



Visual Punjabi articulation test (V-PAT) for Hearing Impaired: Development and Testing

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Abstract

Background: The capacity to physically move the tongue, lips, teeth, and jaw to generate the spoken sound sequences that make up words and sentences is known as articulation. Children who have hearing loss require additional assistance to help them articulate specific sounds since they tend to face high rate of articulation errors.

Objective: Present study aims to develop and test the Visual- Punjabi articulation test (V-PAT) as an aid to improve articulation errors in children with impaired hearing.

Methodology: The Visual- Punjabi articulation test (V-PAT) was developed by selecting the three pictures for each consonant of Punjabi language representing the word with initial, medial and final position of the consonant. The pictures were shown to control healthy and hearing-impaired at the outpatient department of speech therapy. The response for each consonant was recorded for three words representing the initial, medial and final position of the consonant.

Results: The articulation errors in hearing impaired were present for 16.12%, 28.12% and 21.21% consonants belonging to the initial, medial and final position respectively. The articulation error rate was higher in hearing impaired as compared to the healthy control group. The articulation errors were most common for sound 'Oo'rhaa', 'Ai'rhaa', 'thath'thaa', 'dhad'daa', and 'yay'yaa'.

Conclusion: It was found that Visual- Punjabi articulation test (V-PAT) was found to be an interactive method for assessing the articulation errors. Since articulation error rate was higher in hearing impaired children than healthy children, speech therapy techniques specific for this group need to be developed.

Keywords: Speech therapy; articulation; language; Punjabi; audiology.

Introduction

A partial or entire loss of hearing is referred to as deafness. The numbers are startling: 360 million individuals worldwide have permanent hearing loss. This represents a significant 5.3% of the global populace. In India, hearing impairment is also quite common and frequently occurs, 63 million individuals, or 6.3% of the population in India have severe hearing loss. Four children out of every 1000 had hearing loss ranging from severe to profound with more than 100,000 newborns suffering from hearing impairment each year. In India, the prevalence of deafness with an adult onset was assessed to be 7.6%, whereas deafness with a childhood onset was reported to be 2% (1). Deafness in infancy and early childhood is caused by a variety of circumstances and it is more prevalent in developing nations like India. These include a range of prenatal, perinatal, and postnatal variables (2).

Language, speech and cognitive ability development all depend on hearing. Hearing loss may have disastrous effects on a child capacity to learn, communicate and interact with others. Deafness in children is frequently overlooked since hearing impairment is an unseen handicap. Since the development of peripheral and central auditory pathways depends on exposure to a normal acoustic environment, a large decrease in sensory input causes changes to the anatomy and physiology of auditory pathways. If the child doesn't receive auditory rehabilitation by the perilingual phase, they may have permanent speech problems (2).

A child with speech and language impairments is less likely to succeed in school, in college, and in the workplace in the future (1). Children with hearing impairments can accurately produce several phonemes when they are isolated, but they have difficulty combining these phonemes into coherent speech, which reduces the intelligibility of their speech. Children with hearing loss exhibit errors in the production of vowels and consonants, most often replacements, distortions and omissions. Children with hearing impairments have been seen to produce fewer consonants in their speech than vowels (3).

Children with hearing impairments make distinct consonant mistakes at different word places. While replacement mistakes—especially those involving a mid-central—are more prevalent in the word medial position, addition errors predominate in the word initial position. Consonant mistakes in children with hearing impairments are associated with a lower intelligibility of speech. At the segmental level, phonetic errors in consonant production include distortions, replacements, omissions, and additions. Omission and substitution errors are the most damaging to the overall intelligibility of speech in deaf children (3).

There is lack of data regarding the articulation error rate in the deaf children both at national and international level. Moreover, being region specific, data on the articulation error rate in the local language are more scarce. The present study was aimed to develop the Visual- Punjabi articulation test (V-PAT) to assess the articulation error rate among the deaf children. This study will help in identifying the articulation problems in the Punjabi speaking deaf children of Punjab state and devise novel therapy methods to improve the articulation among these children.

