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DEVELOPMENT OF PRESSURE CONSONANT ARTICULAION DRILL MATERIAL IN BENGALI (DRILART-B) FOR CHILDREN WITH REPAIRED CLEFT LIP AND PALATE

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ABSTRACT

In conversation, intelligibility of speech is a measure of how comprehensive speech is in a given condition. In children with cleft lip and palate, their utterances lack formation of clear and distinct sound patterns. The articulatory errors predominantly observed in children with cleft lip and palates are substitution, omission and distortions. Research studies of English speaking children have shown that the phonological development of children with cleft lip and palate are delayed. This study endeavours to develop a material in Bengali language for the subsequent assessment and management. The material was developed in terms of familiarity and homogeneity. Standardization of the developed drill material was done on 30 normal hearing native Bengali speaking children in the age range of 5-7 years. The same drill material was then administered on 30 age matched cleft lip and palate children for the purpose of identifying the discriminant validity. The normal were found to perform better than the age matched cleft lip and palate group. The coefficient of variance depicted a significant co relation between the normal hearing children. On the other hand there was no significant correlation within the cleft lip and palate group owing to the enormous variation in the type and severity of the cleft present.

INTRODUCTION

Articulation refers to the movement of the speech mechanisms (so air escapes through nose only when appropriate) to produce speech. Phonology, on the other hand, encompasses the rules of the sound system of language. These rules over-see speech sounds, including the production and combination of these sounds into intelligible speech.

According to Clark et al. (2007), phonology means the systematic use of sound to encode meaning in any spoken human language, or the field of linguistics studying this use. Sound is produced simply by expelling air from the lungs. However, to vary the sound quality in a way that can be useful for speaking, two speech organs normally need to come close to each other to make contact, so as to create an obstruction that shapes the air in a particular fashion. The most widely cited summary of speech sound disorder prevalence is a systematic review conducted by Law et al., (2000). They reported prevalence estimates ranging from 2% to 25% of children ages 5 to 7 years.

Cleft lip and palate also known as orofacial cleft is a group of conditions that includes cleft lip, cleft palate or both together a cleft lip contains an opening in the upper lip that may extend into the nose the opening may be one sided, both sided or in the middle. Cleft lip and palate is due to tissues of the face not properly joining together during development. They are a type of birth defect and the cause in most cases is unknown. Risk factors include smoking during pregnancy, diabetes, an older mother, and obesity.

Children with cleft palate tend to have the greatest difficulty producing high pressure consonants compared with other classes of sounds. They tend to show a high occurrence of marticulatision for the fricatives and affricates, followed by plosives, glides, and nasals (Peterson et al., 2001).

Misarticulation and compensatory articulation often lead to unintelligible speech in children with cleft lip and palate. A number of variables that influence speech intelligibility include articulation, hypernasality, voice quality, phonetic content, stress, accent, intonation, rate and duration patterns (Fletcher, 1978).

Children with cleft lip and palate are at a risk of disordered articulation leading to unintelligible speech. The disordered articulation is heterogeneous in nature. Plosives (p, b, t, d,g), fricatives (f, s, z, sh) and affricates (ch, dz) have been found to be more affected than the other phonetic classes of nasals (m, n, ng) and glides (j, w). These are called pressure consonants which are particularly vulnerable when there is velopharyngeal dysfunction (VPD) or velopharyngeal insufficiency (VPI). The severity of articulation problems have been seen to increase with severity of the cleft type (Watson and Sell, 2001).

Articulation therapy for the cleft lip and palate population is provided mainly using three modes- auditory, visual and tactile. These modes help in achieving articulation better and faster. An articulation drill material is thus essential for giving therapy. A drill is the most efficient procedure to accomplish articulation therapy, especially when targeting the sounds and syllable and word level.

NEED OF THE STUDY

An articulation drill material is essential for articulation therapy (Goda, 1970). The articulation drill task is important to understand the under lying phonetic and phonological processes involved in a particular language. In India, therapy of articulation has been a problem because one cannot simply adapt tests from one language to other such as English. There are very few tests available in Indian languages. An articulation drill for the children with repaired cleft lip and palate has been developed in other Indian languages except Bengali; this study will be helpful in intervention of children with a repaired cleft lip and palate in the Bengali population.

