Surgical Outcomes in Pediatric Lumbar Spondylolisthesis Following Spinal Fusion by Surgical Approach

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INTRODUCTION: Spondylolisthesis is a common source of low back pain in pediatric patients, most commonly occurring in the lumbar spine. While conservative management is first line treatment for low-grade injury, patients with significant slippage, persistent symptoms, or substantial neurologic deficits may require surgical intervention for neural decompression and spinal fusion. To date, there still remains debate over fixation type, surgical technique, and surgical instrumentation. Current literature primarily consists of single-center studies with small sample sizes given the infrequency of surgical management. The primary outcome of this study was to utilize a national insurance database to generate a large-scale assessment of reoperation rates in pediatric patients with spondylolisthesis undergoing operative repair. The secondary outcomes were to assess trends in surgical approaches, compare patient demographics, and evaluate the use of intraoperative technologies.
METHODS: The nationwide insurance claims database, PearlDiver, was queried for patients under 21 years old diagnosed with spondylolisthesis over a 10-year period from January 2010 – April 2021. Trends in surgical technique were assessed from 2010 to 2020. Three cohorts were created based on surgical approach: anterior lumbar interbody fusion (Anterior), anterior lumbar interbody fusion with posterior instrumentation (Combined), and transforaminal or posterior lumbar interbody fusion (Posterior). Cohorts were then compared using demographic data, 90-day readmission rate, 90-day complication rate, and reoperation rate at 2- and 5-years from the index surgery. Continuous and categorical variables were measured with one-way ANOVA and Chi-squared analyses, respectively. Relationships among clinical outcomes and complications were compared using multivariant logistic regression. Kaplan-Meier curves were used to estimate 2- and 5-year revision-free survival rates.
RESULTS SECTION: A total of 447 (1.3%) patients with spondylolisthesis met inclusion criteria, of whom 97 (20.3%) underwent Anterior, 77 (16.1%) underwent Combined, and 303 (63.5%) underwent Posterior. The incidence of surgical management and type of surgical approach by year remained stable between 2010 and 2020 (**Figure 1**), while the incidence of surgical management was found to increase with age (0.9% in 12-year-olds to 2.4% in 20-year-olds). Diagnosis of Spondylolisthesis was comparable between female and male patients (54.4% vs. 46.6%), however more females underwent surgical treatment than males (63.3% vs. 36.7%, p<.001). The type of surgical approach used did not differ by geographic region (p=.25). Despite 15.3% of patients having an all-cause 90-day readmission, there were low rates of complications within this period (**Table 1**). Rates of pseudoarthrosis (6.3%) did not vary by approach. Revision rates were significantly higher in the Posterior and Combined approaches compared to Anterior with an overall revision rate of 30.5% at 2-years and 35.9% at 5-years. Further analysis revealed patients undergoing Posterior were 2.46 (95% Confidence Interval: 1.81-3.34) times more likely to undergo a revision.
DISCUSSION: Posterior and Combined approaches for pediatric spondylolisthesis were associated with higher revisions rates than previously described. This suggests a need to take a closer at reevaluating the techniques used for pediatric spondylolisthesis. Additionally, further studies should investigate whether methods, such as postoperative bracing, can prevent reoperation. In the meantime, it is perhaps advisable that surgeons have thorough preoperative counseling with patients and their families as well as following these patients postoperatively for a longer period with a possible delay in return-to-sport.
SIGNIFICANCE/CLINICAL RELEVANCE: Spondylolisthesis in the pediatric and adolescent population remains a prevalent diagnosis with debated surgical indications and treatment strategies. The results of our study indicate that surgical management is associated with high revision rates, indicating a need to reevaluate and improve current techniques. Surgeons and patients alike should be aware of the revision rates.

ACKNOWLEDGEMENTS: None

IMAGES AND TABLES:

Figure 1: Percentage of surgical approach utilization by year

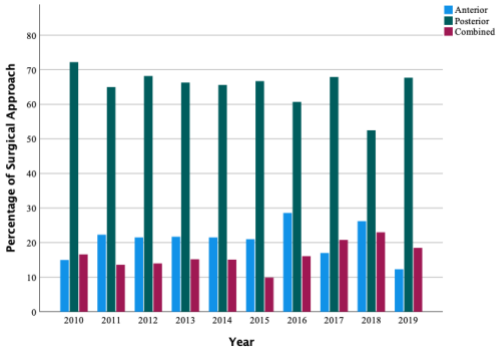

Table 1: 90-day postoperative complications

No. (%)	Spondylolisthesis				
	Anterior n = 97 (20.3%)	Posterior n = 303 (63.5%)	Combined n = 77 (16.1%)	Total n = 477	P
Readmission	15 (15.5)	50 (16.5)	8 (10.4)	73 (15.3)	.41
Neurologic	<11 (<11.3)	0	0	<11 (<2.3)	-
Wound Complication	<11 (<11.3)	<11 (<3.6)	<11 (<14.3)	<11 (<2.3)	.84

*The database interface does not display frequencies of 10 or fewer patients for patient privacy reasons. These instances are represented by "<11" in our data table.