Methodology

Study population: Ten hearing impaired bilingual Punjabi/Hindi-speaking participants, aged between eight to eighteen years were included in the study along with the 10 healthy controls. The V-PAT test was developed and tested to get range of scores in healthy and hearing-impaired. We hypothesize that showing the pictures of word involving the consonant to the with impaired hearing can improve their articulation.



Figure 1: An image from Visual – Punjabi Articulation Test (V-PAT).

Visual – Punjabi Articulation Test (V-PAT): The test consists of the picture of the words for all consonants of the Punjabi language. For each consonant, the V-PAT consists of three words and corresponding three pictures representing the initial, medial and final position of the consonant in the word (Figure 1). In the present study we have taken total 32 consonants and 3 Vowels in the Punjabi language. Some consonants in word at initial, medial or final position are minimal in Punjabi and therefore, 3 words with initial consonant position (15th, 20th and 35th consonant), 3 words with middle consonant position (33-35th consonant), and 2 words with final consonant position (34-35th consonant) were excluded. They have been instructed to them that I am going to show you a picture/ image of some words of Punjabi language. You will have to repeat one by one the same word as you see. In case you are not able to understand the images tell me and I will speak the word for you” (4).

Articulatory assessment and transcription: The articulatory skills of the 10 participants were evaluated using the Visual – Punjabi Articulation Test (V-PAT) through spontaneous picture naming words belonging to Punjabi language consonants and vowels representing with initial, medial and final position of the consonants. The duration of time required for each participant to do the exam varied, ranging from forty to sixty minutes. The frequency of mispronounced speech sounds was determined by counting the number of incorrect consonants productions for each participant's consonants. Correct productions of the target phoneme were scored '1,' whereas incorrect productions of each stimulus word got a score of '0'. This allowed the proportion of errors for each participant for a given phoneme to be calculated. After then, a phoneme was deemed to be an articulation error if it was wrong in one out of every five target words, according to the 20% criterion outlined by McReynolds et al. (5). The percentage of participants who produced more than 20% errors for each phoneme was recorded in order to determine which consonants were mispronounced most frequently.

Results

In the healthy, the articulation error was present for 6.45%, 18.75% and 15.62% consonants belonging to the initial, medial and final position respectively. For sound ‘Oo’rhaa’ and ‘Ngan’ngaa’ the articulation errors were most common and occurred in two positions of the consonants. There is total 6 long consonants in the Punjabi language, sound of which involve more than eight English alphabets. The articulation error rate of these long consonants was 1/6 (16.66%) for initial, 0/6 (0%) for medial and 1/6 (16.66%) for final position of the consonants. Similarly, there are two short consonants in the Punjabi language, sound of which involve less than six English alphabets. The articulation error rate of these short consonants was 0% for initial, middle and final position of the consonants (Table 1).

S. No.	Phoneme	Sound	Initial position	Response (%)	Medial position	Response (%)	Final position	Response (%)
1	ਓ	Oo’rhaa	oongli	100	bnauna	60	kyon	30
2	ਅ	Ai’rhaa	akh	100	guwandi	90	giya	50
3	ਏ	Ee’rhee	elaaj	50	gawaiyaan	100	rajai	100
4	ਸ	sas’saa	sohna	80	hisaab	80	glass	100
5	ਹ	haa’haa	haathi	100	luhaar	90	ghaah	100
6	ਕ	Kak’kaa	kauli	100	hakna	60	kanak	100
7	ਖ	khakh’khaa	khedna	70	makhan	100	akh	100

