A COMPARATIVE STUDY OF SPEECH IN SUBJECTS WITH OPENBITE MALOCCLUSION AND NORMAL OCCLUSION- A SPECTRAL ANALYSIS

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CERTIFICATE

This is to certifiy that tha dissertation, "A comparative study of speech in subjects with open bite malocclusion and normal occlusion- a spectral analysis", is a record of research work done by tha candidate, Dr. Miss. S. Indira, during the period of study for the M.D.S. degree in Orthodontics of the Banglore University and that the thesis prepared had not been formed previously the basis for the award to the candidate of any degree or diploma.

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INTRODUCTION

"Speech disorder", the common terminology used frequently consists of defects in articulation, rythm, voice and language usage. Of these, the disorders of articulation is the one which concerns the orthodontists most.

It is believed that a normal vertical and antero-posterior relation of teeth in the anterior region of the oral cavity is necessary for the proper articulation of speech. Hence, an anterior openbite may interfere in the articulation of certain sounds.

The Orthodontist has great interest in the alignment of the teeth and the speech pathologist concentrates his attention in correcting the speeches of individuals. In other words, both of them are interested in the function of the oral cavity. This mutual interest in the well being of a person leads to increased co-operation in studying some of the closely associated problems in both the fields.

As teeth take part in the articulation of speech, irregularities of the teeth, particularly the anterior openbite condition interested many investigators. Thus came the opinion of the investigators like

Joseph Pomerantz & Adolph Zeller[46], Damaste[17] and others that an anterior openbite malocclusion causes speech defects particularly of lisping. Lisping in a term referred to when there ie incorrect production of sibilant sounds /s/ & /z/.

In controversy with the above findings, Catherine Snow[12] stateo that defective incisor teeth usually do not interfere with the correct articulation of sounds. She found that children with missing incisor teeth articulated the sounds correctly while those with normal teeth did not make the sounds correctly.

Downey[15] also feels that 90% of speech disorders are functional in character and present primarily an educational problem.

Most of the work in evaluation of speech in anterior openbite cases have been done in foreign languages. A study has been done by K.R.Numim[59] in India using the English language in cases of anterior openbite malocclusion. His evaluation mathod consisted of clinical, phonetlcal and cephalometrics. His clinical and phonetical findings showed articulation errors in the malocclusion group.

In the present study, to avoid the possible

articulation disorder due to a foreign language other than the mother tongue, the children who had Kannada, the regional language, as their mother tongue and also second language in their school studies were selected.

Articulation disorders were evaluated by a group of speech pathologists who are trained to hear and find out the defect in articulation of speech sounds, As the hearing acuity varies from person to person, and as this in turn is influenced by the conditions of the nasopharynx and the climatic conditions, and other factors, a spectral analysis was included in order to throw more light on this problem.

REVIEW OF LITERATURE

An outstanding feature of the human beings is the ability to produce articulate sounds in comparision with the lower animals, who could not speak. A human being can think, reason and ultimately can express his ideas and thoughts by means of articulate sounds and language to his society so that he is well understood.

Speech is a complex phenomenon, and as teeth take part in the articulation of speech, a review of the literature on speech, malocclusion - particularly of anterior openbite anamoly - is quite enlightening.

SPEECH

According to the Webster's unabridged dictionary,[84] speech ie defined as the communication or expression of thoughts in spoken words.

Accoustically and organically, speech is breath or voice articulated or formed into speech sounds, transition sounds, syllables and breath groups with word stress, sense stress and intonations, by definite configurations and movements of the vocal organs.

Harlan H. Bloomer[39] (1963) defines speech as "a form of motor and symbolic behaviour that is learned and refined over a number of years. It follows relatively

definite pattern of maturation and is subject to environmental and physiologic influences in the long course of that maturation, its patterns are modified from time to time an the anatomic, physiologic, social and mental states of the individual change over the period of his lifespan".

Mechanism and physiologic aspects of speech :

Speech is produced by the combination of two sets of function (4) :

Vocalisation mechanism - includes larynx and the organs of resonance. They are the chest, the pharyngeal cavity, the nasal cavity, oral cavity and the various cranial sinuses, (especially maxillary, sphenoidal, frontal and ethmoidal sinuses). The resonating chambers aid in the reinforcement and increase in the volume of tone.

