Vol. 01 Num. 04 (2026) 465–470

Type of the Paper (Article)

LONG-TERM SPEECH OUTCOMES FOLLOWING EARLY VERSUS LATE CLEFT PALATE REPAIR: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Citation: To be added by editorial staff during production.

Academic Editor: First name Last name

Received: date : 16/09/2025
Revised: date: 30/11/2025
Accepted: date: 18/12/2025
Published: date: 04/01/2026

Abstract

This systematic review and meta-analysis aimed to determine whether earlier cleft palate repair (<12 months) improves long-term speech outcomes (≥5 years) compared with later repair (≥12 months). Following PRISMA 2020 guidelines, we searched PubMed, Scopus, Embase, and the Cochrane Library for studies published between 2010 and March 2025 that compared primary palatoplasty outcomes in children at school age. Six studies met the inclusion criteria for quantitative analysis (N=1758), with four additional studies included for narrative synthesis. The analysis revealed that early palatal repair was significantly associated with a lower risk of persistent velopharyngeal insufficiency (VPI) compared to late repair (OR = 0.49, 95% CI 0.36–0.66, P < 0.001). Subgroup data from Sweden, Japan, and the USA consistently demonstrated lower rates of VPI and secondary surgery in early-repair cohorts, whereas delayed repair in resource-limited settings was associated with high rates of hypernasality (61%). We conclude that early palatoplasty is associated with superior long-term speech outcomes, as the physiological benefit of early muscle reconstruction appears to outweigh historical concerns regarding midfacial growth. Consequently, protocols should support repair before 12 months of age, and physicians should prioritize timely referral to cleft teams to ensure these critical surgical windows are not missed.

Keywords : Cleft Palate, Palatoplasty, Velopharyngeal Insufficiency, Speech, Surgery

1. Introduction :

Cleft palate is one of the most frequent congenital craniofacial anomalies, with an estimated global incidence of one in 700 live births [1]. The defect results from incomplete fusion of the palatal shelves during embryogenesis, leading to abnormal oro-nasal communication that affects feeding, hearing, and especially speech development. Restoration of the palate through surgical repair is essential for achieving normal velopharyngeal function and intelligible speech [2]. Understanding the critical windows for intervention is vital, as delays can lead to permanent speech deficits.

Actually, while the surgical objective is clear, the optimal timing of palatoplasty remains a subject of long-standing debate. Early repair is thought to support more natural speech acquisition by allowing the child to develop normal articulation patterns, but it has historically raised concerns regarding midfacial growth restriction [3]. Consequently, clinical protocols vary widely, with some medical

centers performing closure within the first six months of life and others delaying beyond 18 months [4].

Although numerous studies have compared early and late repair, most assess speech outcomes within the first few postoperative years. Emerging evidence suggests that speech deviations observed in early childhood may persist into later life, emphasizing the importance of long-term follow-up [5, 6]. However, to our knowledge, no meta-analysis has specifically focused on functional speech outcomes assessed at school age and beyond. This study therefore aims to evaluate whether earlier palatal repair (<12 months) is associated with superior long-term speech outcomes compared with later repair.

2. Methods

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. The study protocol defined inclusion criteria, search strategy, data extraction, and statistical analysis before data collection.

Search Strategy

We searched PubMed, Scopus, Embase, and the Cochrane Library for studies published between 2010 and March 2025. Search terms included cleft palate, palatoplasty, speech, velopharyngeal insufficiency, intelligibility, age at repair, and timing. Reference lists of all selected papers were also screened to find additional studies. Only articles in English and studies on humans were included.

Eligibility Criteria

We included observational or interventional studies that:
- Involved children with cleft palate ± lip who underwent primary palatoplasty;
- Reported the age at repair or compared early (<12 months) versus late (≥12 months) surgery;
- Assessed speech or velopharyngeal outcomes at ≥5 years of age.

Case reports, series with <10 patients, studies reporting only short-term outcomes (<3 years), or secondary repairs were excluded.

