Reliability of Perceptual Assessment for Resonance Disorders in Patients with Cleft Palate

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Objective: *Determine reliabilities of perceptual assessment of resonance disorders in people with cleft palate.*
Material and Method: *A prospective study of inter- and intra-rater reliability of perceptual screening assessment of resonance disorders with 6-scale and 2-scale criteria among19 speech and language pathologists (SLPs) from 30 connected speech samples of children with cleft palate aged 4-17 years via video recorder when compared to principle investigators.*
Results: *The percentage of agreement of inter-rater ranged from 23.33-100.00 while Kappa's coefficients was 0.08-0.67. For intra-rater reliability, the present study showed the percentage of agreement ranged from 46.67-100, Kappa's coefficient was 0.17-1. It seems that the more number of years experiences as an SLP, the better listening skill.*
Conclusion: *Reliabilities of perceptual assessment of resonance varied widely but it appears that listening skill might be directly related to experiences. Training programs for critical listening skills are needed.*

Keywords: *Reliability, Perceptual assessment, Cleft palate*

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Surgical treatment can reduce the physical abnormality of people with clefts, however, they still have a stigma from speech and language problems. There are common speech and language deficits in children with cleft lip/palate[1] including speech and language delay that was found in 92% and in which 49% of them needed speech and language treatment[2]. Articulation disorders, that effect in unintelligibility were found in 51-63%[3], dysphonia 12.5%[4] and velopharyngeal incompetence in 20-30%[5]. The majority of patients needing therapy are well past the age when speech is acquired and perfected.

Speech and language assessment should be done for early detection and early treatment as well as for referring cases with cleft lip/palate to speech and language centers for proper management because children should have adequate speech, language, hearing and resonance perspectives when they enter school at age 5+ with as near as normal a speech profile as possible. Early assessment and detection of problems also allows for timely early intervention and essential parental guidance[6]. Early treatment could prevent delayed development during pre-lingual and peri-lingual stages[7].

As mentioned above, velopharyngeal incompetence or what is generally perceived as resonance disorders is a common defect in people with cleft palate. For resonance evaluation, a subjective perceptual assessment is generally accepted and recommended because it normally agrees with objective measurement (moderate to strong agreement)[8-12]. Universal parameters for perceptual assessment of speech and language defects in cleft palate were recommended to use as the standard tools[13]. Several studies related to speech disorders in patients with cleft palate, used different methodologies for assessing speech outcomes, validity and reliability of each

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procedure, which raises questions about the methodology[14-16]. There are many methodological modalities regarding perceptual evaluation of speech in individuals with cleft lip and palate, including the use of different speech samples, professionals as raters and a lack of intra- and inter- rater reliability[15,17-20]. This makes the comparison of data difficult to validate. Hypernasality, however, should be able to be rated in a reliable fashion regardless of listener experience[9].

For developing countries, particularly in Thailand where there is a lack of speech and language pathologists (SLPs), there are insufficient or nospeech services for children with cleft palate because of the shortage of qualified SLPs[21-23]. While speech services or outreach programs are critically needed, a standard protocol should be developed to make comparisons of the assessment of the outcomes. Unfortunately, there was no evidence that explored the reliability related to the perceptual assessment of resonance among SLPs in Thailand.

The purpose of the present study was to determine the reliability of perceptual assessment of resonance disorders by speech and language pathologists (SLPs) in Thailand where a standard protocol is not available. This project was approved by the Khon Kaen University Ethics committee (The Helsinki Declaration: HE 510429).

Material and Method

Study design

A prospective study.

Participants

Twenty SLPs who attended the "Workshop on screening speech, language and hearing problems in people with cleft lip/palate" which was a part of the Project "Smart Smile and Good Speech" in 2007.

The Project was run based on lectures on theory of speech, language, and hearing problems and remediation in people with cleft lip/palate and was then followed by a workshop on perceptual screening speech, language and hearing problems in people with cleft lip/palate. The focus was on the elementary diagnostic procedures, which are rather simple, noninvasive, but essentially subjective[24] and suitable for developing countries where there is a lack of professionals and instrumentation[21-23]. It was particularly developed for feasibility in Thailand. A comprehensive screening procedure for describing the speech characteristics commonly associated with cleft palate and/or velopharyngeal dysfunction was presented. A unique method of presenting the information visually was proposed by the principle investigator.