The mechanism of articulation - includes the tongue, lips, teeth and hard and soft palates. It is important to note that in reality the most important organ of speech is probably the ear. Since speech is learnt in infancy through auditory stimulation, a perfectly functioning hearing mechanism is an essential pre-requis te to the development of normal speech. From the beginning of babbling speech sound of infancy to about the 3rd year of life, the young child io constantly monitoring between

his speech and hearing mechanism as he masters speech and language formations.

The act of speaking after all, is an overlaid function, that is man has for communicative purposes certain organs and processes, which basically perform life saving functions. This is true of the respiratory organs, it is no less true of the organs of phonation, since the larynx is first of all a life saving valve. It is also true of the process which underlie the articulation of speech - the structure or function of oral mechanism is disturbed to the degree that the muscular movement pattern of chewing and swallowing are over modified, the physiological subsoil is prepared for misuse of the same organs in the articulation of speech, In other words, one articulates speech no more satisfactorily than he chews and swallows.(70)

The larynx is very important in the production of speech and is referred to as the voice box. This is situated at the upper extremity of tho trachea. The bony framework is composed of modified rings of cartilageous as found in the trachea. The larynx is composed of laryngeal cartilages, the most important of which are the cricoid, thyroid, the two arytenoide and the epiglottis. Also tho true and false vocal cords and the laryngeal msucles.

The vocal cords are attached in front of the thyroid cartilages and in the rear to the arytenoid cartilages. The opening between the two sets of vocal cards is the glottis. The movable organs of speech are the vocal cords, soft palate and the tongue and lips.

There are no speech organs as sach. Each of the organs just mentioned was designed for a variety of functions. The vocal cords have the additional protective function of preventing foreign, material from getting into the lungs, and that is why speech and swallowing cannot go on simultaneously. The other physiologic components of speech mechanism play integral part in respiration, deglutition aad many other vital processes.

Speech is not a static phenomenon, but it is a live, dynamic process and results in definite actions perforated by the organe of speech.

Whilst man may have an inborn instinct for some form of expression by which emotions can be expressed. as is shown by different cries of a baby to express hanger, anger or pain, man does not speak by instinct; articulate speech has to be learnt. The learning and perfection of speech parallels the development of occlusion in the deciduous and early stages of the mixed dentition, beginning about the 5th month.

Elizabeth McDowell[18] (1955) states that "every-

thing else being equal, normal speech can be produced, if there is a fairly low and wide palate, a normal sized tongue whose tip is freely movable, a flexible uvula which can close off the nasopharynx, unobstructed by adenoide or any other growth and teeth free from open space between them and which can be closed with a relatively complete obstruction of air. She further states that when such conditions do not prevail, rather definite and consistent types of phonetic responses result.

Voice may be stated as a column of breath of exhaled air, set in vibration by its own impact with the vocal cords, and may be amplified by the addition of overtones in the resonating chambers. (Air molecuses above the vocal cords are set in vibration due to the pulsating action of the vocal cords, not only at a frequency corresponding to the movement of the vocal cords, but also at the same time multiples of these frequencies called overtones, partials or harmonics.) However, it must be modified by the action of the organs of articulation before speech is produced.

Both Gardner[27](l949) & Rathbone[27] (1955) state that many children do not perfect the formation of these consonant sounds like f , th , s , sh and sh until they are seven years of age.

Hopkin and HcEwen[38] (1955) state that most children start talking by three years of age but complete mastery of all consonants is not to be expected until later, particularly the sounds f,th,s,sh, & zh.

Michael Barge[54] (1965) feels that for the initiation of speech, a nervous and endocrine system is necessary to set the speech structures into motion and co-ordinate all the processes involved. The articulators are the structures which act as valves to stop the air stream or to narrow the symbols. The articulators include lips,lower jaw, posterior pharyngeal wall and inner edges of vocal folds, hard and soft palate and the tongue.

DEFECTIVE SPEECH & MALOCCLUSION.

Ramsay[69] (1937) in a study using indirect palatograms found that 80% of lispers had malocclusion.

Gardner[27] (1949) & Rathbone[27] (1955) state that 'a' sound is one of the most commonly found defective sound which is mastered last in the learning process.

Bernett Frank[4] (1955) defines defective speech as "speech which attracts attention to itself becauce of presumable faults of articulation, breathing, rate, pitch, volume, quantity, stress, expression or comprehension of the spoken words,"

The impact of defective speech on the listner is so great that he is often concerned to a greater degree with how much the words are being uttered than with the thought of the message.

He classifies defective speech as functional, organic and psychological.

