Relationship of Perceptual Evaluation for Resonance Disorders to Nasalance Scores in Children with Cleft Palate

Benjamas Prathanee PhD*,
Tawitree Pumnum BSc*, Cholada Seepuaham BSc*

Department of Otorhinolaryngology, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand

Objective: *To determine relationship between screening perceptual assessment for resonance disorders and nasalance scores.*

Material and Method: *Screening perceptual assessment of 115 children with cleft palate with or without lip was performed to determine its relationship to nasalance sores. The perceptual assessment 3-scale (-1: hyponasality; 0: normal; +1: hypernasality) was compared to nasalance scores based on nasometry. To find the weight of Kappa, nasalance scores were converted to a 3-ordinal scale with 3 criteria for cut-off points (-1: nasalance score -1, -1.5 and -2 SD lower than the mean; 0: nasalance score $\pm$ 1 SD, $\pm$ 1.5 and $\pm$ 2 SD of the mean; and +1: nasalance score + 1 SD, + 1.5, and + 2 SD greater than the mean).*

Results: *Correlations between screening perceptual assessment and nasalance scores were good to excellent. The percentage of agreement was good, the Kappa reliability was fair to moderate in passages of a mixture of oral and nasal consonants (My House) and devoid of nasal consonants (Laying Hen). A weak relationship was found for the nasal passage (Winter).*

Conclusion: *The relationship of speech assessments in the present study varied, as it depended on the different variables and analysis. To ensure a strong relationship, further prospective study is needed.*

Keywords: *Perceptual evaluation, Nasalance score, Cleft, Resonance disorders*

Certain speech characteristics are typical of speech of individuals with cleft palate and can usually be identified by subjective perceptual judgments, which is generally accepted and indeed recommended for speech evaluation for clefts because it is a simple, non-invasive, essential procedure for preliminary diagnosis and it agrees with objective measurements (moderate to strong)[1].

Velopharyngeal incompetence is perceived as resonance disorders and a common cleft speech characteristic in children with cleft palate (CP). Resonance disorders are identified perceptually by speech and language pathologists (SLPs) experienced in working with patients with CP. The perceptual reliability among professionals has variability but this improves with experience[2]. In developing countries, where there is a shortage of SLPs and a lack of standard assessment protocol (*e.g.*, Sri Lanka[3,4], Vietnam[5,6], Indonesia[7], Mexico[8,9], India[10], Indonesia[7], Thailand[11,12], Lao PDR[13,14], screening perceptual evaluation for resonance is urgently needed as an outcome measurement.

In the context of diagnosing resonance disorders, an important criterion for establishing the validity of a measurement technique is to determine to what extent these findings agree with the perceptual judgments of velopharyngeal function and oral-nasal resonance for speech. Nasometry is a common objective measurement frequently used instudies of CP speech. It measures acoustic resonance energy and produces nasalance scores. It is the ratio of acoustic nasal energy to acoustic nasal plus acoustic oral energy multiplied by 100. The relationship of nasometry to the perceptual evaluation of resonance in speakers with CP has not been studied extensively. The objective of this study was to determine the relationship between screening perceptual assessment for resonance disorders and nasalance scores using nasometry measurements.

Correspondence to:
Prathanee B, Department of Otolaryngology, Faculty of Medicine, Khon Kaen University, Khon Kaen 40002, Thailand.
Phone: 043-348-396, Fax: 043-202-490
E-mail: bprathanee@gmail.com

Material and Method

Study design

A retrospective cross-sectional study was conducted at the Speech Clinic of Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand

Participants

Children with cleft palate with or without lip (CP $\pm$ L), registered with the project "Smart Smile and Good Speech" between June 2007 and September 2010.

Inclusion criteria

Children with cleft palate CP $\pm$ L.

Exclusion criteria

Children with CP $\pm$ L without data for screening perceptual assessments and/or nasalance scores.

The authors initially included 384 children with CP $\pm$ L but after the exclusions were applied, there were 115 children with CP $\pm$ L in the present study.

