

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-surgery¹.
- 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 care².
- 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 procedures³.
- 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

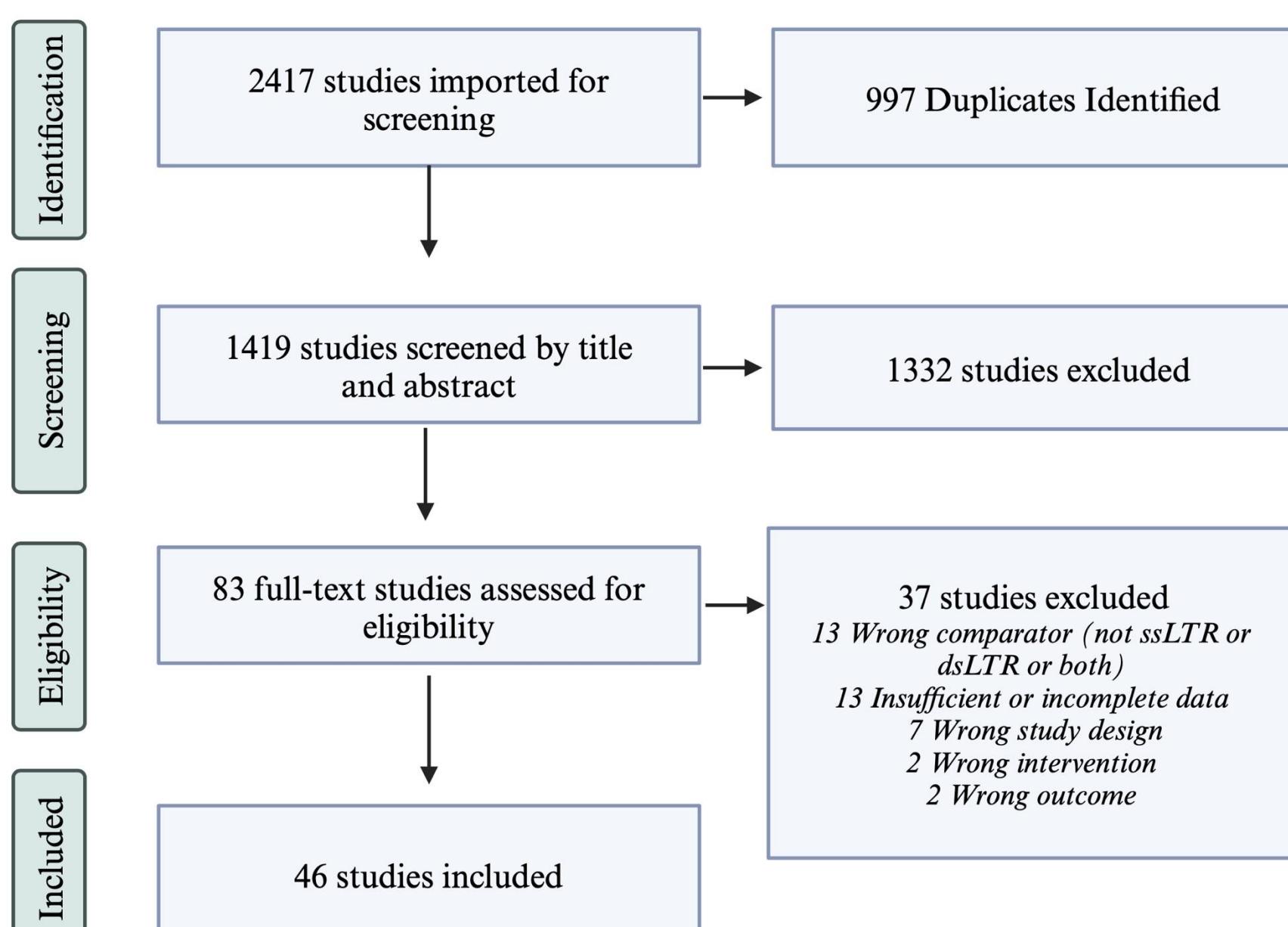


Figure 1: PRISMA Systematic Review Results

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.