Screening for resonance problems: 30 connected speech samples of children with clefts aged 4-17 years were presented via video recorder and assessed by participants and the investigator twice with approximately a 2-hour interval (tested in the morning period and retested in the afternoon period). The tests required participants to fill in case record forms based on 2 criteria: 1) normal and abnormal (2 scales); 2) hyponasality, normal, mild, moderate severe hypernasality, and mixed resonance (6 scales).

Speech samples:

Hypernasality test: - Nonsense syllables: /p^hi p^hi p^hi p^hi p^hi p^hi/
- Connected speech: Counting from 40 t0 50 in Thai language that composed of high oral pressure /s/ and /i:/

Hyponasality test: - /mɛ:mamɔŋma:/

- /ɲɔ:ŋɲunmɔ:n/

- / nu:ŋei:na/

Main outcome

Screening for resonance problems: Children's connected speech samples from the video presentation were assessed using 2 criteria:

1) Category: Score was assessed as 1 of 6 categories as follows[13]:

- Hyponasality (-1): Decreased or insufficient nasal resonance heard on nasal consonance and vowels.

- Normal (0): Nasality exceeds regional speech sample and there is no perceptual evidence of cleft type speech.

- Mild hypernasality (1):

1. Nasality exceeds regional speech nasality.

2. There is increased nasality heard primarily on high vowels.

3. There is inconsistent or intermittent increased nasality across vocalic segments.

4. Nasality is perceived as socially acceptable in most circles.

5. Parents or guardians are satisfied with individual's speech resonance.

6. Speech specialist probably would not recommend physical management after instrumental assessment.

- Moderate hypernasality (2):

1. Hypernasality is perceived as pervasive and draws attention to itself and away from the message.

2. There is increased nasality heard on high and low vowels.

3. Most vowels retain their identification.

4. Speech is socially unacceptable.

5. The speech specialist probably would recommend physical management after instrumental assessment.

- Severe hypernasality (3):

1. Hypernasality is perceived as pervasive and interferes with speech understandability.

2. There is increased nasality heard on vowels and some voiced consonants.

3. Some vowels may lose their identity.

4. Nasality is socially very unacceptable.

5. The speech specialist definitely would recommend physical management after instrumental assessment.

- Mixed resonances (4): Mixed resonances both hyponasality and hypernasality in speech samples.

2) Dichotomous: Score was assessed as normal (0) and resonance defects (1);

Statistical analysis

For the tests, the Cohen Kappa statistics were used for analysis of inter- and intra- rater reliabilities of perceptual assessments between a reference SLP (principle investigator) and 19 SLPs.

Results

SLPs who attended workshop had experiences that included treatment of virtual patients with clefts were tested and the results varied widely as displayed in Table 1.

Screening of resonance problems in the 1st time using the 6-scale criteria revealed that percentage of agreement between SLPs and reference SLP ranged from 40.00-60.00. Inter-rater reliability varied from 0.14-0.43. Similar to the 1st time, screening of resonance problems the 2nd time using the 6-scale criteria revealed that the percentage of agreement between SLPs and reference SLP ranged from 23.33-60.00. Inter-rater reliability varied from -0.08-0.43.

Screening of resonance problems in the test and retest (the 1st and 2nd times) of the 6-scale criteria showed the percentage of agreement ranged from 46.67-76.67. Intra-rater reliability varied from 0.17-0.88 (Table 2).

Screening of resonance problems the 1st time usingthe 2-scale criteria revealed that the percentage of agreement between SLPs and reference SLP ranged from 50.00-80.00. Inter-rater reliability varied from 0.13-0.67. Similar to the 1st time, screening of resonance problems the 2nd time using the 2-scale criteria revealed that the percentage of agreement between SLPs and reference SLP ranged from 60.00-83.33. Inter-rater reliability varied from -0.04-0.53.

