The combined role of Speech Therapy and Audiologic-Phoniatric assessment in enhancing speech outcomes for patients with Cleft Palate

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Abstract: Patients with craniofacial malformations, and in particular with cleft lip and palate, require audiological and phoniatrics assessment. This approach is mandatory, as malformative conditions may affect hearing through conductive or sensorineural hearing losses, related to craniofacial malformations or syndromic conditions. Swallowing impairments may also be present, leading to nasal regurgitation, penetration, or aspiration. Moreover, vocal effort can be detected in this population, due to patients' compensation need for nasal air escape. This condition results in kissing nodules or a hyperkinetic vocal pattern. Analysing speech, cleft palate surgery restores anatomical integrity, but postoperative speech outcomes often vary widely.

In order to investigate speech performances, a retrospective study was conducted on 100 patients treated for cleft palate at the Phoniatric Clinic of Città della Salute e della Scienza Hospital, Turin. A three-year dataset was analysed, comparing phonemic tests before and after speech therapy. Patients were classified by severity of the cleft (mild, moderate, severe). Statistical analysis included Shapiro-Wilk, Wilcoxon signed-rank test, Kruskal-Wallis test, and linear and multiple regression models.

Speech therapy significantly improved speech disorder scores (Wilcoxon $p < 0.001$). The greatest benefit was found in moderately impaired patients; severe cases showed limited progress. Regression analyses indicated that the number of therapy hours alone did not directly predict improvement, suggesting other influential factors such as surgical outcome and age.

Speech therapy is fundamental in postoperative cleft palate rehabilitation. Tailored approaches are required to maximize outcomes in patients with severe deficits.

Keywords: cleft palate, speech therapy, phoniatrics, rehabilitation, speech disorders, velopharyngeal closure, nasoendoscopy, orthodontic management

Introduction

Craniofacial malformations, including cleft lip and palate (CLP), are considered among the most common congenital anomalies, with a global prevalence of approximately 1 in 700 live births (Allori et al, 2017). These conditions may compromise the anatomical and physiological functions of the oral cavity, negatively affecting swallowing, breathing, phonation and speech (Alois et al, 2020). Specifically, speech may be severely impaired due to velopharyngeal insufficiency, maladaptive compensatory mechanisms and acoustic alterations (Allori et al, 2015, Alois et al, 2020).

Consequently, early surgical intervention is essential to correct anatomical defects, although it does not always guarantee complete restoration of speech and phonatory function (Phalke et al, 2024). As a matter of fact, even after surgery, up to 30–40% of patients continue to present speech disorders

impaction on speech intelligibility and social communication (Blum et al, 2024). On this regard, studies have demonstrated that early and targeted speech therapy can significantly improve speech quality and reduce articulatory compensations (Lane et al, 2022).

This study aims to evaluate the effectiveness of postoperative speech therapy in the rehabilitation of speech in patients who have undergone cleft palate surgery, specifically analysing whether patients who follow a structured speech therapy program achieve significantly greater improvements than those who do not receive any treatment.

Materials and Methods

A retrospective analysis was conducted on a cohort of 100 patients diagnosed with cleft palate, admitted to the Phoniatric Clinic of Città della Salute e della Scienza Hospital, Turin. Patients were included if they had participated consistently in a multidisciplinary follow-up protocol, including speech therapy, orthodontic evaluations, and phoniatric assessments**.** The phoniatric assessment included: (1) fibrolaryngoscopic examination, (2) Nasopharyngoscopic evaluation with fiber optics, (3) sonogram and spoken voice analysis using the MDVP voice analysis software to check for the presence of a harmonic spectrum, voice breaks, maximum phonation time, background noise and vocal onset, (4) audiometric and impedance tests. Assessment of dental class, degree of expansion of the hard palate, and swallowing was also performed. Patients were categorized according to cleft type (Allori et al, 2017). Speech outcomes were evaluated both pre- and post-therapy through phoneme production analysis obtained with "Schindler's repetition test" (Tresoldi et al, 2015).

Statistical analysis

Normality was assessed using the Shapiro–Wilk test. Due to the non-normal distribution of the post-treatment data, the Wilcoxon signed-rank test and Kruskal–Wallis test were applied for pre–post and group comparisons, respectively. Spearman's correlation and multiple regression analyses were used to explore associations between variables.

Results

Out of the 100 initial cases, 22 patients fully completed the planned treatment and follow-up protocol. Reasons for non-completion included delayed referral to specialized care, international adoption from countries with differing healthcare systems, poor patient or family compliance, family relocation, socioeconomic limitations, lost to follow up during COVID-19 pandemic.

Patients presented with unilateral cleft lip and palate accounted for the majority of cases (59.09%), followed by unilateral cleft palate only (22.73%), bilateral cleft lip and palate (9.09%), bilateral cleft lip only (4.55%), and unilateral cleft lip only (4.55%).

Post-therapy outcomes showed a statistically significant improvement in speech articulation, as evidenced by the Wilcoxon signed-rank test ($p = 0.00019$). However, the Kruskal-Wallis test revealed no significant differences in post-therapy outcomes across the different surgical cleft categories ($p = 0.48$), suggesting that the type of cleft alone did not substantially influence the degree of phonemic improvement.