8	ਗ	gag'gaa	glass	100	angoor	100	tanga	100
9	ਘ	ghag'ghaa	ghar	90	beghar	60	kangha	100
10	ਙ	Ngan'ngaa			langhna	60	changa	40
11	ਚ	chach'chaa	chabi	100	khichna	70	uchaa	80
12	ਛ	chhachh'chhaa	chhat	100	macchar	100	aacha	50
13	ਜ	jaj'jaa	jeb	90	rajai	100	kaagaj	100
14	ਝ	jhaj'jhaa	jhag	100	khijna	40	majh	100
15	ਞ	Njan'njaa						
16	ਟ	tain'kaa	tamatar	100	matar	100	beta	90
17	ਠ	thath'thaa	thanda	80	baithna	100	ikaath	80
18	ਡ	ddad'daa	dabba	100	haddiyaan	100	laddu	100
19	ਢ	dhad'daa	dhid	100	kaddna	60	tedha	80
20	ਣ	nhaa'nhaa			manka	80	dakhan	100
21	ਤ	tat'taa	taadi	100	dattan	90	putt	100
22	ਥ	thath'thaa	thhal	100	hatheli	100	saathi	90
23	ਦ	dad'daa	dand	100	paidal	100	neend	60
24	ਧ	dhad'daa	dhuaan	100	madhani	80	kandh	90
25	ਨ	nan'naa	nimbu	100	lahnnat		jameen	80
26	ਪ	pap'paa	pagg	100	kapda	100	baapu	80
27	ਫ	phaph'phaa	phhal	100	safed	100	saaf	100
28	ਬ	bab'baa	bachhi	100	kabootar	100	amb	100
29	ਭ	bhab'baa	bhanda	100	sambhalna		khambha	100
30	ਮ	mam'maa	mulli	100	chamach	100	aadmi	90
31	ਯ	yay'yaa	yaar	80	fariyaad	80	rupaiyaa	80
32	ਰ	ra'raa	rona	100	amrood	100	ghar	100
33	ਲ	lal'laa	latt	100	glass	100	haspatal	100
34	ਵ	vav'vaa	vadda	80	halwai	100	tawa	100
35	ੜ				sarak	100	ghadi	100

Table 1: Punjabi phoneme and their sounds in the healthy group. The data showed the response for consonants for their initial, medial and final position in the word. Boxes highlighted in red showed the articulation error, rows highlighted in blue represent long consonants and rows highlighted in green represent short consonants.

In the hearing-impaired, the articulation error was present for 16.12%, 28.12% and 21.21% consonants belonging to the initial, medial and final position respectively. For sound ‘Oo’rhaa’, ‘Ai’rhaa’, ‘thath’thaa’, ‘dhad’daa’, and ‘yay’yaa’ the articulation errors were most common and occurred in two positions of the consonants. There is total 6 long consonants in the Punjabi language, sound of which involve more than eight English alphabets. The articulation error rate of these long consonants was 2/6 (33.33%) for initial and 2/6 (33.33%) for final position of the consonants. Similarly, there are two short consonants in the Punjabi language, sound of which involve less than six English alphabets. The articulation error rate of these short consonants was 1/2 (50%) for final position of the consonants (Table 2).

S. No.	Phoneme	Sound	Initial position	Response (%)	Middle position	Response (%)	Final position	Response (%)
1	ਓ	Oo’rhaa	oongli	100	bnauna	77.7	kyon	77.7
2	ਅ	Ai’rhaa	ankh	100	guwandi	77.7	giya	55.5
3	ੲ	Ee’rhee	elaaj	44.4	gawaiyaan	100	rajai	100
4	ਸ	sas’saa	sohna	55.5	hisaab	88.8	glass	100
5	ਹ	haa’haa	haathi	100	luhaar	88.8	gaah	100
6	ਕ	Kak’kaa	kauli	100	hakna	44.4	kanak	100
7	ਖ	khakh’khaa	khedna	66.6	makhan	100	akh	100
8	ਗ	gag’gaa	glass	100	angoor	100	tanga	55.5
9	ਘ	ghag’ghaa	ghar	100	beghar	44.4	kangha	100
10	ਙ	Ngan’ngaa						
11	ਚ	chach’chaa	chabi	100	khichna	88.8	uchaa	88.8
12	ਛ	chhachh’chhaa	chhat	88.8	macchar	100	aacha	66.6
13	ਜ	jaj’jaa	jeb	100	rajai	100	kaagaj	100
14	ਝ	jhaj’jhaa	jhag	100	khijna	55.5	majh	88.8
15	ਞ	Njan’njaa						
16	ਟ	tain’kaa	tamatar	100	matar	100	beta	88.8
17	ਠ	thath’thaa	thanda	77.7	baithna	100	ikaath	77.7
18	ਡ	ddad’daa	dabba	100	haddiyaan	100	laddu	100
19	ਢ	dhad’daa	dhid	88.8	kaddna	66.6	tedha	66.6
20	ਣ	nhaa’nhaa			manka	88.8	dakhan	88.8
21	ਤ	tat’taa	taadi	100	dattan	100	putt	77.7
22	ਥ	thath’thaa	thhal	100	hatheli	100	saathi	88.8

