Vowel Duration in Alaryngeal Speech

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Intelligibility depends highly on the acoustic, temporal and spectral characteristics of the speech. Various studies have indicated that measures of time were highly correlated with the overall judged acceptability of esophageal speech.

Based on the results of Christensen and Weinberg (1976), Weinberg (1982) commented that total laryngectomee produced changes in articulatory behavior as evidenced by altered durational characteristics of vowels. Robbins, Christenser and Kempster (1986) reported that the Te speakers exhibited the longest vowel durations on the three vowels /i/, /a/ and /u/. The normal speakers had the shortest duration while the esophageal speakers had intermediate values. The normal speakers did not differ significantly from esophageal speakers and the TE speakers did not differ significantly from esophageal speakers However /a/ was significantly longer in duration. Robbins et.al. (1986) suggested that the pulmonary air driven voicing source influenced the vowel duration in TE speakers. Further they attributed the increased vowel duration in TE speakers to the availability of larger air supply and the effect of the interposed prosthesis, creating an average airway resistance 3.5 times greater than offered by the normal language. They felt that the differences in vowel duration between TE and esophageal speakers represented the distinctive aerodynamic components of TE speech. They further speculated that the greater vowel duration in TE speakers may be attributed to greater air pressures and sustained flow rates driving the neoglottis producing a slower decay in RE. segment vibration.

The information about the vowel duration in alaryngeal speakers was considered to be contributing to understand the influence of phonatory control on the articulatory behaviour, thereby acceptability and intelligibility of speech, hence the present study was undertaken.

Methodology

Subjects: Three groups of male speakers namely, tracheo esophageal with Blom Singer prosthesis, esophageal and normals matched in terms of age, sex and number participated in the study. All of them were screened for hearing, motor and other sensory abilities.

In the first group five subjects who had a tracheoesophageal puncture (TEP) as a secondary procedure, having undergone laryngectomee earlier and using Blom-Singer's voice prosthesis were selected for the study. The mean age of this group was 57.4 years with a range of 50-69 years.

Alaryngeal speakers who used esophageal mode of speech formed the second group. The mean age of this group was 53 years with a range of 37-67 years.

Five normal laryngeal speakers matched for age and language with the alarybngeal speakers participated in the study. This group had no speech, voice or hearing impairments. The mean age of the group was 50 years ranging from 38-67 years.

Material

A set of six words were segmented from a standard Kannada passage read by the subjects. These words consisted of vowels /a/, /i/, *lul, lot* and *lei,* which

were free from any contextual influences like following or preceeding semi-vowels, glides and nasal sounds.

Method

All the subjects after adequate familiarisation read the passage at comfortable loudness levels and read into a microphone placed at a distance of 15 cms from the mouth. The reading samples of all the subjects were recorded on hi-bias metal cassettes using professional stereo cassette deck (Akai-CS-M4).

The speech samples of each subjects were digitised at the rate of 8khz using 12 bit VSS data input and output card by feeding the signal from tape deck to the speech interface units through line feedings. The digitised samples were used for analysis of vowel duration.

The mean and standard deviation was computed for all the three groups and "t" test was applied to find out the significance of difference between the groups.

Vowel duration

Vowel duration in milliseconds was measured for each vowel /a/, /\/, *lul, lei,* /o/from the spectrographic display. The vowels were identified on the spectogram and the duration from the onset of phonation indicated by the initial periodic striations of the first formant to the last vertical striations associated with the second formant were considered as the duration of the vowel

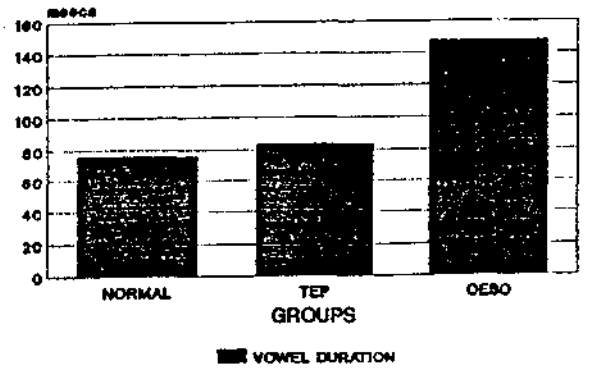
Results and Discussion

Tables I shows the mean, standard deviation and the range of vowel duration (m. sec.) of /a/, /i/, *lul, lei* and /o/ in esophageal, TE speakers and normals.

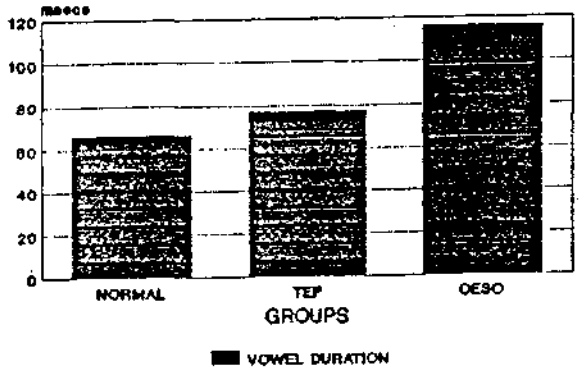
Consonants	Oesophageal		TEP		Normal	
	Mean	Range	Mean	Range	Mean	Range
/a/	147	62-304	83	50-125	76	39-97
	(96)		(33)		(24)	
tut	108	45-267	79	31-183	82	30-153
	(92)		(68)		(53)	
lot	85	58-96	97	80-106	102	65-132
	(18)		(10)		(27)	
/\/	116	86-146	77	62-100	66	57-80
	(24)		(15)		(9)	
let	77	58-100	64	46-97	86	63-122
	(16)		(19)		(21)	

Table - 1 : The Mean, S.D. (in parenthesis) and Range of Vowel duration (msec) of /a/. /\/, *l u l,* /o/, and *lei* in Oesophageal,, TEP and Normal Speakers.