Functional disorders appear due to a functional misuse of the speech mechanism which is capable of producing normal speech.

The organic disorders an those that result from a pathological involvement of either the speech mechanism or some related mechanism and psychological disorders include those which are predominatly emotional in nature.

The most important in the functional group is the articulation defect. They are in the from of distortions, substitutions or omissions of consonants and vowel sounds in speech.

Speech pathology also deals with speech defects of rythm, voice and langaage. Symptoms of rythm defects occur in blocking, repetitions, prolongations and avoidance of stuttering and in the slurred and irregular syllabifications of cultured speech. Voice disorders include the phonatory manifestations of the laryageal pathoses and dysfunctions and the resonatory function of the resonatory cavities of the month, pharynx and nose.

Bernett Frank[4] (1955) state that 80% to 90% of people who lisp also have a dental malocclusion. Normally, the teeth serve as a sounding board for the sibilant sounds of 's' and 'z', but if the tongue gets in between the teeth, it acts as a damper and modifies

the sound produced. Therefore, any abnormality of the anterior teeth may interfere with theproduotion of sibilant sounds. He also feels that children develop lisping if the upper central incisore have been lost. In his openion lisping in older children is associated with class II and class III malocclusion or openbite.

He further puts fourth the point that anterior openbite may result in the lingual protrusion lisp, that is, 'th' for the normal 's' sound. They will also have difficulty with the lingue-dental sounds of voiceless 'th' (thank) and voiced 'th' (this), 'ch' & 'sh' also nay be defective in these cases.

Kalervo K. Koivumaa[49](1956) conducted an oscillographic study of 's' sound in a patient who had 4 mm. of space between his upper anterior teeth and lower anterior partial denture, a condition simulating an anterior openbite. The production of 's' was in-accurate and distinct. An onlay was fitted to the denture to correct the openbite and after two months, the pronounciation of 's' sound in selected test words when compared with that of a phonetically perfect 's' showed a clearer and distinct pattern with the onlay than without it.

Bernstein N.[10] (1957) examined 11,243 children of 6 to 17 years age group to determine whether any significant difference exists in the number of malocclusion found in a group of children with speech defeets and in a similar group with normal speech. Out of 11,243 children, 712 were defective speakere and he found that defective speakers do not have a greater number of malocclusion than normal speakers, speech defects are not related to malocclusion generally, except in openbite cases. In openbite cases, the severity of lisping does not vary with the amount of openbite or with the amount of overjet.

Joseph Pomerantz & Adolph J.Zeller[46] (1965) examined 253 children and found non-normal speech in 104 children, the most defective speech sounds were 's' and 'z', voiced 'th' and '1'. No significant difference was found between the sexes . Also no significant relationship was found between speech disorder and abnormal tongue function. No significant relationship was detected between defective sounds and anterior open bite as well as edge to edge occlusion.

There are many etiological factors cammon to both problems, that is, speech and malocclusion. The malocclusion being a coincidental factor, emotional

disturbance in children is recognised as a cause of defective speech, many of then may have aconcommittant malocclusion.

Armpld[1] (1958) states that lisping was move commonly observed among female patients and may be accompanied by varying degrees of functional hypernasality.

Jann H. W[45] (1960) observed that by 8 years of age, a child will normally have learnt and be using all of the consonant sounds.

Catherine Snow[12] (1961) examined the articulatory defects of 438 children of 6 to 8 years of age who had missing upper anterior teeth. She tested six consonant sounds, that is, 'f', 'v', 'th', 's', 'z', 'dz' and compared then with the normal samples. She found that most of the children with missing teeth made the sounds correctly than children with normal teeth who did not make the sounds correctly. Hence she concluded that defective incisor tooth usually did not interfere with the correct articulation of the dental sounds studied.

Fymbo L. H.[25] (1962) state that most observers seem to agree that persons with defective speech articulation tend to have a proportionately high incidence of malocclusion. This statement does not necessarily mean

that malocclusion is the cause of defective speech.

Fymbo L. H.[24] (1962) found that 38% of his speakers who had severe malocolusion and 24% with facial deformity resulting from malocclusion had satisfactory speech.

Fairbanks & Leutner[23] found that 10 out of 30 young adults who were rated as superior speakers had one or more marked dental deviations.

Harlan H. Bloomer[39] (1963) devised a chart which identifies the various relationships as follows :

Abnormal structures + normal movements = normal speech.