Outcomes

The main outcomes of the present study were an ordinal 3-point rating scale (-1 = hyponasality; 0 = normal; +1 = hypernasality) for screening perceptual assessment of resonance disorders and percentages of nasalance scores for finding relationships.

Resonance disorders

Screening perceptual assessment was estimated based on the perception of speech samples comprising nonsense syllables, Thai serial speech with high oral pressure consonants (counting from 1-20 and 40-50) with 4 simple sentences loaded with all of the consonants and 3 nasal sentences, by the principal investigator with 20 years experience in cleft palate.

Speech samples of screening perceptual assessment were

Hypernasality test: - Nonsense syllables: /pʰi pʰi pʰipʰipʰipʰi/

- Connected speech: Counting from 40 to 50 in Thai language,

comprising high oral pressure sounds: /s/ and

Simple sentences: -/mɛ: sa:i mu:ak du tʰee wee/

- /pʰɔ: ʔa:n naŋ sɯ: rɯ:aŋ pet kap ŋu:/
- /nɔŋ len rot fa:i lɛ hun yon/
- /tɕa:n kha:u tɕʰɔn pʰat lom ʔu: bon to:/

Hyponasality test: - /mɛ: ma mɔŋ ma:/

- /nɔ:ŋ nun mɔ:n/
- /nu: ŋei: na/

The screening perceptual rating included:
1 = hyponasality; 0 = normal;
+1 = hypernasality

Nasalance scores

Nasometry (Nasometer II 6450 Kaypentax) the objective measure of resonance was used as an indication of the average nasalance scores for 3 standard Thai passages, *viz.*: (1) My House-having a mixture of oral and nasal consonants; (2) Laying Hen-devoid of nasal consonants; and (3) Winter-full of nasal consonants. The respective means (SD) of the nasalance score for My House, Laying Hen and Winter among normal Thai children were 14.3 ($\pm$ 5.8), 35.6 ($\pm$ 5.9) and 51.1 ($\pm$ 6.4)[15].

In order to compare the reliability coefficients, the nasalance scores were converted to an ordinal 3-scale rating according to 3 criteria. The three cut-off criteria were the mean of the nasalance scores for normal children $\pm$ 1, 1.5 and 2 SD. Abnormality of the resonance scores was identified as:

-1 = hyponasality or nasalance scores -1, -1.5 and -2 SD lower than the mean nasalance scores;

0 = normal or nasalance scores were between mean nasalance scores $\pm$ 1, $\pm$ 1.5 and $\pm$ 2 SD;

+1 = hypernasality or nasalance scores were +1, +1.5 and +2 SD above the mean nasalance scores.

Statistic analyses

Spearman's rank correlation test was used to analyze the relationship between screening perceptual assessment of resonance disorders and the percentage of nasalance scores (from the individuals).

The Cohen Kappa statistic of the tests was used to assess the reliability of the screening perceptual assessment for resonance disorders and the rating of nasalance scores themselves.

Results

The characteristics of the 115 subjects are presented in Table 1. The proportion of females to males was ~6 to 4.

The Spearman's rank correlation test showed that the correlation coefficients between screening perceptual assessment of resonance disorders and the percentage of nasalance scores ranged from moderate to excellent (Table 2).

The percentage of agreement between screening perceptual assessment of resonance disorders and percentage of nasalance scores ranged from moderate to good while the Cohen's Kappa

coefficients ranged between poor and moderate (Table 3).

Discussion

Improving the correlation and reliability of auditory perceptual assessments of nasality, especially for hypernasality, is a challenge for speech and language pathologists, as it requires an objective assessment instrument. In order to increase the understanding of hypernasality and its assessment, different aspects of the evaluation of nasality of speech in children with $CP \pm L$ need to be investigated.