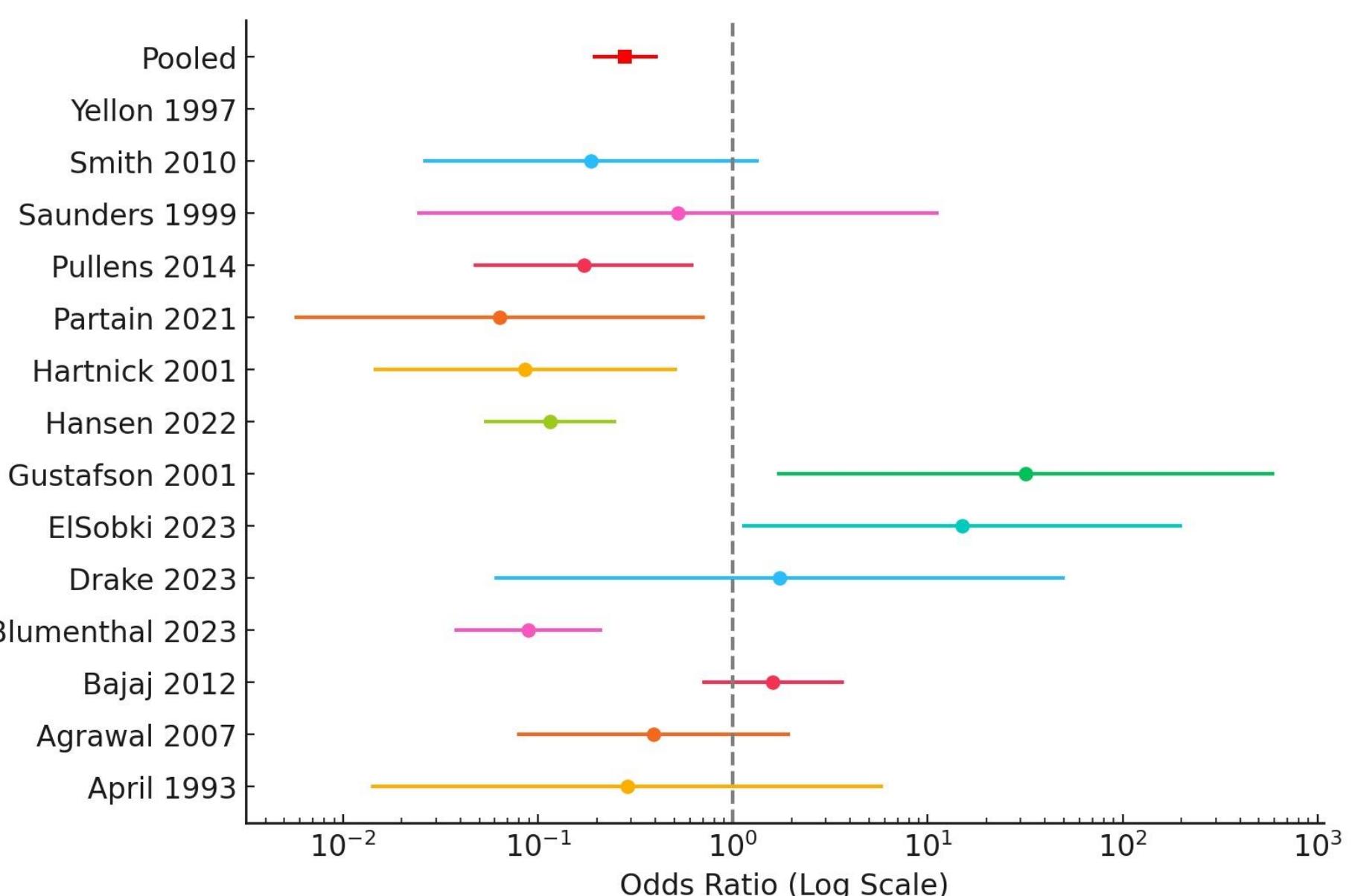


Figure 2. Metanalysis: Odds Ratio of Decannulation in DSLTR Compared to SSLTR.