AIM OF THE STUDY

The aim of the present study was development of pressure consonant articulation drill material for children with repaired cleft lip and palate in Bengali (DRILART- B), and to standardize this material in terms of validation, internal consistency, and test retest reliability.

OBJECTIVES OF THE STUDY

To develop an articulation drill material in Bengali.

To obtain normative data for the developed articulation drill material on native Bengali speaking normal children.

To measure the item wise validity in children with repaired cleft lip and palate.

To measure the reliability of the developed articulation drill material.

HYPOTHESIS

There will be significant co-relation between test and retest scores obtained in the children with and without cleft lip and palate.

There will be internal consistency in the item wise scores in children with and without cleft lip and palate.

METHODOLOGY

Participants

Group-I: 30 normal hearing native Bengali speaking children with age range of 5-7 yrs with no history of delayed speech and language were included. The participants having misarticulation, childhood dysarthria, neurological problems and cognitive deficits were excluded.

Group-II: 30 normal hearing native Bengali speaking children with repaired cleft lip and palate with age range of 5-7 years having age appropriate receptive and expressive language development as well as cognitive skills were included. Children having dental anomaly and associated facial cleft were excluded.
Cool Edit software was used for sound recording and sound monitoring respectively. Nuendo (version 4.0) software was used for sound editing at sound recording studio. The recorded sound was burned into a CD by Nero Express software.

Procedure

1. Identification of pressure consonant in Bengali:

The pressure consonants in Bengali language were identified which are listed below. The following classification is based on Bengali Phonetic Reader (Bhattacharya, 1988) which includes 10 stops and 2 fricatives.

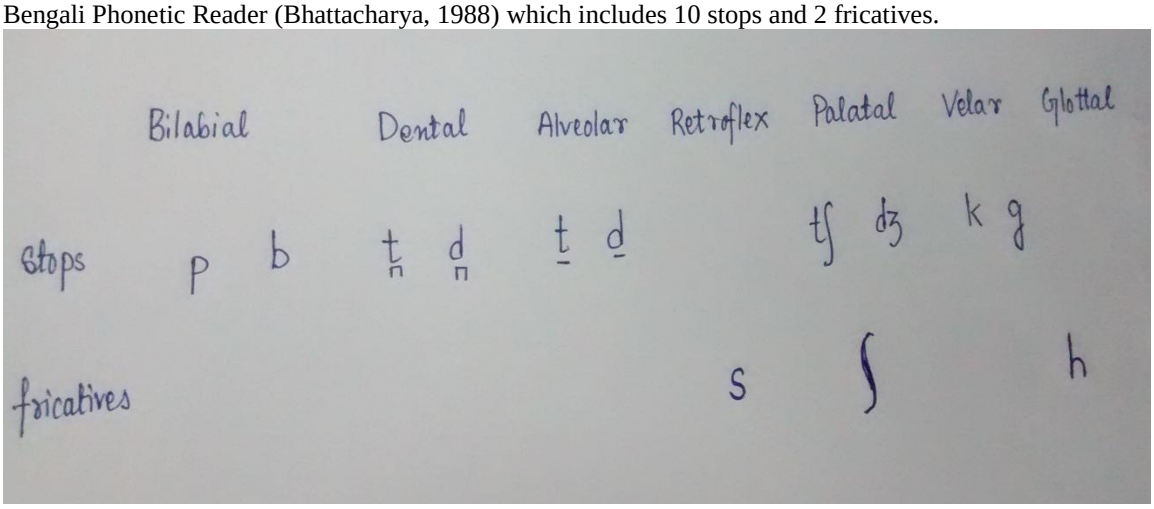

Figure 4.1.: The selected Bengali pressure consonants.

2. Development of the test material

Development of the stimuli for articulation drill material in Bengali (words)

Words from dictionary and school text books (standard I and II Bengali text books) were collected randomly to develop the word list for each target phoneme. The randomly selected words were simple, bi- syllabic or tri- syllabic. Words with clusters and nasal consonants were not included in the wordlist. The selected words were provided in the Bengali language and in International Phonetic Alphabet (IPA). For each target phoneme, a total of 30 words were selected in which the given specific speech sound would occur in initial, medial and final position. Based on clarity and final judgment 5 words per target phoneme were included.