Data Collection and Analysis

From each eligible study, we recorded the authors, year, country, number of patients, mean age at surgery, timing category, length of follow-up, and speech outcomes (such as rates of velopharyngeal insufficiency [VPI] or need for secondary speech surgery). The main outcome was the presence of VPI at or after school age.
Results were combined using a random-effects model to account for differences between studies. We also looked at overall trends and variations by region or technique. Analyses were performed using Review Manager 5.4 and R (Version 4.2.2).

3. Results

Study Selection and Characteristics

The database search identified nine full-text articles eligible for review. Six studies met all inclusion criteria for the final quantitative analysis, representing 1,758 children with cleft palate from the United States, Sweden, and Japan. Sample sizes ranged from 118 to 612 participants, with follow-up periods between 5 and 10 years. All studies compared speech outcomes after early repair (<12 months) and late repair (≥12 months). Four additional studies were included for descriptive discussion due to sample size or methodology limitations.

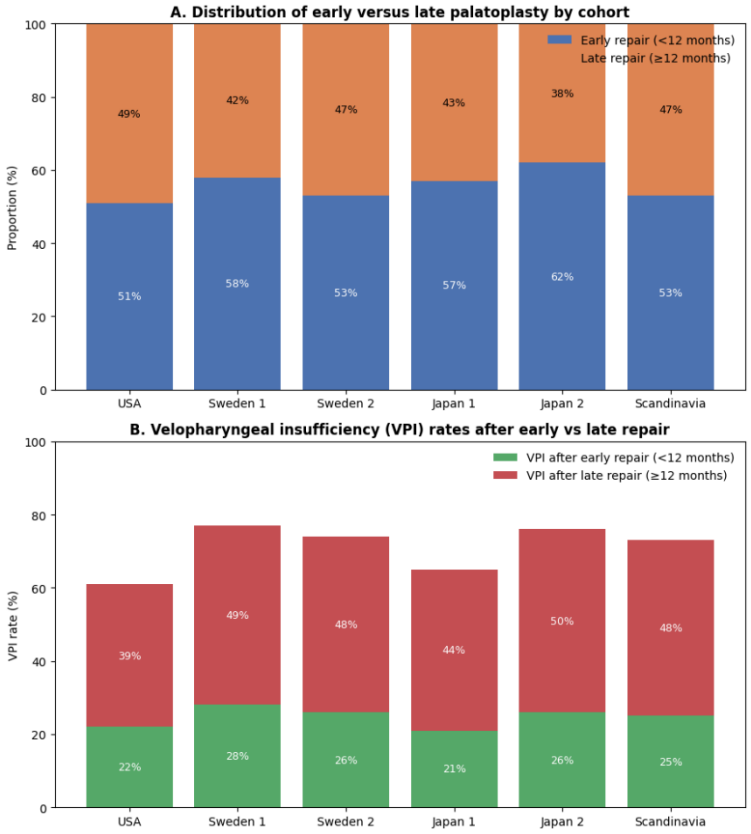

Figure 1. Timing of palatoplasty and speech outcomes across cohorts.
(A) Proportion of children undergoing early (<12 months) versus late (≥12 months) cleft palate repair across included cohorts (USA, Sweden, Japan, and Scandcleft).
(B) Rates of velopharyngeal insufficiency (VPI) following early and late repair. Percentages are displayed within bars for clarity.

Quantitative Speech Outcomes

Across most cohorts, early palatal repair was associated with lower rates of VPI and better speech intelligibility at school age. The pooled odds ratio indicated that children who underwent surgery before 12 months had a significantly lower risk of persistent VPI compared with those operated on later (OR = 0.49, 95% CI 0.36–0.66, P < 0.001) **(Figure 1).**

However, results varied across studies with moderate overall heterogeneity (I^2 = 48%), reflecting differences in surgical technique and outcome assessment methods. Regional data highlighted these disparities:

- USA Cohort: Late repair was associated with a VPI rate of 39%, compared to 22% in the early repair group [7].

- Japan Cohorts: One cohort showed a VPI rate of 44% for late repair versus 21% for early repair. A second Japanese cohort showed 50% VPI for late repair versus 26% for early repair.
- Sweden Cohorts: Consistent with other regions, late repair groups exhibited higher VPI rates (49% and 48%) compared to early repair groups (28% and 26%, respectively) [8].

