



The Estimation of Resonance in Individuals with Repaired Cleft Palate by Using Temple Street Scale

Arooba Asmat^{1*}, Atia-ur-Rehman¹, Munawar Ahmed Malik², Arshad Mehmood¹ and Insbat Asmat²

¹ University of Lahore, Lahore, Pakistan

² University of Punjab, Lahore, Pakistan

*Corresponding e-mail: arooba.dev@gmail.com

ABSTRACT

The objective was to estimate resonance in individuals with repaired cleft-palate by using Temple-Street-Scale by cross-sectional sampling study. Data was collected from Clapp General Hospital, Lahore. This study was conducted by modifying Temple-Street-Scale after consent focusing on nasality, nasal emission. Total of 60 individuals with repaired cleft-palate, age ranging from 8-15 years with evidence of resonance disorders was recruited in the study. Results showed that the percentage of ages of an individual with repaired cleft palate was the high rate at 12 years (22%) which was high in males. The percentage of hyper-nasality (90%) at mild-moderate (26.7) level was higher than other resonance problems with consistency of 67%. The frequency of nasal emission was 83% with the consistency of 63%. The frequency was notable among individuals with repaired cleft-palate, having different levels, consistency, and frequency. So it was concluded that individuals with cleft-palate must follow proper speech-therapy sessions after repairing cleft for their better prognosis.

Keywords: Cleft palate, Nasality, Resonance, Temple-street scale

INTRODUCTION

The splits or any separation either in the palate (roof of the mouth) or in the upper lip or sometimes in both of them is a cleft. Mainly, a cleft lip/palate occurs when the separate areas of the face are not joined properly in the mother's womb during the development of baby [1]. During the fifth (5th) till ninth (9th) weeks of maternal pregnancy period; development of the child's face and superior lip takes place [2]. The cleft-lip and the cleft-palate are the birth problem that happens when the child is during its developmental period in the uterus of the mother. The upper lip and roof of the child's mouth are normally formed when the tissues (soft muscles) and the bones of the mouth, upper jaw, and nose of the baby come together at the sixth (6th) to tenth (10th) week of mother's pregnancy. During the development of the fetus when the tissue in its mouth and its palate are unable to combine together, the infant can be born with the cleft-lip or the cleft-palate and/or with both [3].

Reverberation (resonance) is characterized as "the route by which wind stream for the speech generation is formed when it is gone through the mouth and the nose (oral and nasal) holes." During the speech generation, the principle objective is great wind stream through the mouth for all the speech sounds aside from m/n, and n/g [4].

To coordinate the air through the mouth, back piece of the top of the mouth i.e. palate is lifted upwards and is moved towards the back of the throat. This development shut the velopharyngeal valve which is the opening between the mouth and the nose. If there should be an occurrence of an opening, a conflicting development or potentially any obstacle influencing the route by which air courses through the nasal or oral pit; a resonance disorder can happen [5].

Hyper-nasality occurs when there is too much sound resonating in the nasal cavity during speech usually due to velopharyngeal insufficiency/incompetence or an oro-nasal fistula which is most perceptible on vowels, because these sounds are voiced, relatively long in duration, and produced by altering oral resonance. The voiced oral consonants become nasalized (m/b, n/d, ŋ/g) which is an obligatory distortion and other consonants may be substituted by nasals

(i.e., n/s), which is a compensatory production. The severity depends on the size of the opening, the etiology, and even articulation [6].

Hypo-nasality occurs when there is not enough nasal resonance on nasal sounds (m, n, ŋ) which is due to nasal cavity obstruction (nasal congestion, enlarged adenoids, deviated septum, stenotic nares, nasal polyps, or maxillary retrusion which restricts pharyngeal cavity space), nasal phonemes sound similar to their oral cognates (b/m, d/n, g/ŋ) and also noted on vowels. The intermittent hypo-nasality can be due to timing errors in lowering the velum for the production of nasal sounds [7].

Cul-de-Sac resonance occurs when the sound resonates in a cavity (oral, pharyngeal, or nasal cavity), but cannot get out due to obstruction at the cavity's exit point. The voice sounds muffled and is low in volume [8]. Cul-de-Sac has 3 types: oral, nasal and pharyngeal Cul-de-Sac resonance.