Development of the picture drill material

Colourful, interesting and unambiguous pictures of some words which have the target speech sound were included. For each target phoneme, 10 pictures were selected. Based on clarity and final judgment 2 pictures per target phoneme were included.

Measurement of familiarity and redundancy error and linguistic validity through judge's paradigm

The selected 30 words and 10 pictures per phoneme were distributed amongst two linguists for the purpose of inter rater agreement and the Cronbach's alpha was calculated. After the words that agreed with the criterion were selected, they were distributed amongst 10 native Bengali speaking professional (5 linguists and 5 speech language pathologists) to judge the familiarity by five point familiarity rating scale which consisted of 1 for unfamiliar, 2 for doubtful, 3 for not very familiar, 4 for familiar, and 5 for most familiar. For each set, words rated of minimum 4 or more than 4 were considered as a familiar word list set. Thus on the basis of the inter rater agreement a word list was developed containing 5 words and 2 pictures for each target phoneme.

Recording parameters

The selected familiar Bengali words from the list were spoken by a native colloquial Bengali speaker. This recorded material was thus the developed material for DRILART- B.

3. Standardization of the developed DRILART- B material on normal native Bengali speaking children aged 5- 7 years

The developed DRILART- B material was then administered on 30 normal hearing native Bengali speaking children who passed the subject selection criterion. The children were made to wear the headphone and listen to the developed material played using a laptop and asked to repeat. The responses were recorded and accordingly scored.

4. Discriminant validity by using the same developed DRILART-B material on the children with repaired cleft lip and palate

The developed DRILART- B material was also administered on 30 normal hearing native Bengali speaking children with repaired cleft lip and palate who passed the subject selection criterion. The children were made to wear the headphone and listen to the developed material played using a laptop and asked to repeat. The responses were recorded and accordingly scored.

5. Test Retest Reliability

To look for there being no confounding factor during the intervening time interval, the 30 normal hearing native Bengali speaking children aged 5-7 years and the 30 age matched children with cleft lip and palate were retested after one month interval using the same recorded DRILART-B test material to check the test retest reliability.

6. Scoring

The responses obtained from the subjects were scored as correct or wrong. Each correctly articulated word was given a score of one and a misarticulated word (including words that were substituted, omitted or were distorted) was given a score of zero. The responses obtained from the subjects were statistically analyzed.

Statistical Analysis

Statistical analysis using SAS software (version, 9.2) was carried out for the data obtained. The coefficient of variance was incorporated to evaluate and compare the significant differences between the normal and age matched cleft lip and palate children. The coefficient of variance was also administered to evaluate the internal consistency measure amongst both the groups. The paired t- test was administered in order to evaluate and compare the test retest reliability.

RESULTS

The aim of the study was to develop an articulation drill material for children with repaired cleft lip and palate. One of the objectives was to find out the normative data for the developed material in native Bengali speaking children. Statistical analysis using SAS software (version, 9.2) was carried out for the study. Coefficient of variance was used to measure the internal consistency amongst the 30 normal hearing Bengali speaking children who were included.

Table-1: Coefficient of variance showing within group scores of normal hearing native Bengali speaking children.

Number of subjects	Mean	Standard Deviation	Coefficient of variation
30	92.20	1.21	1.32

The above table suggests that there was a significant correlation amongst the normal hearing children as lesser the coefficient of variance, higher the consistency.

Coefficient of variance was used to measure the internal consistency amongst the 30 age matched children with repaired cleft lip and palate who were included.

Table-2 shows that there was no significant correlation amongst the subjects of the age matched children with repaired cleft lip and palate. The coefficient of variance was calculated to be 22.48 with a standard deviation of 7.05 within group and a mean score of 31.40.

Table-2: Depicts Coefficient of variance showing within group scores of age matched children with repaired cleft lip and palate.

Number of subjects	Mean	Standard Deviation	Coefficient of variation
30	31.40	7.05	22.48

The above table suggests that there was no significant correlation amongst the subjects of the age matched children with repaired cleft lip and palate.

Statistical analysis using SAS software (version, 9.2) was carried out for the data obtained. T test was done to measure the difference between the 30 normal hearing native Bengali speaking subjects and the 30 age matched children with repaired cleft lip and palate.