Screening of resonance problems in the test and retest (the 1st and 2nd times) using the 2-scale criteria showed the percentage of agreement ranged from 66.67-100. Intra-rater reliability varied from 0.29-1 (Table 3).

Discussion

Screening assessment of resonance disorders with the 6-scale evaluation (1st and 2nd times) showed a fair to moderate percentage of agreement and poor to moderate inter-rater reliability. For the 2-scale criteria (1st and 2nd times), the percentage of agreement was moderate to good while inter-rater reliability was poor to moderate. These results agreed with the previous study that found reliability was lowest for hypernasality[17,25]. Reliability of the percentage of agreement in screening assessment of resonance disorders in the 2-scale criteria showed up better than that 6-scale criterion. This indicated that assessment using the 2-scale might be appropriate for screening. Cohen

Table 1. Demographic characteristics of SLPs

Characteristics	Number (n = 19)
Number of year working as SLPs (years)	
Mean (Standard deviation)	15.16 (7.99)
Median (Minimum-Maximum)	13 (4-30)
Number of years working with cleft palate patients (years)	
Mean (Standard deviation)	13.82 (8.88)
Median (Minimum-Maximum)	12 (0-30)
Number of patients with clefts/year	
Median (Minimum-Maximum)	3 (1-100)

Table 2. Test and retest reliabilities on resonation screening: 6 categories

Speech and language pathologist	Number of subject	6 categories (normal, -1, 1, 2, 3, 4)			
		Percent of agreement	Kappa coefficient	z-test	p-value
1	30	53.33	0.37	3.52	< 0.01
2	30	73.33	0.61	5.6	< 0.01
3	30	73.33	0.56	4.16	< 0.01
4	30	76.67	0.62	4.72	< 0.01
5	30	56.67	0.36	3.15	< 0.01
6	30	56.67	0.42	4.18	< 0.01
7	30	53.33	0.30	2.73	< 0.01
8	30	60.00	0.38	3.02	< 0.01
9	30	63.33	0.43	3.34	< 0.01
10	30	53.33	0.30	2.61	< 0.01
11	30	70.00	0.54	4.33	< 0.01
12	30	70.00	0.56	4.83	< 0.01
13	30	53.33	0.26	2.01	0.02
14	30	53.33	0.34	3.02	< 0.01
15	30	56.67	0.45	5.14	< 0.01
16	30	76.67	0.63	5	< 0.01
17	30	76.67	0.67	6.14	< 0.01
18	30	46.67	0.17	1.35	0.09
19	30	93.33	0.88	6.21	< 0.01
20	30	46.67	0.29	3.01	< 0.01

Table 3. Test and retest reliabilities on resonation screening: 2 categories

Speech and language pathologist	Number of subject	2 categories (normal, not normal)			
		Percent of agreement	Kappa coefficient	z-test	p-value
1	30	76.67	0.39	2.19	0.01
2	30	86.67	0.59	3.56	< 0.01
3	30	80.00	0.61	3.44	< 0.01
4	30	83.33	0.67	3.66	< 0.01
5	30	80.00	0.55	3.06	< 0.01
6	30	86.67	0.63	3.44	< 0.01
7	30	76.67	0.43	2.44	0.01
8	30	80.00	0.55	3.06	< 0.01
9	30	73.33	0.46	2.54	0.01
10	30	70.00	0.31	1.77	0.04
11	30	86.67	0.73	3.99	< 0.01
12	30	83.33	0.64	3.78	< 0.01
13	30	66.67	0.31	1.67	0.05
14	30	76.67	0.38	2.08	0.02
15	30	83.33	0.53	3.28	< 0.01
16	30	90.00	0.61	3.36	< 0.01
17	30	80.00	0.60	3.59	< 0.01
18	30	80.00	0.29	1.61	0.05
19	30	100.00	1.00	5.48	< 0.01
20	30	83.33	0.35	1.92	0.03

Kappa's coefficients in the screening assessment of resonance disorders in 2-scale criteria and 6-scale criteria, however, were ranged widely and were not significantly different. This indicated that a training program is required for the standard assessment protocol to compare among SLPs and centers.