The correlation coefficients determined in the current study for screening perceptual ratings of nasality and nasalance scores for My House and Laying Hen ranged from good to excellent (0.67-0.86) (Table 2). This result is similar to reports of reliability between 0.69 and 0.74[16]. A strong relationship was found between the perceptual ratings of hypernasality and nasalance scores for the My House and Laying

Table 1. Demographic characteristics of children with $CP \pm L$

Characteristic	Number	Percentage
Sex		
Female	68	59.13
Male	47	40.87
Total	115	100
Age (years)		
0-2	18	15.65
2-4	28	24.35
4-7	20	17.39
7-15	31	26.96
15+	18	15.65
Total	115	100
Diagnosis		
Cleft palate	18	15.65
Left cleft lip and palate	38	33.04
Rightcleft lip and palate	18	15.65
Bilateral cleft lip and palate	41	35.65
Total	115	100

Table 2. Correlation of screening perceptual assessment of resonance disordersand percentage of nasalance scores

Variable	Perceptual Assessment	Nasalance scores		
		My house	Winter	Laying hen
Perceptual Assessment	1.00	-	-	-
Nasalance scores				
My house	0.68	1.00	-	-
Winter	0.48	0.84	1.00	-
Laying hen	0.68	0.86	0.67	1.00

Table 3. Percentage of agreement and Cohen's Kappa coefficients vis-a-vis perceptual assessment of resonance disorders and percentage of nasalance scores

Criteria	Percentage of agreement	Cohen's Kappa coefficients	Standard Errors	Z	p-value
My house					
Mean $\pm$ 1.0 SD	70.43	0.42	0.08	5.30	< 0.01
Mean $\pm$ 1.5 SD	73.04	0.48	0.08	5.79	< 0.01
Mean $\pm$ 2.0 SD	76.52	0.56	0.08	6.76	< 0.01
Winter					
Mean $\pm$ 1.0 SD	50.43	0.20	0.06	3.11	< 0.01
Mean $\pm$ 1.5 SD	48.71	0.19	0.06	3.27	< 0.01
Mean $\pm$ 2.0 SD	40.88	0.09	0.05	1.75	0.04
Laying Hen					
Mean $\pm$ 1.0 SD	69.57	0.35	0.07	5.01	< 0.01
Mean $\pm$ 1.5 SD	71.30	0.38	0.077	5.12	< 0.01
Mean $\pm$ 2.0 SD	74.78	0.46	0.08	5.93	< 0.01

Hen passages but a weak relationship for the passages containing nasal consonants confirming the results of a previous study[1]. This observation might be the result of loading different contexts *i.e.,* which effectively are sounds in the passage. The reason why Winter had a low relationship to the perceptual assessment might be because Winter has mostly nasal sounds that are minor sounds in normal Thai conversation[15]; whereas My House, like the Rainbow passage, has a mixture of oral and nasal consonants and Laying Hen, like the Zoo Passage, is devoid of nasal consonants. Auditory perception of nasalance scores from the My House and Laying Hen passages for detecting hypernasality might therefore be more sensitive than those from the nasalance scores of the Winter passage, which is the ostensible goal for detection hyponasality.

The percentage of agreement between hypernasality perceptual assessment and nasalance scores with three criteria were high or good vis-a-vis nasalance scores for the My House and Laying Hen passages were (69.57-67.52) (Table 3) and moderate for the passage Winter. The weighted kappa measurement had a moderate correlation between percentage of agreement vis-a-vis hypernasality perceptual assessment and nasalance scores for the My House and Laying Hen passages but low for the Winter (nasal) passage. The kappa measure for reliability is a conservative measure in that it assumes that any agreement that could have been obtained by chance was[17]; therefore, the kappa measure for reliability was chosen for determination the correlation beyond chance in the present study. Unlike a previous study[18] that found the reliability was acceptable (Kappa's coefficients range, 0.63 to 0.84), the Kappa's coefficients in the current study represented only fair to moderate reliability (range, 0.35-0.56) vis-a-vis the perceptual assessment and nasalance scores for My House and Laying Hen passages but were poor (range, 0.09-0.20) for the Winter passage. There was good reliability for the three criterion with a 2-SD cut-off with regard to the nasalance scores for My House and Laying Hen passages. This suggested that the criterion with $\pm$ 2 SDs might be appropriate for clinical interpretation. The reliability of speech assessments, perceptual assessment and nasalance scores in the present study was not in an acceptable range, therefore, further prospective research is needed to improve the reliability. As perceptual evaluation must remain the gold standard for evaluating speech[19], nasometry should be a supplement to perceptual assessments of nasality[16]; however, the relationship between velopharyngeal function and perceptual assessment objective assessment needs to be standardized.