Furthermore, linear regression analysis showed that the number of hours dedicated to speech therapy accounted for approximately 52.6% of the variance in phoneme improvement ($R^2 = 0.526$). Interestingly, the regression slope was negative (-0.0136), indicating that while therapy hours were predictive of improvement, a higher number of hours was paradoxically associated with diminishing returns. This finding may reflect confounding factors such as increased therapy needs for more severe cases or variability in individual response to therapy.

To further elucidate the impact of additional variables, multiple regression analysis was performed. When patient age and pure-tone average (PTA) were included as covariates, the explanatory power of the model improved substantially ($R^2 = 0.619$). In this model, patient age demonstrated a significant positive association with phonemic improvement, suggesting that older patients may benefit more effectively from structured speech therapy, possibly due to greater cognitive maturity and compliance. In contrast, PTA exerted minimal influence, indicating that mild hear-

ing impairment within this cohort did not substantially affect therapy outcomes.

Quantitatively, the mean number of impaired phonemes decreased markedly from 7.23 (SD ±1.75) prior to intervention to 1.82 (SD ±1.03) following completion of the therapy program. A paired t-test confirmed the statistical significance of this reduction ($p < 0.0001$). This substantial improvement emphasizes the critical role of targeted speech therapy in the comprehensive management of patients with cleft palate anomalies.

Overall, these results corroborate existing evidence highlighting the necessity of speech therapy as an integral component of post-surgical rehabilitation for individuals with cleft lip and/or palate. The findings align with the conclusions of Allori et al. (2017) and are further supported by more recent contributions (Alois et al., 2020), reinforcing the consensus that interdisciplinary care—combining surgical correction with sustained speech therapy—is indispensable for optimizing functional speech outcomes and enhancing the quality of life for this patient population.

Discussion

The significant difference between patients who received speech therapy and those who did not highlights the central role of structured rehabilitation in optimizing surgical outcomes (Lane et al, 2022).

Despite advances in surgical techniques, altered speech persists in a significant proportion of patients due to residual velopharyngeal insufficiency, maladaptive articulatory compensations, and morpho-functional alterations of the oral cavity (Deot et al, 2024). This underscores the need for a multidisciplinary approach integrating surgery, speech therapy, phoniatrics and orthodontics. In patients with a markedly arched palate and severe malocclusions, phonetic disorders are partly attributable to altered articulation sites (Lee et al, 2015). In these cases, speech therapy alone is not sufficient and must be combined with orthodontic treatment to modify the articulation zones and facilitate a more accurate phonation.

Another relevant aspect concerns the interindividual variability in response to speech therapy. Previous studies suggest that factors such as the severity of velopharyngeal insufficiency, age at the start of rehabilitation, and therapy intensity significantly influence outcomes (Sales et al, 2021). Our data support this evidence, showing that patients with moderate disorders gain the greatest benefit, while those with severe deficits require more complex rehabilitation strategies.

Finally, although our study confirmed the key role of speech therapy, the question of the interaction between speech therapy and other factors -such as auditory perception, neural plasticity, and structural changes induced by surgery- remains open. Future research should investigate these aspects to optimize rehabilitation protocols and personalize treatment.

Variability in patient response highlights the need for individualized, multidisciplinary protocols combining surgery, orthodontics, and speech therapy. Persistent velopharyngeal insufficiency requires careful phoniatric assessment, potentially indicating secondary surgery.

Conclusions

This study underscores the pivotal role of structured postoperative speech therapy in enhancing speech outcomes for patients with cleft palate, demonstrating significant improvements in phoneme articulation and overall speech intelligibility. The findings reveal that therapy hours and patient age are influential factors, with older children benefiting more markedly from intervention. Despite surgical correction, residual speech impairments remain common, emphasizing the importance of an interdisciplinary approach that integrates surgical, orthodontic, and rehabilitative strategies. The variability in individual responses highlights the need for personalized treatment plans tailored to the severity of the disorder and patient-specific factors. Early and targeted speech therapy not only improves phonemic accuracy but also contributes to better social integration and quality of life. Future research should focus on refining rehabilitation protocols, exploring neural and structural factors influencing therapy efficacy, and developing personalized interventions to optimize long-term functional outcomes in this population.

Limits of the study

The retrospective design of this study limits the ability to establish causality and control for all confounding variables. Moreover, the small sample size of only 22 patients who completed the full protocol reduces the statistical power and the generalizability of the results. Variability in therapy adherence and the lack of standardized therapy intensity across patients could influence outcomes. Additionally, the study did not account for psychosocial factors or detailed neurocognitive assessments that might impact therapy responsiveness. Future prospective studies with larger, more diverse cohorts are necessary to validate these findings and develop tailored treatment algorithms.

Conflict of Interest

The authors declare that there are no actual or potential conflicts of interest regarding the research, authorship, and publication of this article.

Ethics Statement

Informed consent was obtained from all participants or their guardians.

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