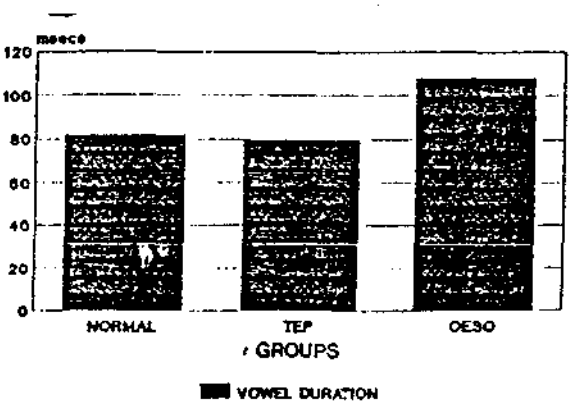
Graph I, II, III, IV, & V shows a comparison of the average vowel duration between the alaryngeal speakers and normal subjects for various vowels (/a/, /i/, /u/, *lei, 16).*



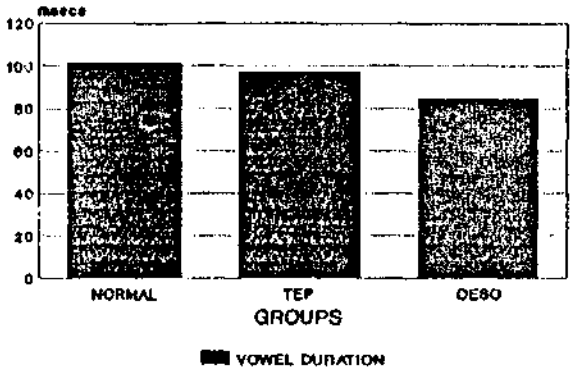
Graph-I : Mean Duration of /a/ in Normal, Tep and Oeso Speakers



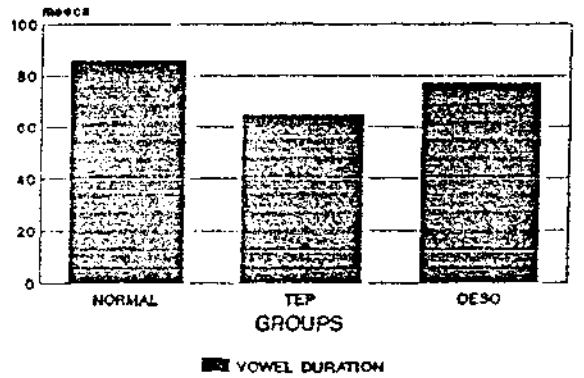
Graph-II : Mean Duration of /i/ in Normal, Tep and Oeso Speakers



Graph-III : Mean Duration of /u/ in Normal, Tep and Oeso Speakers



Graph-IV : Mean Duration of /o/ in Normal, Tep and Oeso Speakers



Graph-II : Mean Duration of */ei/* in Normal, Tep and Oeso Speakers

The alaryngeal speakers as a group exhibit longer vowel duration than the normal speakers. Increase in the duration of vowels /a/, */\/, /u/* in esophageal speakers was in agreement with the findings of Christensen & Weinberg(1976).

The results that TE speakers exhibiting longer duration for vowels /a/, */\/* and */u/ axe* similar to the results of Robbins, et.al., (1986) who also report longer duration of /a/, */\/,* and */u/* vowels. For vowels */ei/* and /o/ the reverse trend was noted i.e. the alaryngeal speakers exhibiting less than the normal values. However, statistically significant difference was not observed. It is also noteworthy that alaryngeal speakers also present with high degree of variability as is evident from the values, of standard deviation. The range of vowel duration is also greater in the alaryngeal speakers with the esophageal speaker demonstrating a higher values than the TE speakers.

The vowel durations being more in the alaryngeal speakers than in normals may be related to fundamental frequency of voice, nature of PE segment as demonstrated in the studies of Doyle, Danhauer, and Reed (1988). Furtherthey speculate that the differences in average vowel duration between the two groups of alaryngeal speakers may be due to the aerodynamic differences and the airway resistance provided by the neoglottis. Weinberg (1982) also comments that total laryngectomy produced changes in articulatory behaviour as evidenced by changes in vowel duration. The results of the present study are also in agreement with those reported in the literature.

Thus it may be concluded that the differences in the values of vowel duration from normal values in the alaryngeal speakers reflect their poor control over their new voice production mechanism, aerodynamic differences and air way resistance provided by the neoglottis. All these factors need to be considered and methods of evaluation developed for a successful rehabilitation of laryngectomees and improve their intelligibility.

Reference

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