Conclusion

The reliability of speech assessments in the study varied, as they depended upon different variables and types of analysis. Constructed speech samples and development in the reliability of perceptual ratings of speech and objective measures of nasalance scores need further prospective study.

Potential conflicts of interest

None.

References

1. Laczi E, Sussman JE, Stathopoulos ET, Huber J. Perceptual evaluation of hypernasality compared to HONC measures: the role of experience. Cleft Palate Craniofac J 2005; 42: 202-11.
2. Paal S, Reulbach U, Strobel-Schwarthoff K, Nkenke E, Schuster M. Evaluation of speech disorders in children with cleft lip and palate. J Orofac Orthop 2005; 66: 270-8.
3. Wirt A, Wyatt R, Sell D, Mars M, Grunwell P, Lamabadusuriya S. Training counterparts in cleft palate speech therapy in the less developed world: an extended report. Br J Disord Commun 1990; 25: 355-67.
4. Wirt A, Wyatt R, Sell DA, Grunwell P, Mars M. Training assistants in cleft palate speech therapy in the developing world: a report. Cleft Palate J 1990; 27: 169-75.
5. Landis PA. Training of a paraprofessional in speech pathology: a pilot project in South Vietnam. ASHA 1973; 15: 342-4.
6. Winterton T. Providing appropriate training and skills in developing countries. Int J Lang Commun Disord 1998; 33 (Suppl): 108-13.
7. Willcox DS. Cleft palate rehabilitation: interim strategies in Indonesia. Cleft Palate Craniofac J 1994;

31: 316-20.

8. Pamplona C, Ysunza A, Patino C, Ramirez E, Drucker M, Mazon JJ. Speech summer camp for treating articulation disorders in cleft palate patients. Int J Pediatr Otorhinolaryngol 2005; 69: 351-9.

9. Pamplona MC, Ysunza A, Espinosa J. A comparative trial of two modalities of speech intervention for compensatory articulation in cleft palate children, phonologic approach versus articulatory approach. Int J Pediatr Otorhinolaryngol 1999; 49: 21-6.

10. D'Antonio LL, Nagarajan R. Use of a consensus building approach to plan speech services for children with cleft palate in India. Folia Phoniatr Logop 2003; 55: 306-13.

11. Prathanee B, Dechongkit S, Manochiopinig S. Development of community-based speech therapy model: for children with cleft lip/palate in northeast Thailand. J Med Assoc Thai 2006; 89: 500-8.

12. Prathanee B, Lorwatanapongsa P, Makarabhirom K, Suphawatjariyakul R, Thinnaithorn R, Thanwiratananich P. Community-based model for speech therapy in Thailand: implementation. J Med Assoc Thai 2010; 93 (Suppl 4): S1-6.

13. Prathanee B, Lorwatanapongsa P, Anantapong D, Buakanok N. Thai Speech Parameters for Patients with Cleft Palate in a Universal Reporting System.

Asia Pac J Speech Lang Hear 2011; 14 : 31-49.

14. Prathanee B, Pumnum T, Jaiyong P, Seepuaham C, Xayasin V. Satisfaction of speech and treatment for children with cleft lip/palate in Lao People's Democratic Republic. J Med Assoc Thai 2011; 94 (Suppl 6): S40-4.

15. Prathanee B, Thanaviratananich S, Pongjunyakul A, Rengpatanakij K. Nasalance scores for speech in normal Thai children. Scand J Plast Reconstr Surg Hand Surg 2003; 37: 351-5.