- Oral Cul-de-Sac resonance: Sound is mostly in the oral cavity which is due to small oral cavity size or small mouth opening (micro-stomia). The parents describe the speech as “mumbling” (which is not opening the mouth very much)
- Nasal Cul-de-Sac resonance: Sound is mostly in the nasal cavity which is due to VPI and nasal obstruction (deviated septum, stenotic nares, etc.). It is common with cleft palate and craniofacial anomalies
- Pharyngeal Cul-de-Sac resonance: Sound is mostly in the pharynx. It is common in patients with very large tonsils, which block sound transmission to the oral cavity. It has been called “potato-in-the-mouth” speech (enlarged tonsils are the “potatoes”)
- Mixed nasality: This occurs when there is hyper-nasality and/or nasal air emission on oral consonants, and hypo-nasality on nasal consonants. Its cause includes any form of nasopharyngeal obstruction (such as enlarged adenoids) and velopharyngeal dysfunction, or apraxia [9]

The most effective tool for the children/individuals having errors in speech or resonance disorder is “speech therapy”. The major goal for therapy is to guide and help the child to learn the correct use of his/her lips, tongue and the velopharyngeal valve [10]. The SLP and ENT cooperate with the guardians and the youngster to choose if the kid may profit by the surgical intercessions to improve [11].

A Speech-Language Pathologist (SLP) completes an underlying evaluation after the surgery that is trailed by facilitating appraisal when a youngster is 3 years of age. After the appraisal, the SLP uncovers issues with the child's elocution or utilization of the speech, the SLP instruct the guardians and/or the child numerous speech practices that can help in child's speech advancement. SLP can likewise convey many coordinated activities with the youngster [12].

The SLP works with the youngster for whatever length of time that he/she needs help, in spite of the fact that the treatment isn't required following 7-years old. As a rule, assist surgery should be possible to help in enhancing the child's speech i.e. ‘Pharyngeal fold surgery’ [13].

Temple-Street Scale is an enlightening scale for the appraisal of nasality and the nasal wind current that was tried for the legitimacy, agreeableness, and reliability. This approach surveys nasality and nasal wind stream mistakes, utilizing itemized meanings of terms and clear meanings of scalar focuses. The engaging hyper-nasality and hypo-nasality scales have in this manner been embraced in the Cleft Audit Protocol for Speech-Augmented. The TSS is isolated into 2 segments: 1. Nasality 2. Nasal airflow mistakes. It incorporates the parameters of hypernasality, hypo-nasality, parkway reverberation (Cul-de-Sac), nasal emanation, nasal turbulence, and nasal fricatives. Every parameter was appraised in the wake of tuning into and translating a standard discourse test [14].

Review of the Literature

Sinko, et al., surveyed the discerning nasality in a companion investigation of 36 patients experienced childhood in eastern Austria with a repaired congenital fissure. The evaluation was sorted in 4 grades i.e. 0=ordinary, 1=mellow, 2=direct, and 3=extreme hyper-nasality. The normal age goal was 8 to 27 years. About 13 members were females with a proportion of 36.1% and the remaining 23 were males with a proportion of 63.9%. About 86.1% were congenital fissure/sense of taste patients. They watched that 22.2% of these patients indicate ordinary nasality while 77.8% of the patients had hyper-nasality. In this manner, the perceptual appraisal of nasality by SLPs remains the best quality

level technique for the conclusion of reverberation issue [15].

Larangeira et al., led an exploration that was a review comprising of 331 patients with a worked one-sided congenital fissure in lip and palate. The outcome demonstrated that the most noteworthy rates of appearance of hyper-nasality were gotten from perceptual measurements (79%). Lower rates of hypo-nasality were acquired by judges [16].

Hosseiniabad et al., directed a review considered by utilizing the records of patients alluded to Isfahan Cleft Care Team in the vicinity of 2005 and 2009. About 131 patients with a background marked by congenital fissure (with or without congenital fissure) who had experienced essential palate repair and were no less than 4 years old at the season of the speech assessment were incorporated into this survey. The essential result of this examination was "hyper-nasality". An auxiliary result was the relationship of sexual orientation (gender) and age of the person. Results acquired were: mild hyper-nasality in 15.3% of patients, moderate or serious hyper-nasality in 66.5% of patients. Remaining cases gave ordinary reverberation. There was a fundamentally higher frequency of hyper-nasality in young men than in young ladies ($p < 0.001$) [17].

Prathanee et al., completed a near cross-sectional examination which was performed on 98 worked CLP and 109 non-cleft subjects that matured between 8-12 years of age. Results demonstrated the high prevalence of hyper-nasality and nasal emission [18].

Henningson et al., conceived widespread parameters for the detailing of congenital fissure resonance results: hyper-nasality, hypo-nasality, nasal emanation, nasal turbulence, and consonants generation errors. The results obtained showed the high level of hyper-nasality than hypo-nasality and nasal emission was also found [19].