Table-3 Shows that there was a significant difference in the DRILART-B scores obtained for the 30 normal hearing native Bengali speaking subjects and the 30 age matched children with repaired cleft lip and palate. The p value was < 0.0001 (t= 48.09, df= 29) suggesting that the performance of the 30 normal hearing native Bengali speaking subjects was significantly better than the 30 age matched children with repaired cleft lip and palate.

Table-3: 't' test showing the scores of 30 normal hearing native Bengali speaking subjects and the 30 age matched children with repaired cleft lip and palate.

difference	df	t value	p value
Normal children test v/s clp children test	29	48.09	<0.0001

Figure 1 indicates the comparison of the mean and the standard deviation between the two groups. The mean obtained of the normal hearing native Bengali speaking subjects was 92.20 and that for the age matched children with repaired cleft lip and palate was 31.40. Similarly standard deviation of the normal hearing native Bengali speaking subjects was 1.21, and for the age matched children with repaired cleft lip and palate was 7.06. The values obtained suggested that the performance of the normal hearing native Bengali speaking subjects was better than the age matched children with repaired cleft lip and palate.

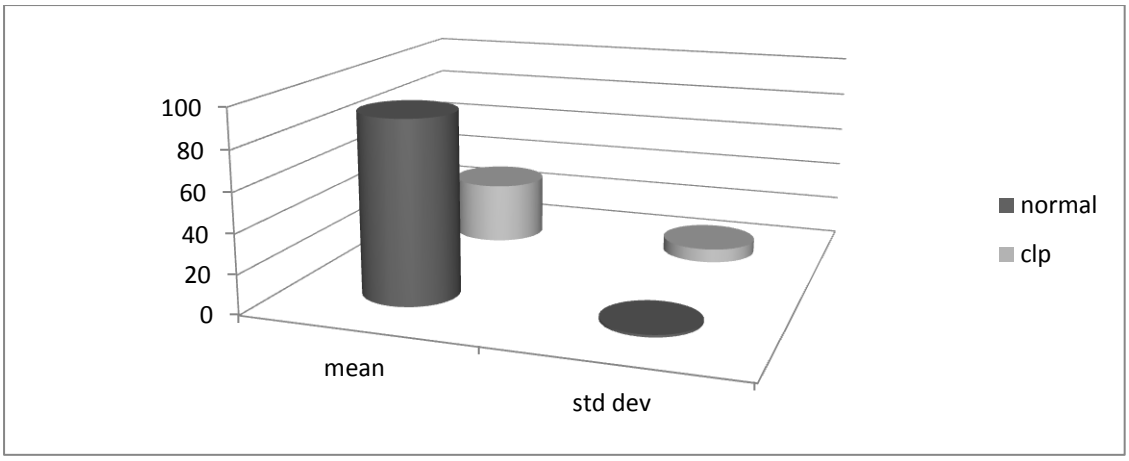

Figure.1: Depicts Clustered cylinder bar diagram showing mean and standard deviation of the 30 normal hearing native Bengali speaking subjects and the 30 age matched children with repaired cleft lip and palate.

Combined results of table-3 and figure-1 suggested that the performance of the normal hearing native Bengali speaking subjects was better than the age matched children with repaired cleft lip and palate.

The developed DRILART-B material was administered on 60 participants (30 normal hearing native Bengali speaking subjects and the 30 age matched children with repaired cleft lip and palate). The same developed material was administered on the 60 participants of the original sample for the second time one month from the first time of measure. The paired t test was done to compare the test retest scores of the 60 participants.

Table-4: Depicts Paired 't' test of test retest scores of the 30 normal hearing native Bengali speaking subjects.

Difference	mean	sd	df	t value	p value
Normal children test- retest	-0.139	0.29	29	0.00	1.0000

Table-4 shows that there was no significant difference in the test retest scores obtained by the 30 normal hearing native Bengali speaking subjects. The p value was calculated to be 1 which is insignificant, which showed that a significant correlation was observed.

Table-5: Paired t test of test retest scores of the 30 age matched children with repaired cleft lip and palate.

Difference	mean	sd	df	t value	p value
Clp children test-retest	-1.66	00.99	29	-2.63	0.0134

Table-5 shows that there was a significant difference in the test retest scores obtained by the 30 age matched children with repaired cleft lip and palate. The p value was calculated to be 0.0134 which is significant, which showed that a significant difference was observed.