16. Sweeney T, Sell D. Relationship between perceptual ratings of nasality and nasometry in children/ adolescents with cleft palate and/or velopharyngeal dysfunction. Int J Lang Commun Disord 2008; 43: 265-82.

17. Cordes AK. The reliability of observational data: I. Theories and methods for speech-language pathology. J Speech Hear Res 1994; 37: 264-78.

18. Brunnegard K, Lohmander A. A cross-sectional study of speech in 10-year-old children with cleft palate: results and issues of rater reliability. Cleft Palate Craniofac J 2007; 44: 33-44.

19. Henningsson G, Kuehn DP, Sell D, Sweeney T, Trost-Cardamone JE, Whitehill TL. Universal parameters for reporting speech outcomes in individuals with cleft palate. Cleft Palate Craniofac J 2008; 45: 1-17.

ความสัมพันธ์ของการประเมินด้วยการฟังความผิดปกติของการสั่นพ้องของเสียงกับคะแนนสัดส่วนพลังงานเสียงที่ออกทางจมูกและปากของเด็กปากเพดานโหว่

เบญจมาศ พระธานี, ทวิตรี ภูมินำ, ชลดา สีพั้วฮาม

วัตถุประสงค์: เพื่อหาความสัมพันธ์ของการประเมินด้วยการฟังแบบคัดกรองความผิดปกติของการสั่นพ้องของเสียงกับคะแนนสัดส่วนพลังงานเสียงที่ออกทางจมูกและปาก

วัสดุและวิธีการ: การประเมินคัดกรองด้วยการฟังแบบคัดกรองความผิดปกติของการสั่นพ้องของเสียงของเด็กเพดานโหว่ที่มีหรือไม่มีปากแหว่งจำนวน 115 คน ถูกนำมาศึกษาความสัมพันธ์กับคะแนนสัดส่วนพลังงานเสียงที่ออกทางจมูกและปาก การประเมินด้วยการฟังแบบให้คะแนน 3 ระดับ (-1: เสียงขึ้นจมูกน้อยเกินไป; 0: ปกติ; +1: เสียงขึ้นจมูกมากเกินไป) ถูกเปรียบความสัมพันธ์กับคะแนนสัดส่วนพลังงานเสียงที่ออกทางจมูกและปากถูกแปลงเป็นคะแนน 3 ระดับด้วย 3 เกณฑ์ (-1: คะแนนที่ต่ำกว่าค่าเฉลี่ย-ความเบี่ยงเบนมาตรฐาน 1 เท่า, 1.5 เท่าและ 2 เท่า, 0: คะแนนที่อยู่ระหว่างค่าเฉลี่ย ± ความเบี่ยงเบนมาตรฐาน 1 เท่า, 1.5 เท่า และ 2 เท่า; +1: คะแนนที่อยู่สูงกว่าค่าเฉลี่ย + ความเบี่ยงเบนมาตรฐาน 1 เท่า, 1.5 เท่า และ 2 เท่าตามลำดับ)

ผลการศึกษา: ความสัมพันธ์ของการประเมินคัดกรองด้วยการฟังแบบคัดกรองความผิดปกติของการสั่นพ้องและคะแนนสัดส่วนพลังงานเสียงที่ออกทางจมูกและปากมีค่าดีถึงดีมาก ร้อยละของความสอดคล้องอยู่ในระดับดี ส่วนความเที่ยงของแคบป้าอยู่ระหว่างความพอใช้ถึงปานกลางในข้อความที่ประกอบด้วยเสียงพยัญชนะที่ออกปากและจมูก (บ้านของฉัน) และข้อความที่หลีกเลี่ยงเสียงนาสิก (ไก่ออกไข่) พบความสัมพันธ์ต่ำในข้อความเสียงนาสิก (หน้าหนาว)

สรุป: ความสัมพันธ์ของการประเมินการพูดในการศึกษาครั้งนี้มีค่าค่อนข้างแตกต่างกันขึ้นกับตัวแปรและการวิเคราะห์ การศึกษาแบบไปข้างหน้าในอนาคตเป็นสิ่งจำเป็น