PATIENTS AND METHODS

The descriptive cross-sectional study design was used to conduct the study and the target population included the individuals with repaired cleft palate. A total of 60 individuals with cleft palate, age ranging from 8 to 15 years were studied. The Temple-Street-Scale was modified and was then used for each individual coming in the Clapp General Hospital that was based on their demographic profile, nasality, and nasal airflow. The data was collected by the researcher from all individuals with repaired cleft-palate without any gender discrimination. Inclusion criteria were individuals with age range from 8-15 years, both male and females with repaired cleft palate and the familial history of speech disorders, cousin marriages of parents. Exclusion criteria were the individuals with evidence of normal resonance, who had undergone pharyngoplasty, hearing loss more than moderate, active upper respiratory tract infections at the time of data collection, known behavioral, sensory or motor problems or any known syndrome, having other speech disorders, behavioral problems, mental retards, intellectual disabilities. The data were analyzed by SPSS version 21.

RESULTS

Results obtained were that the percentage of the ages of individual with repaired cleft palate showed 8 years (16%), 9 years (13%), 10 years (11%), 11 years (16%), 12 years (22%), 13 years (18%), 14 years (4%).

Table 1 Age of individuals with repaired cleft palate

| Age of Individuals | |
|---------------------|-------|
| Mean | 11.18 |
| Standard Deviation | 2.11 |
| Minimum Age (Years) | 8 |
| Maximum Age (Years) | 15 |

The descriptive statistics of age according to which minimum age was 8 years and the maximum age was 15 years. The mean age was 11.28 years and the standard deviation was 2.11 years. Out of 60 individuals with repaired cleft palate 38% were females and 62% were males.

Table 2 showed the percentage of the hyper-nasality present in 54% and absent in 6%. The percentage of hypo-nasality was present in 10% and absent in 50%. The percentage of Cul-de-Sac resonance was lowest among all other resonance disorders i.e. 3% present and 57% absent.

Table 2 The percentage of resonance disorders

| Types | Present | Absent |
|----------------|---------|--------|
| Hyper-nasality | 54% | 6% |
| Hypo-nasality | 10% | 50% |
| Cul-de-Sac | 3% | 57% |

Figure 1 showed the cone charts contain levels of hyper-nasality; mild (13.3%), mild-moderate (26.7%), moderate (18.3%), moderate/severe (15%), severe (16.7%).

■ Mild ■ Mild/Moderate ■ Moderate ■ Moderate/Severe ■ Severe

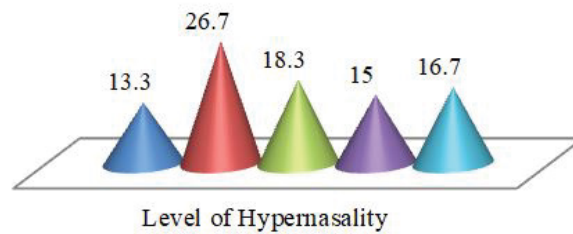


Figure 1 Levels of hyper-nasality

Figure 2 showed the cone charts containing a level of hypo-nasality; mild (10%), moderate (3.3%), severe (3.3%), other (83.3%) have no hypo-nasality. Nature of nasality obtained was 66.7% consistent in hyper-nasality and 85% consistent in hypo-nasality. The nasal emission was frequent in 83.3% and consistent in 63.3%.

■ Mild ■ Moderate ■ Severe

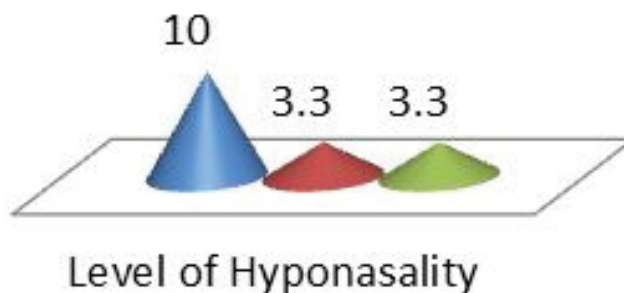


Figure 2 Levels of hyponasality

DISCUSSION

The perceptual discourse appraisal is vital to the assessment of discourse (speech) results related to congenital fissure and velopharyngeal dysfunction. The present study shows that the percentages of the ages of individual with repaired cleft palate were 16%, 13%, 11%, 16%, 22%, 18%, 4% in 8 years, 9 years, 10 years, 11 years, 12 years, 13 years, and 14 years respectively. These results were quite similar to a study conducted by Adeyemi. The variation in the results is due to the environmental, cultural and socio-economic factors [20].