For the 2-scale criteria, results showed quite a high percentage of agreement but low Kappa's coefficients that might be possible from the imbalance or asymmetric data in a 2 x 2 table and can be solved by designing further research with a large sample size of children's speech samples for investigation of the reliability to decrease the observers' disparities in the positive and negative direction to confirm consistency of reliability[26].

According to intra-rater reliability, the percentage of agreement revealed moderate to excellent reliability while Cohen Kappa's coefficients showed poor to excellent. The SLP who got the highest percentage of agreement (1st time: 0.93 and 2nd time: 100) and intra-rater reliability (1st time: 0.88 and 2nd time: 1) was a participant who was the most experienced rater or SLP. Eighty-two percent of the SLPs who had $\geq$ 10 years experiences had moderate to good inter-rater reliability (Cohen Kappa's coefficients = 0.40-0.80). These results might indicate that the more number of years experiences as an SLP, the better listening skill for assessment of resonance disorders and this agrees with the previous study that found the less experienced raters showed greater variability[25]. This study indicated that the number of years working as SLPs $\geq$ 10 years had good inter-rater reliability for screening assessment and that the standard workshop training for perceptual evaluation is needed for further education.

Conclusion

Over all, the percentage of agreement was a little bit better than Kappa's coefficients. Reliability widely varied from poor to excellent and might relate to years of working as speech and language pathologists. This indicates need for standard and universal training to increase reliability. The training program and uniform methods for collecting and reporting data to enhance their knowledge of critical listening skills are needed.

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Potential conflicts of interest

None.

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ความเที่ยงของการประเมินด้วยการฟังความผิดปกติของการสั่นพ้องของเสียงในผู้ป่วยเพดานโหว่

เบญจมาศ พระธานี, ปรียา หล่อวัฒนพงษา, กัลยาณี มกราภิรมย์, รัชนี สุภวัตรจริยากุล, ศรีวิมล มโนเชี่ยวพินิจ, รัตนา ถิ่นนัยธร

วัตถุประสงค์: *เพื่อศึกษาความเที่ยงของการฟังคัดกรองความผิดปกติของการสั่นพ้องของเสียงในผู้ป่วยปากแหว่งเพดานโหว่*

วัสดุและวิธีการ: *ทำการศึกษาแบบไปข้างหน้าเพื่อหาความเที่ยงระหว่างบุคคลและภายในบุคคลของ ในการฟังคัดกรองความผิดปกติของการสั่นพ้องของเสียงทั้งแบบใช้เกณฑ์ 6 ระดับและ 2 ระดับของนักแก้ไขการพูด 19 คน จากวีดิทัศน์การพูดที่ต่อเนื่องของเด็กเพดานโหว่อายุ 4-17 ปี จำนวน 30 คนเปรียบเทียบกับผู้วิจัยหลัก*

ผลการศึกษา: *ร้อยละของการสอดคล้องในการฟังระหว่างบุคคลมีค่า 23.33-100.0 ค่าสัมประสิทธิ์ของความเที่ยง (Kappa's coefficients) มีค่าอยู่ระหว่าง 0.08-0.67 สำหรับความเที่ยงภายในบุคคลพบว่ามีค่าร้อยละของความสอดคล้อง 46.67-100 มีค่าสัมประสิทธิ์ของความเที่ยง 0.17-1 เป็นไปได้ว่ายิ่งมีจำนวนปีของการมีประสบการณ์ในการเป็นนักแก้ไขการพูดนานเท่าไรยิ่งมีทักษะในการฟังของเสียงดีมากเท่านั้น*

สรุป: *ความเที่ยงของการฟังของการสั่นพ้องของเสียงมีค่าแตกต่างกันมากทั้งนี้ทักษะการฟังอาจขึ้นกับประสบการณ์ในการทำงาน โปรแกรมการฝึกฟังอย่างเข้มข้นเป็นสิ่งจำเป็นที่ต้องทำต่อไป*