DISCUSSIONS

The present study was aimed at developing and standardizing the Bengali pressure consonant articulation drill material for the purpose of articulation therapy of children with cleft lip and palate.

A total of 10 words per speech sound were randomly selected from a pool of words obtained randomly from school text books of class I and class II state board by two linguists for inter rater agreement. Both the linguists were given the list of the selected words and asked to rate the words on the basis of unambiguity, the Chronbach's alpha was calculated to be 0.17.

The next important parameter was the judgment of familiarity of the selected words. According to Lyregaard (1997) the more one is acquainted with the stimulus, the more readily one recognizes it. Familiarity was also explained based on the effect of intelligibility. Tillman and Jerger (1959) reported that prior knowledge of the test vocabulary yields a better threshold of the participants.

For familiarity rating the Bengali words that the linguists selected were further distributed amongst 10 professional native Bengali speakers out of which 5 were linguists and 5 were speech language pathologists. A five point rating scale was provided in order to judge the familiarity that consisted of 1- unfamiliar, 2- doubtful, 3- not very familiar, 4- familiar and 5- most familiar. When each word was rated 4 or more than that, the words have been then defined familiar. The final list thus formed contained 5 words and 2 picturable words per speech sound based on familiarity weighage.

The sample tested in the present investigation for obtaining normative data consisted of 30 participants with an average age of 5.79 years within the age range of 5-7 years. All the subjects were native Bengali speakers.

Word identification and articulation was significantly good in the normal hearing children. Statistical analysis using SAS software (version, 9.2) was carried out for the study. Coefficient of variance was used to measure the internal consistency amongst the 30 normal hearing Bengali speaking children who were included. Table-1 shows that there was a significant correlation amongst the subjects of the normal hearing Bengali speaking children. The coefficient of variance was calculated to be 1.32 with a standard deviation of 1.21 within group and a mean score of 92.20. There was a significant correlation amongst the normal hearing children as lesser the coefficient of variance, higher the consistency.

A possible reason for the above findings can be explained according to Templin (1957) and Wellman et al., (1931) who stated that average age estimates and upper age limits of customary consonant production starts at the median age of customary articulation by 2 years of age and stops at an age level of 7 years at which 90% of all the children are customarily producing all the sounds.

The sample tested in the present investigation for obtaining discriminant validity, data consisted of 30 participants with an average age of 5.79 years within the age range of 5-7 years. All the subjects had cleft lip and palate and were native Bengali speakers.

Coefficient of variance was used to measure the internal consistency amongst the 30 age matched children with repaired cleft lip and palate who were included. Table-2 shows that there was no significant correlation amongst the subjects of the age matched children with repaired cleft lip and palate. The coefficient of variance was calculated to be 22.48 with a standard deviation of 7.05 within group and a mean score of 31.40. There was no significant correlation amongst the subjects of the age matched children with repaired cleft lip and palate.

According to Templin (1957) children with cleft lip and palate had delayed phonological development. Articulation is characterized by distortions, substitutions and omissions. Obviously, omissions represent a greater deficiency than substitutions and distortions; and substitutions greater than distortions.

The heterogeneity of the articulation skills within the cleft palate population has been discussed by Spriestersbach et al., 1964. He argued that the articulatory processes across children amongst the cleft lip and palate group also vary. The variations differ on the basis of the type and degree of the cleft. Although he pointed out at the dearth of literature to the reasons for articulation delays in children with cleft lip and palate.

Table-3 Shows that there was a significant difference in the DRILART-B scores obtained for the 30 normal hearing native Bengali speaking subjects and the 30 age matched children with repaired cleft lip and palate. The p value was < 0.0001 ($t= 48.09$, $df= 29$) suggesting that the performance of the 30 normal hearing native Bengali speaking subjects was significantly better than the 30 age matched children with repaired cleft lip and palate. Figure-1 indicates the comparison of the mean and the standard deviation between the two groups. The mean obtained of the normal hearing native Bengali speaking subjects was 92.20 and that for the age matched children with repaired cleft lip and palate was 31.40. Similarly standard deviation of the normal hearing native Bengali speaking subjects was 1.21, and for the age matched children with repaired cleft lip and palate was 7.06. The values obtained suggested that the performance of the normal hearing native Bengali speaking subjects was better than the age matched children with repaired cleft lip and palate. Combined results of table-3. and figure-1 suggested that the performance of the normal hearing native Bengali speaking subjects was better than the age matched children with repaired cleft lip and palate.

