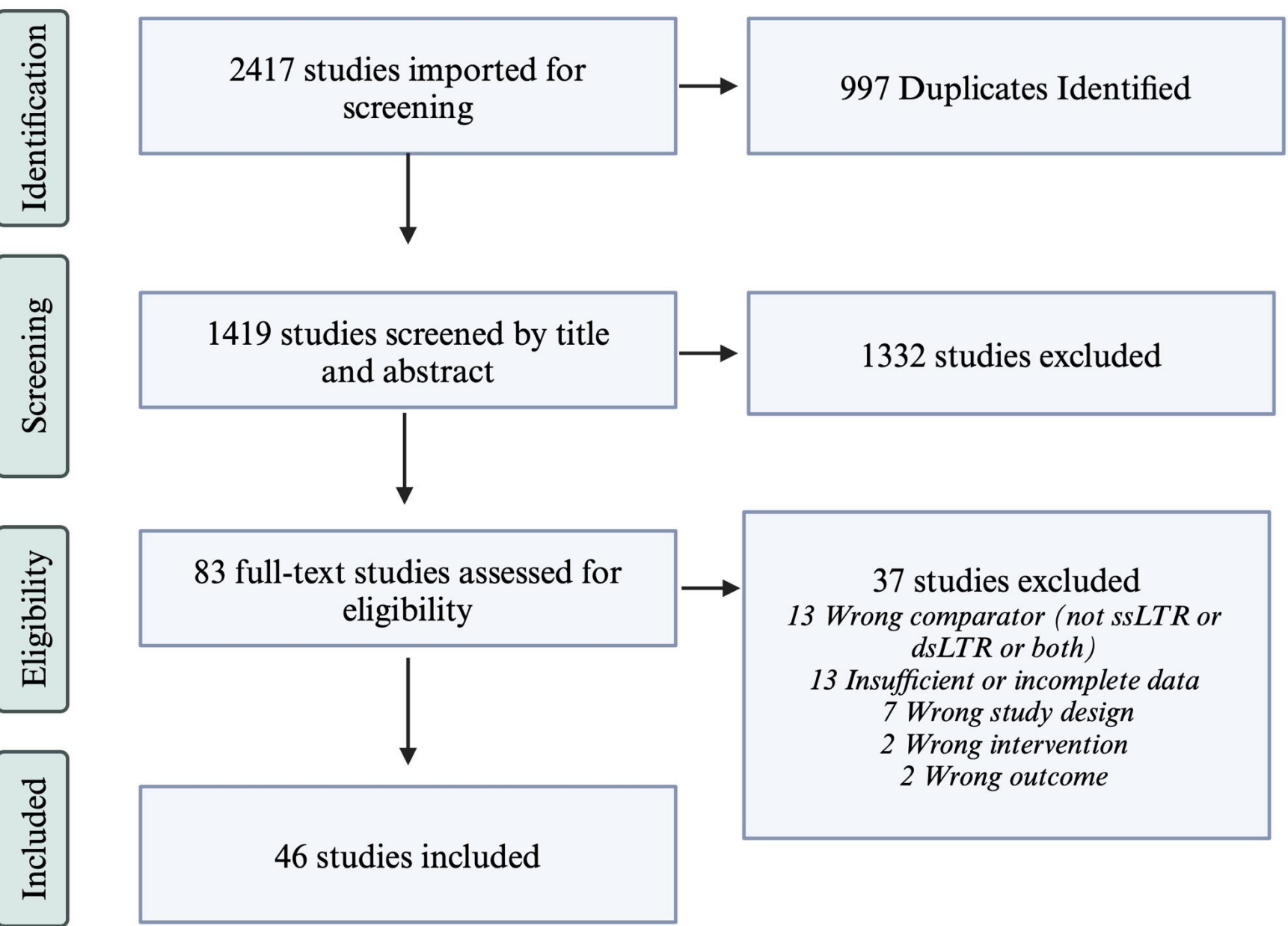


Figure 1: PRISMA Systematic Review Results

## Results

### Meta-analysis

- Pooled decannulation rates were significantly higher for ssLTR (89.1%) than dsLTR (72.8%), with an odds ratio of 0.28 ( $p < 0.001$ ).
- After adjusting for stenosis grade, ssLTR remained associated with a 15% higher decannulation rate, but this did not reach statistical significance ( $p = 0.069$ ).
- When further divided into grades of stenosis, only 3 studies evaluated both ssLTR and dsLTR, including stenosis grade.
- Patients with grade III stenosis showed a significantly lower decannulation rate for dsLTR procedures compared to ssLTR.