In this study, the ratio of males with cleft palate is higher than females. Our study also confirms that individuals with repaired cleft palate have a higher rate of hyper-nasality than hypo-nasality and Cul-de-Sac resonance which is similar to a study conducted by Elahi, et al., which showed that the ratio of males was higher than the females [21].

In this study, the velopharyngeal dysfunctions are most common in individuals with repaired cleft palate. The levels of hyper-nasality show higher percentage of mild-moderate hyper-nasality that was unacceptable distortion which

was evident on high vowels. The lowest level of hyper-nasality was mild i.e. evident but acceptable. The nature of hyper-nasality was seen consistent in individuals with repaired cleft palate. The same study was conducted by Dailey et al., [22]. In this study, the percentage of hypo-nasality was absent in more individuals with repaired cleft palate. Hypo-nasality was absent in most individuals with repaired cleft palate and the level of hypo-nasality was more at a mild stage which was evident but acceptable. The moderate and severe level was almost equal in all individuals with repaired cleft palate. The nature of hypo-nasality was seen more inconsistent in individuals with repaired cleft palate. These results are near to a similar study conducted by Eshghi et al., [23]. In this study, the ratio of Cul-de-Sac resonance was seen low in individuals with repaired cleft palate with the similarity of results of the study conducted by Hartsfield et al., [24].

The percentage of nasal emission was more frequent and more consistent in individuals with repaired cleft palate. The percentage of nasal turbulence was less frequent and more infrequent in individuals with repaired cleft palate. The nature of nasal emission was less consistent and more inconsistent in individuals with repaired cleft palate. These results show great similarity with a study conducted by Ma et al., [25].

All studies included in this present systematic review contribute to increase the knowledge on resonance disorders in individuals with repaired cleft palate and help to select the criteria to improve the resonance disorders in individuals with repaired cleft palate.

Despite the lack of a standard definition, studies included in this review show that the prevalence of resonance disorders is high among individuals with repaired cleft palate. As the resonance disorders is a complex phenomenon that is expressed in several ways and has different levels of severity, it would be interesting to have more than one standardized case definition, reflecting different stages and severity of the disorder.

CONCLUSION

The frequency of resonance disorders was notable among individuals with repaired cleft palate in our research, having different levels, consistency, and frequency. This frequency of resonance disorders is likely to increase among individuals with repaired cleft palate if there is no proper speech follow-up.

This study concluded that the ratio of resonance problems in individuals with repaired cleft palate was particularly higher in male gender because of age, family history and cousin marriage and the presence of hyper-nasality was higher than other resonance problems. The level of the nasal emission was frequent and consistent in an increased number of individuals. So it must have a proper assessment, diagnosis and intensive speech therapy sessions of individuals with repaired cleft palate.

Due to the short research time period, all factors were not possible to achieve. Given results show that there is an increased ratio of hyper-nasality, nasal airflow in individuals with repaired cleft palate. That proves that there is a great need to create awareness about intensive and proper speech therapy sessions even after various procedures of cleft palate repaired. Study proves SLTs/SLPs should arrange seminars, lectures, etc. to aware people about resonance disorders.

Recommendations

This study recommends that SLP/SLT must:

- Need awareness workshops on success case reports and workshops in order to become skilled at different types of resonance disorders
- Special schools/academies can play an encouraging role in creating awareness about resonance problems
- Need practice all assessment procedures during the study
- Students should learn more and more about the assessment and management of resonance
- More researches are required for the resonance and other velopharyngeal dysfunctions
- Require more researches with different speech and language disorders with different age groups

- Health education programs should be held in order to educate people at different levels of resonance disorders and take precautions
- Study related to resonance should be conducted in discriminate of socio-economic status