Abnormal structures + maladaptive movements = abnormal speech

Normal structures + maladaptive movements = abnormal speech

Abnormal structures + adaptive movements = nomal (compen–satory) speech.

As per Van Riper[83] (1965), "speech is said to be defective when it deviates so far from the speech of other people that it calls attention to itself, interferes with communication or causes its possessor to be mal-adjusted."

Michael Marge[54] (1965) says that the dental abnormalities are found more frequently among individuals with speech disorders, and these dental abnormalities frequently influences speech pattern advereley, but usually are not the primary cause of speech disorders.

OPENBITE, TONGUE THRUST & SPEECH.

Anterior openbite malocclusion is a type of malocclusion of teeth where one or all the six upper anterior teeth fail to maintain the normal overbite in the vertical plane.

Graber[28] defines openbite ae a condition wherein a space exists between the occlusal surfaces of the maxillary and mandibular teeth in the anterior or buccal segments when the mandible is brought in to centric occlusion.

Daniel Subtelay & Mamoru Sakuda[71] (1964) stated that the definition of openbite differs among various authors and investigators. While quoting the opinion of others, he says that the condition can be called as openbite even When there is less than an average over-bite or an edge to edge bite or a definite degree of openness oust be present between the occlusal surfaces of the teeth.

Hence, to call a condition as openbite, there should be a definite lack of contact in the vertical direction between the opposing segments of the teeth. They further stated that the degree of openness can vary from person to person, but an edge to edge bite or some

degree ef overbite cannot be rightfully called as "openbite".

For the same condition, Nafe C.W. & Kydd .L[60] called "partially occluded dentition".

Openbite may be skeletal or dento-alveolar in origin. It may occur in the anterior region or posterior region of the oral cavity or both. Out of the two types, anterior openbite is more common in occurance than the posterior openbite, in which case, a number of teeth of both opposite buccal segments may fail to reach occlusion, though there is on incisal contact.

Hatfield [40] (1919) after examining 900 rachetic children concluded that the dental arches were on the whole well formed and developed, and there was nothing characteristic about them than the normals.

Many investigators like Thoma[81] .'Salzman [76], Graber[29] and Brash[7] considers rickets as the causative factor for the openbite malocclusion.

Hellman[34] (1931,34) examined openbite malocolusion and said that it not only involves the growth of the mandible but also an arrest of growth in the incisor segments and suggests that if growth is favourable, then the prognosis is excellent.

Decoster[16] (1934) agrees with Hellman and says that along with the growth arrest in the mandible, a lesion also extends to upper jaw and to the base of the cranium.

Nord[61] (1937) said that openbite caused by bad habite like finger and thumb sucking is commonly seen in decideous dentition and those due to tongue thrust-ind is seen during the change from deciduous to the permanent dentition.

McCoy[56] (1937) states that these bad habits operate so quietly and unconsciously that the child is unaware of the condition.

Hass[36] (1937) reported that all children including the breaet fed babies showed sucking habits up to 2 yeare of age and it decreases as the child grows. He also said that the greatest deformity of jaws and teeth develop in thumb sucking children if it is predisposed with rickets, bottle feeding or severe retrusion of mandible at birth.

Froeschels[20] (1937) found that lisping was due to tongue position and activity and not due to mal-occlusion.

Levy[53] (1938) observed openbite in a monkey who had a constant finger sucking habit.

Among 38 thumb sucking children examined by Swineheart[71] (1938), 90% had protrusion of maxillary teeth, 64% had openbite and 40% had retrusion of mandibular incisors.

Johnson[44] (1939) stated that the malocclusion caused by thumb sucking usually gets corrected if the habit ceases and lip function improves.

Campion and Campion[11] (1931) analysed two cases of openbite and found that the distance- nasion to upper first permanent molar, nasion to submental point, height of palate and length of the upper arch in one case were greater than the normal sample while the width between the upper first premolars was less than normal. In the other case nasion to subnasal point, nasion to upper first permanent molar, nasion to sub-mental point and zygomatic width were greater than the normal range of variation.

Brown and Loach[8] (1939) showed openbite in the cases of musclar dystrophy. Brown[8] (1939) described 5 each cases as a result of paralysis of facial muscles.

Jutkowitz[41] (1941) reported a case of openbite which oven after treatment showed an increase in the total face height.

Swineheart[72] (1942) examined 112 children and found that 55.6% openbites had Angle's Class I malocclu-

sion, 40% had Angle's class II malocclusion and 4.4% had Angle's class III malocclusion.