Surgery	Mean Decannulation Rate $\pm$ SD (%)	Beta Coefficient	P-value
dsLTR	72.83 $\pm$ 32.54	0.15	0.069
ssLTR	89.10 $\pm$ 18.87		

Table 1. Linear Regression Analysis of ssLTR Versus dsLTR Overall Decannulation Rates, Adjusted for Grade of Subglottic Stenosis.

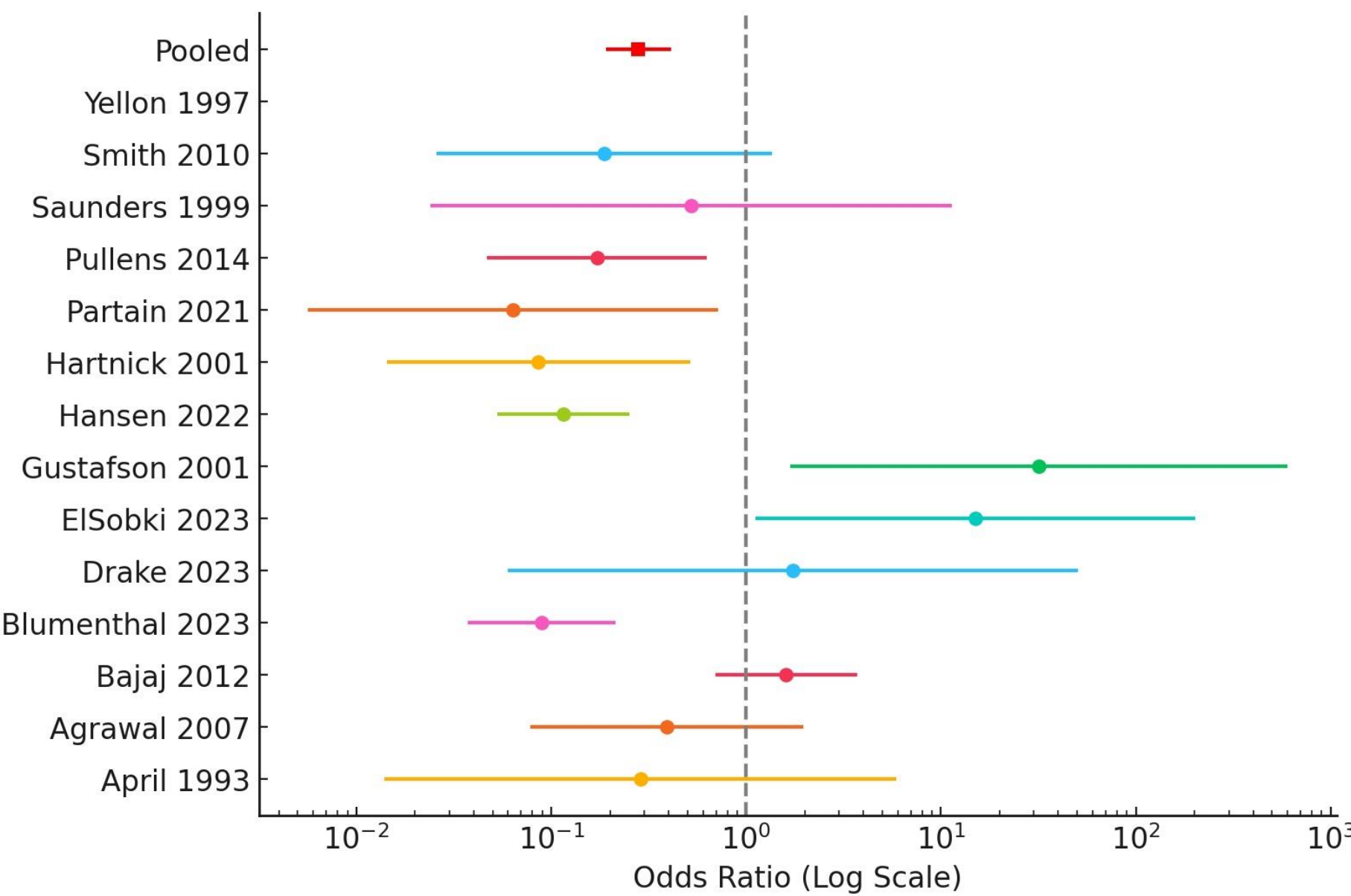


Figure 2. Metanalysis: Odds Ratio of Decannulation in dsLTR Compared to ssLTR.