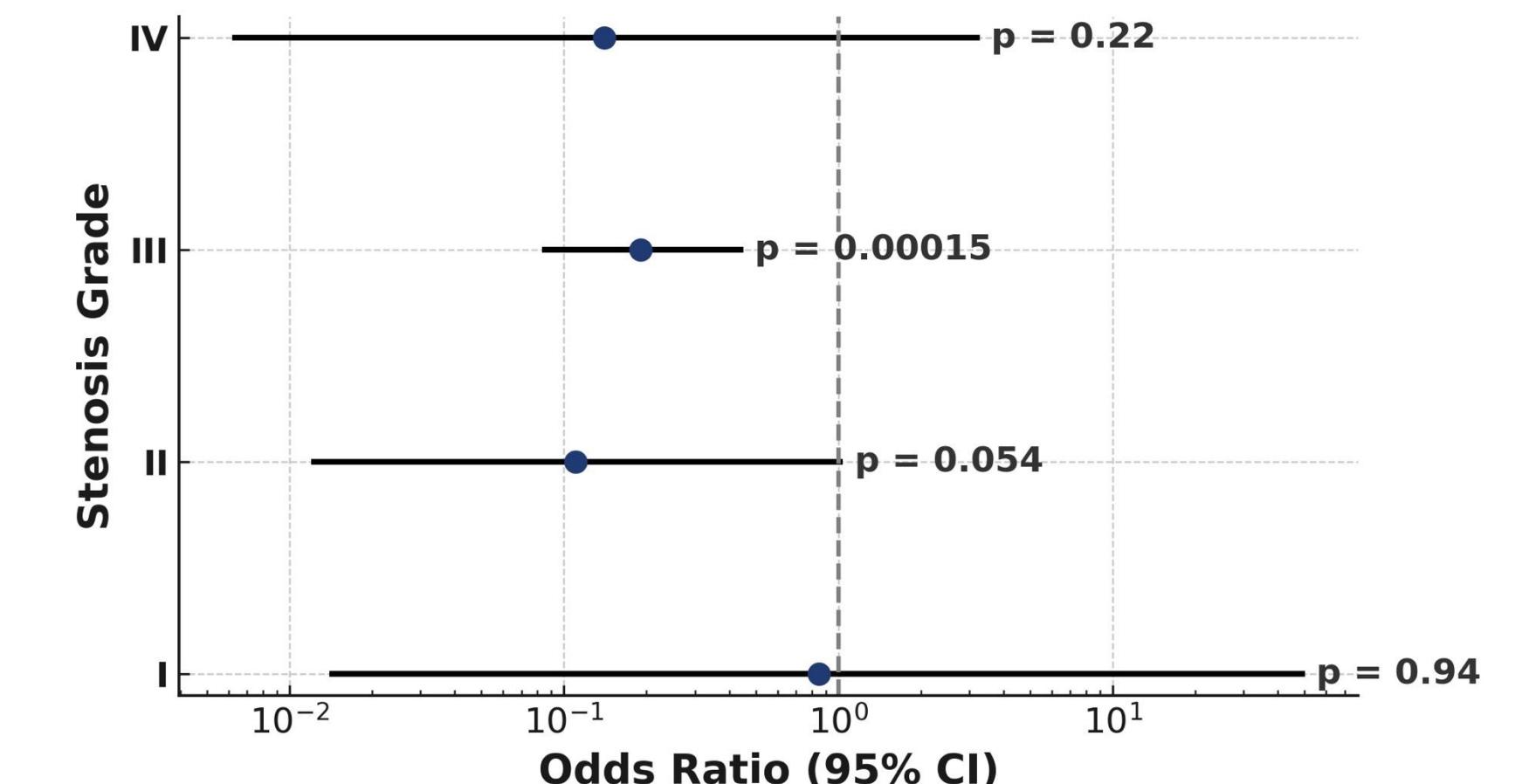