23	ਦ	dad'daa	dand	100	paidal	88.8	neend	100
24	ਧ	dhad'daa	dhuaan	100	madhani	55.5	kandh	100
25	ਨ	nan'naa	nimbu	100	lannat		jameen	100
26	ਪ	pap'paa	pagg	100	kapda	100	baapu	88.8
27	ਫ	phaph'phaa	phhal	100	safed	100	saaf	88.8
28	ਬ	bab'baa	bachhi	88.8	kabootar	100	amb	100
29	ਭ	bhab'baa	bhanda	88.8	sambhalna	44.4	khambha	88.8
30	ਮ	mam'maa	mulli	100	chamach	100	aadmi	88.8
31	ਯ	yay'yaa	yaar	66.6	fariyaad	77.7	rupaiyaa	88.8
32	ਰ	ra'raa	rona	100	amrood	100	ghar	100
33	ਲ	lal'laa	latt	100	glass	100	haspatal	100
34	ਵ	vav'vaa	vadda	88.8	halwai	100	tawa	100
35	ੜ				sarak	100	ghadi	100

Table 2: Punjabi phoneme and their sounds in hearing impaired group. The data showed the response for consonants for their initial, middle and final position in the word. Boxes highlighted in red showed the articulation error, rows highlighted in blue represent long consonants and rows highlighted in green represent short consonants.

Discussion

It is preferable that deaf children are continuously assisted with properly fitting hearing aids so that they might have the chance to hear sounds and spoken language. Present study aims to develop and test the Visual-Punjabi articulation test (V-PAT) as an aid to improve articulation errors in with impaired hearing. We hypothesize that showing the pictures of word involving the consonant to impaired hearing can improve their articulation. In the phase one of the study, V-PAT test was developed and tested on healthy normal group to get normal range of scores.

Kalra et al. conducted a survey among 1200 children in the age group of 5 to 12 years and the incidence of defective articulation was found to be 10.25% (6). In present study the articulation error was higher ranging from 16.12% to 28.12%. John et al. found that prevalence of speech disorder overall was 58%, with the most common subtype being phonological delay in 49% of in school-age children with hearing loss (7).

We have calculated the error rate using the 20% criteria described by described by McReynolds et al. (5) and previous studies may have used a different criteria. Recent study conducted by

Sreedevi and Mathew analyze the articulation errors in the Malayalam speaking children with hearing impairment have used the same criteria as present study (3).

The existing literature highlighted that consonants are more misarticulated than vowels, since vowels do not require as much precision in their articulatory positions compared to consonants (3). Since present study involve only consonants, further studies are requisite to compare the misarticulation rate in the vowels and consonants.

Targeting the mispronounced phonemes in articulation treatment will help with hearing impairments acquire spoken sounds more quickly and enhance the intelligibility of their speech. The current study brought to light common consonant errors made by Punjabi/Hindi-speaking children. Since this work was exploratory in nature, formal sample size calculations were not performed. However, our technique might be replicated in future research with a larger, statistically calculated sample. Research in other Indian languages may yield valuable insights for speech-language pathologists as they prepare therapies to improve the quality of life and speech intelligibility with hearing impairments.

Conclusion

It was found that Visual- Punjabi Articulation Test (V-PAT) was found to be an interactive method for assessing the articulation errors. The articulation errors in hearing impaired were present for 16.12%, 28.12% and 21.21% consonants belonging to the initial, medial and final position respectively. The articulation error rate was higher in hearing impaired children as compared to the healthy control group. The articulation errors were most common for sound ‘Oo’rhaa’, ‘Ai’rhaa’, ‘thath’thaa’, ‘dhad’daa’, and ‘yay’yaa’. Since articulation error rate was higher in hearing impaired than healthy group, speech therapy techniques specific for this group of children need to be developed.

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