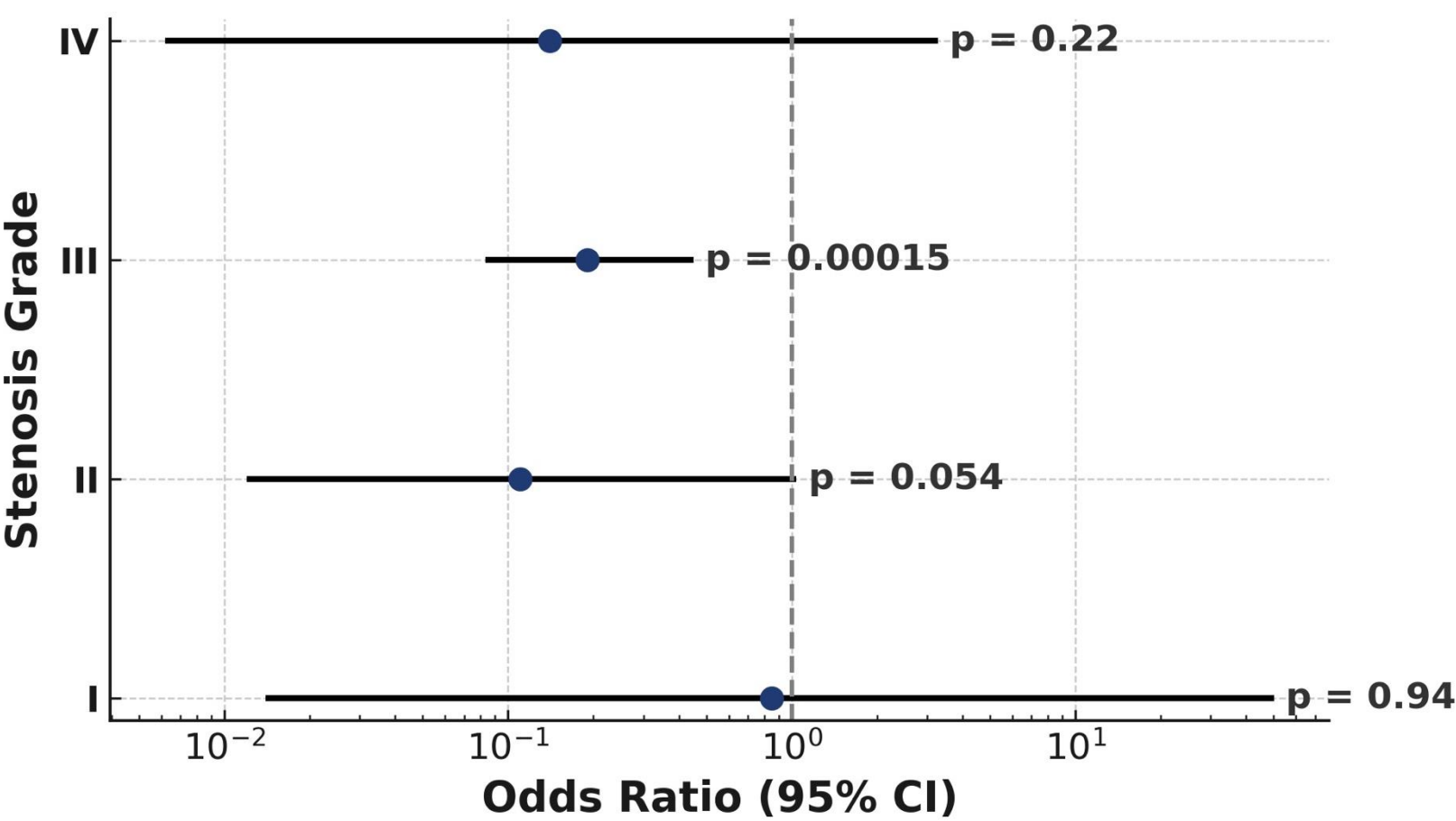