DECLARATIONS

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

- [1] Blackburn, Carolyn, Barry Carpenter, and Jo Egerton. *Educating children and young people with fetal alcohol spectrum disorders: constructing personalized pathways to learning*. Routledge, 2012.
- [2] Fehrenbach, Margaret J., and Tracy Popowics. *Illustrated dental embryology, histology, and anatomy*. Elsevier Health Sciences, 2015.
- [3] Siren, Kathleen. "Cleft lip and palate." *Child and Adolescent Communication Disorders: Organic and Neurogenic Bases*, 2014, p. 203.
- [4] Nip, Ignatius. "SLHS 606-Voice, resonance, and fluency disorders." 2015.
- [5] He, Ling, et al. "Automatic evaluation of resonance and articulation disorders in cleft palate speech." *2015 IEEE China Summit and International Conference on Signal and Information Processing, China (SIP)*. IEEE, 2015.
- [6] Williams, Dale F., and Richard K. Adler. "Voice and resonance disorders." *Communication Sciences and Disorders*. Psychology Press, 2017, pp. 213-52.
- [7] Rickheit, Gert, and Hans Strohner, eds. *Handbook of communication competence*. Walter de Gruyter, Vol. 1, 2008.
- [8] Lallh, Amarpreet K., and Anne Putnam Rochet. "The effect of information on listeners' attitudes toward speakers with voice or resonance disorders." *Journal of Speech, Language, and Hearing Research*, Vol. 43, No. 3, 2000, pp. 782-95.
- [9] de Stadler, Marie, and Cheryl Hersh. "Nasometry, videofluoroscopy, and the speech pathologist's evaluation and treatment." *Surgery for Pediatric Velopharyngeal Insufficiency*, Karger Publishers, Vol. 76, 2015, pp. 7-17.
- [10] Kennison, Shelia M. *Introduction to language development*. Sage Publications, 2013.
- [11] Bedwinek, Anne Plummer. *An analysis of needs: School speech-language pathologists and children born with cleft lip/palate*. Union Institute and University, 2007.
- [12] Hansen, Kelly, et al. "Role of the speech-language pathologist, (SLP) in the head and neck cancer team." *Multidisciplinary Care of the Head and Neck Cancer Patient*. Springer Cham, 2018, pp. 31-42.
- [13] Shaye, David, C. Carrie Liu, and Travis T. Tollefson. "Cleft lip and palate: An evidence-based review." *Facial Plastic Surgery Clinics*, Vol. 23, No. 3, 2015, pp. 357-72.
- [14] Howard, Sara, and Anette Lohmander, eds. *Cleft palate speech: assessment and intervention*. John Wiley and Sons, 2011.
- [15] Sinko, Klaus, et al. "Assessment of nasalance and nasality in patients with a repaired cleft palate." *European Archives of Oto-Rhino-Laryngology*, Vol. 274, No. 7, 2017, pp. 2845-54.
- [16] Larangeira, Fabiane Rodrigues, et al. "Speech nasality and nasometry in cleft lip and palate." *Brazilian Journal of Otorhinolaryngology*, Vol. 82, No. 3, 2016, pp. 326-33.
- [17] Hosseinabad, Hedieh Hashemi, et al. "Incidence of velopharyngeal insufficiency and oronasal fistulae after cleft palate repair: A retrospective study of children referred to Isfahan Cleft Care Team between 2005 and 2009." *International Journal of Pediatric Otorhinolaryngology*, Vol. 79, No. 10, 2015, pp. 1722-26.

- [18] Thanawirattananit, Panida, and Sanguansak Thanaviratananich. "Speech, language, voice, resonance and hearing disorders in patients with cleft lip and palate." *Journal of Medical Association Thailand*, Vol. 96, No. 4, 2013, pp. 71-80.
- [19] Henningsson, Gunilla, et al. "Universal parameters for reporting speech outcomes in individuals with cleft palate." *The Cleft Palate-Craniofacial Journal*, Vol. 45, No. 1, 2008, pp. 1-17.
- [20] Adeyemi, Tokunbo Abigail. "Cleft lip and palate care in Nigeria: Current status of orthodontic residents' training in the management of children with cleft lip and palate." *Journal of Craniofacial Surgery*, Vol. 26, No. 4, 2015, pp. 1106-08.
- [21] Elahi, Mohammed Mehboob, et al. "Epidemiology of cleft lip and cleft palate in Pakistan." *Plastic and Reconstructive Surgery*, Vol. 113, No. 6, 2004, pp. 1548-55.
- [22] Dailey, Scott, and Kris Wilson. "Communicating with a cleft palate team: Improving coordination of care across treatment settings." 2015, pp. 35-38.
- [23] Eshghi, Marziye, and David J. Zajac. "Velopharyngeal status of vowels produced with and without hard glottal attack in children with repaired cleft palate." *The Journal of the Acoustical Society of America*, Vol. 139, No. 4, 2016, pp. 2219-20.
- [24] McDonald, Ralph E., David R. Avery, and James K. Hartsfield Jr. "Acquired and developmental disturbances of the teeth and associated oral structures." *McDonald and Avery Dentistry for the Child and Adolescent*, 2010, p. 85.
- [25] Ma, Li, et al. "Velopharyngeal function assessment in patients with cleft palate: Perceptual speech assessment versus nasopharyngoscopy." *Journal of Craniofacial Surgery*, Vol. 24, No. 4, 2013, pp. 1229-31.