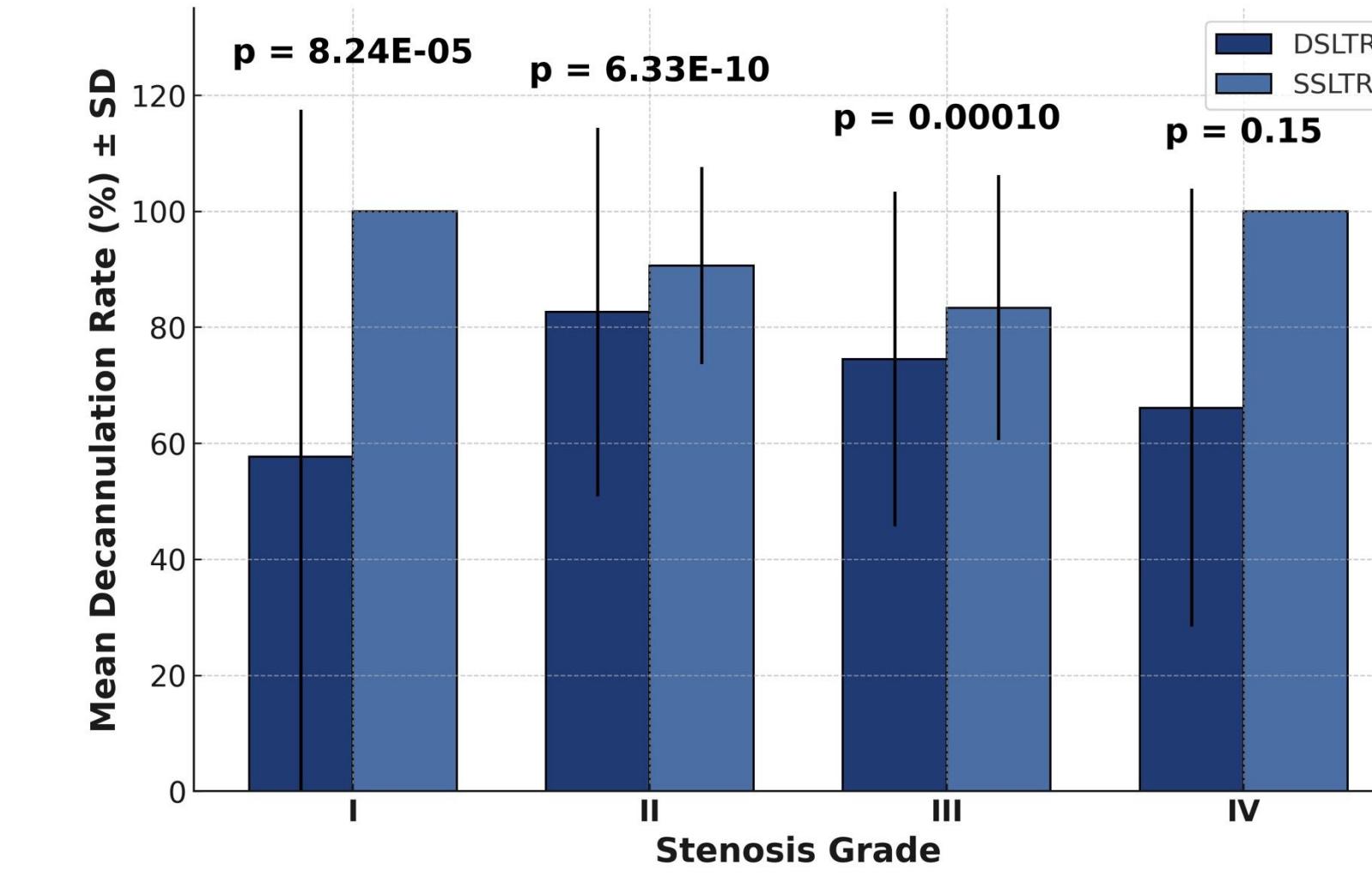