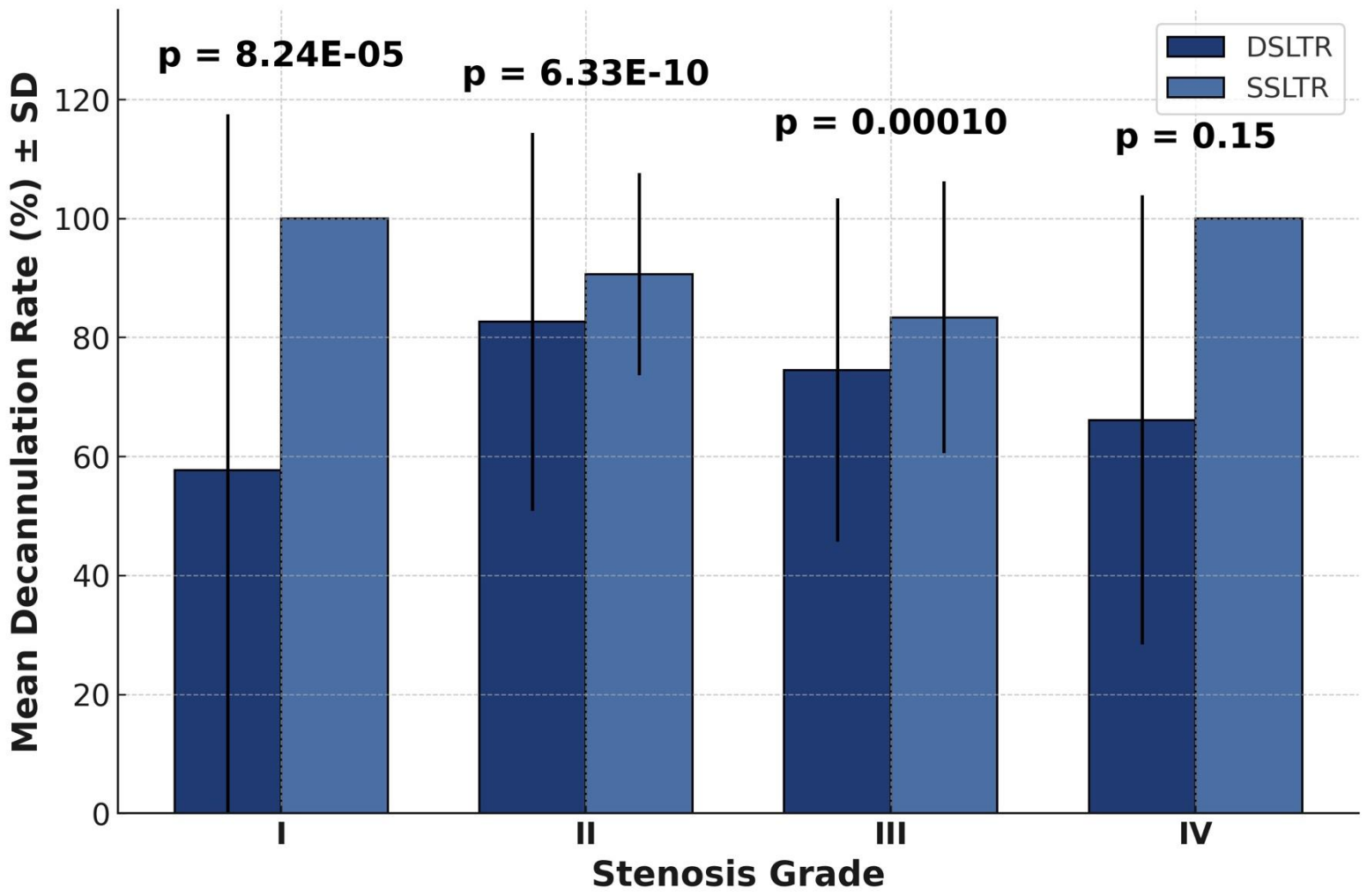