Swineheart [75] (1942) also stated that he found little evidence of genetic or congenital etiology for openbite malocclusion.

McCalls[55] (1944) found an incidence of 8.5% of 2 to 6 years age group and 4.1% of 7 to 11 years age groups falling into the openbite malocclusion group.

Rix[67] (1946) found that 81% of tongue thrust swallowers had malocclusion including openbite in compa—rision to the 36 % who were normal swallowsrs.

Rogers J.[65] found that 57% exhibited tongue thrust swallowing and he found 92% association between openbite and abnormal swallowing.

Massler & Wood[57] (1949) said that if the finger sucking habit continues beyond 2 years, it indicates some emotional disturbance in the child. They felt that malocclusion of mixed or permanent dentition caused by habit are not self corrective.

Hausser[35] (1952) found shallow glenoid fossa and a very low articular eminence in anterior openbite cases.

Strang[73] agrees with Swineheart[72], subtelny D.J. and Manoru. Sakuda[71] that openbite cases often show vertical growth deficiencies of the ramus, posterior supra-occlusion, obtuse mandibular angle, downward bending of the angle and also presence of habits like thumb and finger sucking and abnormal swallowing.

Ruttle et al[68] (1953) studied dental changes in 36 children with sucking habits and found that there was definite openbites in 28% of cases. In all but one cases the habit started at first year of life and the maxillary arch formed was modified by elongation of anterior teeth producing spacing and labial inclination of anterior teeth,

Pruzansky[63] described severe openbite in a boy of 8 years who had an attack of poliomyelitis.

Anderson et al [3] (1933) produced failure of jaw growth, crowding of teeth and openbite by injecting testo-aterone (male sex hormone) to six month old rhesus monkeys.

Siepel et al[78] (1954) found an associated hyper-trophy of the tongue with injection of sex hormone.

Hovel[33] (1955) said that anterior tongue thrust with teeth together swallow causes proclination of and prevents the eruption of the upper and lower incieors, thus resulting in anterior openblte with proelination.

If lip posture is normal then the openbite produced will be of considerable degree with very little incisor overjet. In tooth apart swallow with tongue thrust, the anterior openbite is less marked because separation of the jaws allows room for the tongue to protrude without impeding the eruption of incisor and these may in fact be no openbite at all.

Arsen & Kemp [2] (1955) demonstrated that from cinefluorographic methods, the tongue went in between the teeth during swallowing in persons with no obivious facial or associated dental deformity or known abnormalities of speech or swallowing.

Hopkin & McEwen[36] (1955) supports the view that in general, speech defects are as likely to be found with normal occlusion as with malocclusion. No definite relationship between tongue behaviour and lisping was established.

Ballard et al [6] (1936) believed that both soft and hard tissue of dento-alveolar structures confirmed to aa inherited pattern and this charecteristic morphology remains remarkably constant and cannot be changed either by treatment or by soft tissue behaviour. They concluded that persistant thumb sucking can aggreviate the condition that is existing but it never causes it.

Brash J. C[7] (1956) concludes that openbite in the incisor or canine region is probably due to a failure of growth of alveolar process involving anterior segment of one or both jaws.

Rydd[66] (1956) estimated a force of 5.2 pounds anteriorly and 2.5 pounds posteriorly by the tongue in abnormal awallowers.

Theodore K. Wendorff[81] (1956) compared cephalometrically 45 cases of openbite with 41 cases presenting some other type of malocclusion. His analysis did not corroborate earlier findings that openbites were associated with either a short ramus, larger gonial angle or some other cranial deviations. He found a supraeruption of Maxillary solars and increase in the lower face height.

Barber & Renfroce[9] (1957) in an article entitled "Interceptive Orthodontics", states that various types of tongue thrusting occurs in conditions like lisping, abnormal swallowing and resting with the tongue protruded.

Habitual resting of the tongue between the anterior teeth occur in lisping and during swallowing procedure. Passive anterior thrusting of the tongue also occurs when the mandible is brought into normal rest position. This is seen in children who were watching a movie or conic with their tongue thrust between their

teeth. Such a habit may or may not interfere with the eruption of teeth or speech.

Francis[21] (1958) states that in cases of maxillary protrusion with openbite and tongue thrusting, 's' & *z* become interdental or the tongue is slightly protruded between the teeth at the same time being pressed behind the teeth and giving the form of 'th'.