According to Jocelyn, Penko, and Rode (1996) children with CLP had significantly lower scores on tests of cognition, comprehension, and expressive language abilities than matched control children at 60 to 84 months of age. Early identification and treatment of these delays may reduce subsequent verbal deficits and academic difficulties.

Reliability and the consistency of a test material or measurement are frequently quantified in the movement sciences literature. According to Weir (2005) the intra class correlation coefficient and its variants can be used to construct confidence intervals for individual scores and to determine the minimal difference needed to be exhibited for one to be confident that a true change in the performance of an individual has occurred.

The developed DRILART-B material was administered on 60 participants (30 normal hearing native Bengali speaking subjects and the 30 age matched children with repaired cleft lip and palate). The same developed material was administered on the 60 participants of the original sample for the second time one month from the first time of measure. The paired t test was done to compare the test retest scores of the 60 participants. Table-4 shows that there was no significant difference in the test retest scores obtained by the 30 normal hearing native Bengali speaking subjects. The p value was calculated to be 1 which is insignificant, which showed that a significant correlation was observed. Table-5 shows that there was a significant difference in the test retest scores obtained by the 30 age matched children with repaired cleft lip and palate. The p value was calculated to be 0.0134 which is significant, which showed that a significant difference was observed and the children performed better in the retest condition. This significant difference in the test retest scores of the children with repaired cleft lip and palate can be accounted from the findings of Locker, Jokovic, and Tompson (2005) though on the child perceptions questionnaire (CPQ) scores of their study, there were few differences in the scores obtained by the children with orofacial conditions and children with dental caries in the test retest situations. This may suggests that the majority of these children are well adjusted and able to cope with the adversities they experience as a result of their conditions. This may reflect the quality of the stimulations received in the home environment without any significant therapeutic intervention or due to natural fluctuations. Although its validity and reliability have been established in cross-sectional studies (Jokovic et. al., 2002) its ability to detect meaningful change in therapeutic contexts has yet to be demonstrated.

CONCLUSIONS

A cleft of the lip or palate is a congenital deformity that occurs in utero during the first trimester of pregnancy. It may be unilateral, bilateral or medial cleft. Most clefts are caused by the combination of genetic as well as environmental factors.

The cleft of the lip and the palate leads to articulation and resonance disorders, among which misarticulation is the biggest contributor to the intelligibility loss. The major articulatory errors observed in children with cleft lip and palates are in the pressure consonants which include stops, fricatives and affricates. These errors include substitutions, omissions, distortions, additions. Most frequently seen articulatory error types are distortions and omissions. Hence articulation therapy is required to achieve speech intelligibility.

The most efficient procedure to accomplish articulation therapy, especially when targeting sounds at the syllable and word level is a drill. An articulation drill material will lighten the task of a speech pathologist that frequently needs to spend considerable time developing word lists and organizing speech materials from diverse sources. An articulation drill enhances speech therapy, it is essential to develop drill material for the cleft lip and palate population in each language. Since there are several articulation drill materials in the cleft palate population in English language, there was a need to develop such drill materials in Indian languages as well.

The study involved reviewing literature to formulate a framework for the development of the material. In order to develop the drill material, the pressure consonants in Bengali language were identified first. The drill material was prepared for those target sounds. A list of non picturable and picturable words with the target pressure consonants was developed. The words selected were familiar, meaningful and most frequently occurring. Words without clusters were selected.

Implications

It can be used for articulation therapy of clients with cleft lip and palate.

It can be given to parents for home training.

It may be used as a descriptive as well as analytical instrument to trace the normal as well as impaired articulatory and phonological development.

Future Directions

This tool can be developed in different Indian languages.

Drill materials can be developed across different age range.

Therapeutic efficacies can be studied by using this material.

Limitations

The criteria for 5 non-pictorial and 2 pictorial words could not be achieved for all the target sounds.

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