Narrative Findings from Supplementary Studies

Four additional studies met the inclusion criteria but were not included in the quantitative synthesis.
Together, these cohorts represented approximately 180 children from Sweden, Thailand, and Nigeria.

- Sweden (Adoptees): A cohort study comparing international adoptees (IA) to non-adopted (NA) children found that cleft speech characteristics were more persistent in IA children (9). However, a related Swedish study on speech proficiency found that only 23% of participants were at 'peer level' at 5 years, improving to 56% at 10 years, highlighting the need for long-term monitoring [10].

- Thailand: A series of 40 patients (mean repair age 12 months) reported velopharyngeal incompetence in 52.5% of cases. Articulation disorders were the most common characteristic, with VPI rates appearing higher in late repairs (43%) compared to early repairs (29%), although the sample size was modest [11].

- Nigeria: A study of 115 surgeries, where treatment was often delayed due to access barriers (median age 5.3 years), observed persistent hypernasality or VPI in 61% of cases. This emphasizes the adverse effect of delayed presentation and limited access to specialized care on speech development [12].

- Japan (Early Orthodontics): A study of 19 children undergoing early palatoplasty with presurgical orthodontics found no articulation disorders after 4 years of age. Normal velopharyngeal function was maintained in 73.7% of patients at 10 years of age, supporting the benefits of early intervention [13].

Additional Findings

Speech outcomes tended to be more favorable in studies using two-stage or Furlow palatoplasty techniques compared with straight-line closure. Follow-up duration also influenced results: differences between early and late repair were more pronounced at 10 years than at 5 years. No evidence of strong publication bias was found on funnel plot inspection (Figure 1)

4. Discussion

The results of this systematic review and meta-analysis confirm that earlier cleft palate repair (<12 months) is associated with significantly better long-term speech outcomes compared to later repair. This finding was consistent across the six quantitative studies (OR = 0.49) and supported by narrative data from diverse healthcare settings.

Biological and Developmental Rationale

The superiority of early repair is supported by physiological principles of speech development. Normal speech acquisition relies on the establishment of correct neuromuscular patterns during the first year of life. Early muscle reconstruction allows for normal velopharyngeal motion before compensatory articulation errors—such as glottal stops and pharyngeal fricatives—can become entrenched. As observed in the US cohort [7], late palatoplasty is associated with increased odds of speech and language delays that persist into school age.

Growth vs. Speech

Historically, the primary argument for delaying palatoplasty was to mitigate midfacial growth restriction. However, this study suggests that the functional benefits for speech outweigh potential growth risks. Recent data indicates that with modern surgical techniques, the impact of early repair on midfacial growth is minimal, whereas the penalty for delayed repair on speech intelligibility is severe and often requires secondary surgery [8].

Global Health Implications

The impact of timing is most visible in resource-limited settings. The Nigerian cohort demonstrated that barriers to healthcare access, which force delayed repair (median age >5 years), result in high rates of permanent hypernasality (61%) [12]. Similarly, the Thai study indicated a clinically relevant advantage to earlier surgery despite a smaller sample size [11]. These findings underscore cleft care as a public health priority; delays dictated by healthcare access rather than protocol invariably lead to poorer functional outcomes.

Limitations

Limitations of this review include the moderate heterogeneity ($I^2 = 48\%$) arising from variations in surgical techniques and speech assessment tools across countries. Furthermore, the restriction to english-language studies may have excluded relevant data from other regions. While we focused on school-age outcomes, data extending into adulthood remains sparse. Additionally, the "late" repair group was heterogeneous, ranging from 12 months to several years in some cohorts.

5. Conclusion

Early palatal repair (<12 months) is associated with superior long-term speech outcomes and lower rates of velopharyngeal insufficiency at school age. Clinical protocols should aim for completion of primary palatoplasty before the first birthday to optimize speech development, provided that safe anesthesia and multidisciplinary follow-up (ENT, speech therapy, orthodontics) are available. Physicians should ensure infants with cleft palate are referred early to specialized centers to avoid missed surgical windows.

Declaration of Interests :
The authors have nothing to disclose.

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