Figure 3. Odds Ratio of Decannulation in dsLTR Compared to ssLTR Stratified by Stenosis Grade

## Results

### Indirect Comparison

- Independent comparisons showed significantly higher decannulation rates with ssLTR for grade I–III stenosis, but no difference for grade IV.

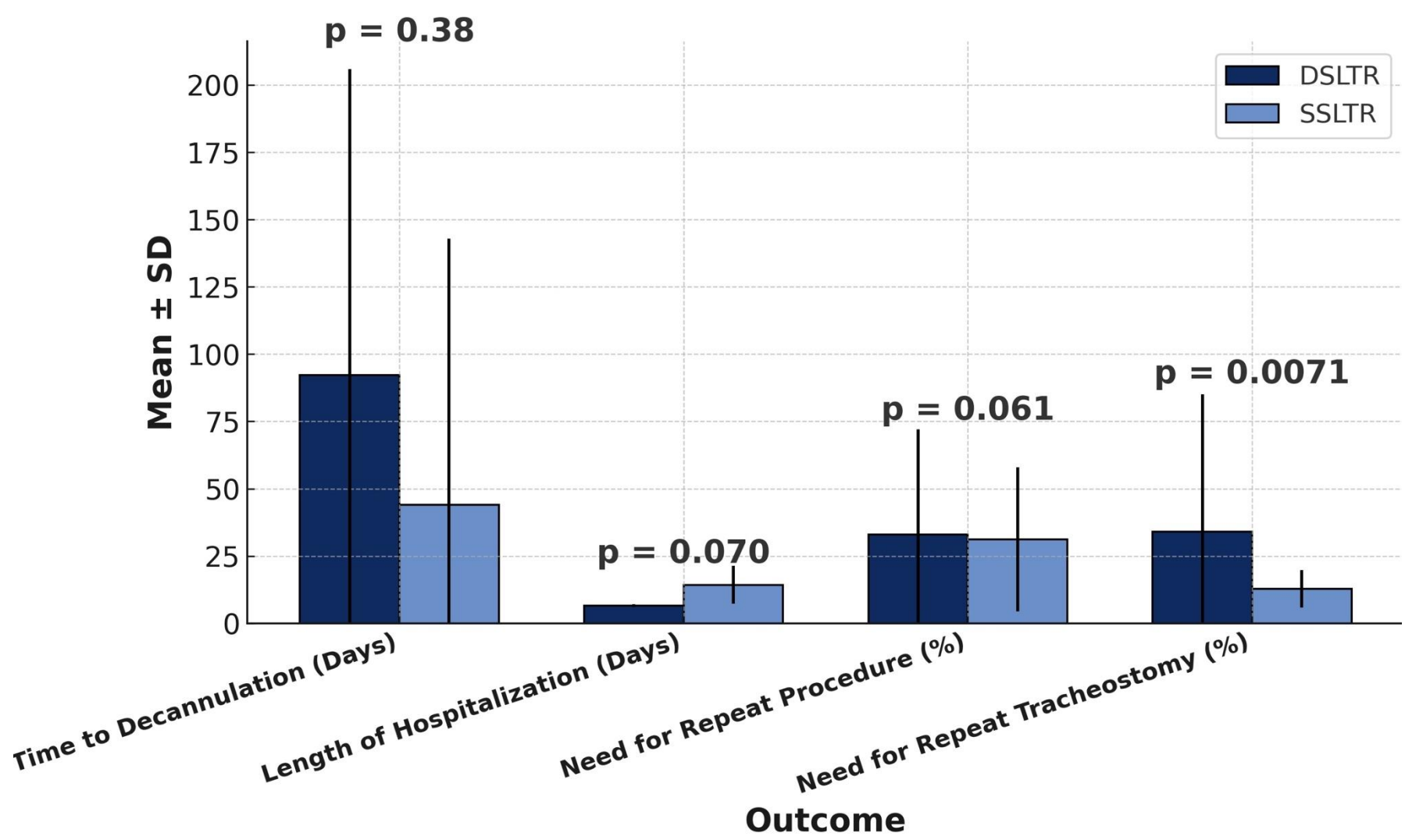


Grade	# of Studies	
	dsLTR	ssLTR
I	2	2
II	8	9
III	9	10
IV	7	2

Figure 4. Indirect Comparison of Single-Stage vs. Double-Stage LTR, Stratified by Stenosis Grade

### Secondary Outcomes

- Repeat tracheostomy was more common following dsLTR ( $p = 0.0071$ ) while other outcomes were similar.



Outcome	# of Studies	
	dsLTR	ssLTR
Time to Decannulation	9	7
Length of Hospitalization	3	5
Repeat Surgery	7	8
Repeat Tracheostomy	5	13

Figure 5. Secondary Outcomes of Single-Stage vs. Double-Stage LTR

## Conclusions

- ssLTR was associated with higher decannulation rates, particularly in patients with grades II and III stenosis.
- By incorporating recent data and separately analyzing ssLTR and dsLTR outcomes, this review expands upon the existing literature and provides a more comprehensive and updated assessment of surgical outcomes.
- These findings support broader consideration of ssLTR in appropriately selected patients and highlight the need for further standardized head-to-head studies.

## Resources

- Jacobs BR, Salman BA, Cotton RT, Lyons K, Brill R. Postoperative management of children after single-stage laryngotracheal reconstruction. *Crit Care Med*. Jan 2001;29(1):164-8. doi:10.1097/00003246-200101000-00032
- Hansen A, Chorney SR, Johnson RF. Estimating perioperative outcomes after pediatric laryngotracheal reconstruction surgery in accordance with ACS-NSQIP-P reporting. *J Pediatr Surg*. Aug 2022;57(8):1573-1578. doi:10.1016/j.jpedsurg.2021.08.002
- Padia R, Sjogren P, Smith M, Muntz H, Stoddard G, Meier J. Systematic review/meta-analysis comparing successful outcomes after single vs. double-stage laryngotracheal reconstruction. *Int J Pediatr Otorhinolaryngol*. May 2018;108:168-174. doi:10.1016/j.ijporl.2018.03.003