Figure 3. Odds Ratio of Decannulation in DSLTR Compared to SSLTR Stratified by Stenosis Grade

Results

Indirect Comparison

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

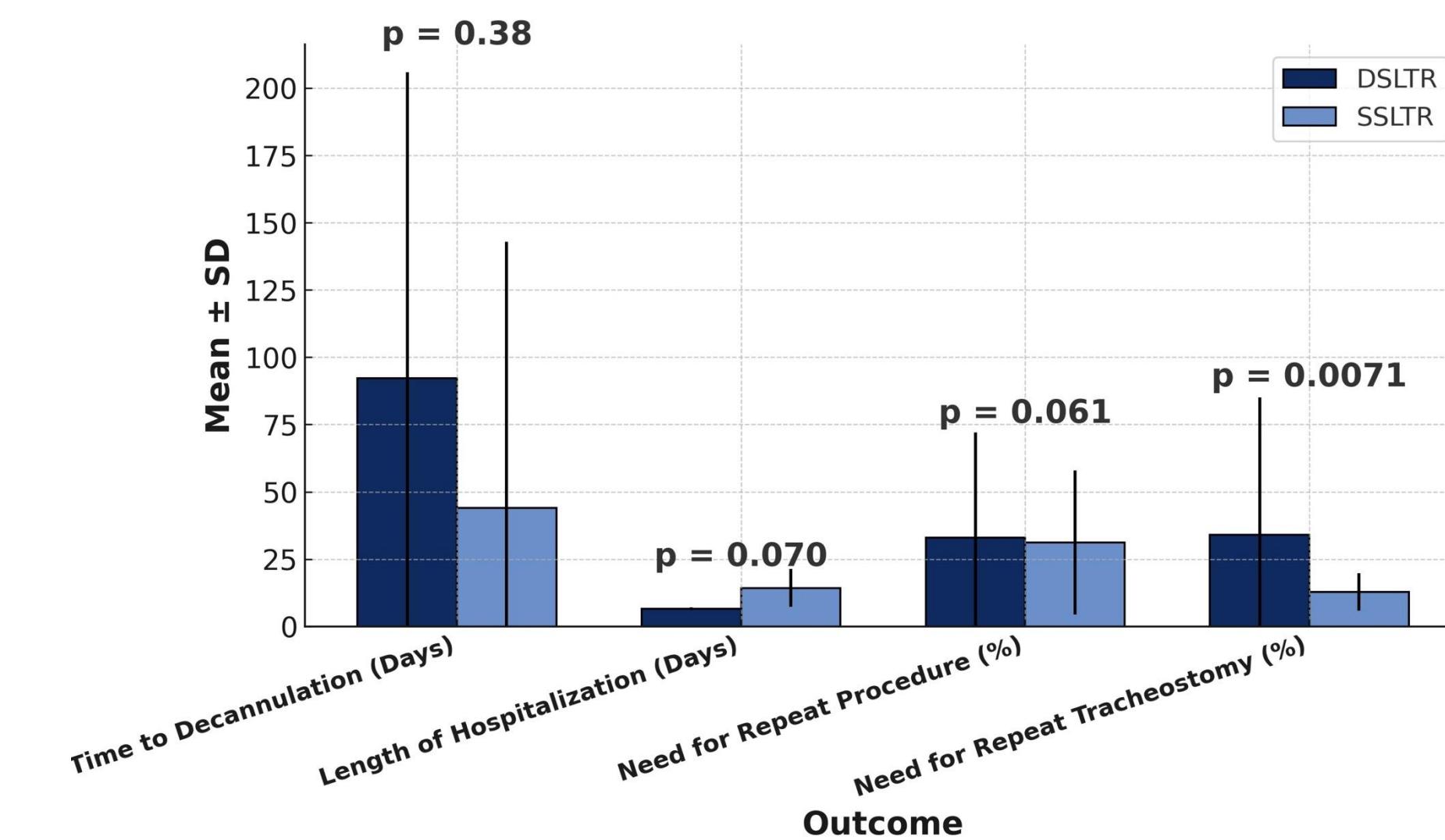


Grade	# of Studies	
	dsLTR	ssLTR
I	2	2
II	8	9
III	9	10
IV	7	2

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, Brilli RJ. 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