Francis further states that ten sounds, 'n', 't', 'a', 's', '1', 'th', 'v', 'f' and 'dz' should not be made on the upper front teeth in normal articulation but on surfaces near them. The wrong articulation on the teeth have some significance in assessing the effect on the teeth, especially when accompanied by the tongue thrusting. It is believed that probably tongue thrusting ia the basic cause of incorrect articulation. It may also be suggested that even if tongue thrusting ia overcame, the uncorrected articulation may maintain the teeth in malocclusion due to constant pressure exerted during speech.

Jaraback[43] (1959) states that posterior cross bite may result due to the adverse muscular forces associated with thumb sucking.

Even though there aye good grounds to believe that anterior teeth irregularities caused by sucking

habits, the modern tendency is to attribute most mal-occusion to hereditary factors.

jann H. W.[45] (1960) found an incidence of 10% of openbite cases in six year old children.

Hainz C. Brande[37] (1960) found 25% increase in the incidence of openbite in thumb sucking children. He concluded this after examining 700 Israeli children.

Strang[73] (1958) is of the opinion that openbite is produced mainly by two conditions namely extrinsic and intrinsic causes. Extrinsic causes are these substances like baby comfortere, blankets, toys and finger and thumb which can cause openbite and intrinsic causes are abnormal use of oral structures like lips, cheeks and tangue.

Smith [74] (1960) said that it is more prevalent to see openbites in bottle raised than cup raised monkeys and also more prevalent in males than female monkeys.

Straub[76] (1960) describes abnormal swallowing as a syndrome which includes thrusting of the tongue, absence of closure of mandible and maxilla, and over-activity of the orbicularis oris muscle. The patient shows a strained musculature about the face and throat, where as normal act of swallowing is very relaxed.

Various names have been given to the abnormal swallowiag nemely tongue thrust swallow, atypical swallow, visceral swallow, etc. All these basically describe the clinically observed "Tongue protruding between the teeth during swallowing."

Law's[52] cineflnorographic study revealed a consistent difference in the initiation phase of the swallow in both normal and abnormal swallowers.

Jana H. W.[45] (1960) observed the frequency of swallowing to be 150 times and feels for an early interruption of the habit to prevent development of severe anterior openbite.

Dixon[14] (1960) showed that an imbalance of the muscle force exists in the lingual and outer aspect of teeth and the tongue pressure is always greater in malocclusion causes having abnormal swallowing habits.

Peter Blyth[64] (1959) in concluding his cephalometric study of interdental sigmation stated that the skeletal morphology has little if any influence in the production of such a sigmatism. He says that there is an extremely close relationship between Angle's Glass II, division 1 malccclusion and abnormal swallow. He cautions in interpreting this statement saying that, it ie not the indoor relationship which is the cause of speech

defect, but rather the tongue behaviour with which it is associated. It is the latter which is one of the causative factor in producing each a malocclusion.

Fletcher, Casteel & Byadley[22] (1961) found a significant number of articulatory problems accompanied by tongue thrust swallowing.

Jaan H. W.[45] states that in perverted swallowing the sounds 't', 'd', 'n', '1', 's', 'z' & 'sh' may become interdental or lateral emissions, the africates 'oh' and 'j' (dz) may also become interdental or lateral emissions 'r' may be distorted and '1' may be omitted or incorrectly pronounced.

Guha[26] (1961) mentions that at birth a space exists in the anterior region of the gum pads when the mandibular and maxillary gum pads come in contact. In that space, tongue will be seen lying. Thus an (anterior) openbite of gum pads ie a normal condition in the foetue and at birth. It may persist up to the eruption of the deciduous teeth.

Openbite seen in the deciduous dentition may persist in some cases even after the eruption of the permanent teeth. Hence openbite seen ia permanent dentition ie considered to be pathological.

Fletcher, Casteel & Bradley[22] (1961) also agrees with Straube's description of abnormal swallowing and further says that there is diminution or absence of palapable contraction the muscles of mastication during swallowing act.

These three workers have also shown that the subjects with a tongue thrust swallowing pattern were much more likely to have an associated sibilant distortion than the subjects without abnormal swallowing pattern. Also they did not find significant relationship between age and sibilant distortion in tongue thrust swallowere, whereas sibilant distortion was statistically related to the age of the patient ia normal swallowers and it decreased with increased age.

Windere[84] (1962) recorded a pressure of 207.62 gms. per sq. cm on the maxillary central incisors in atypical swallowers.

Subtelny & Subtelny's[79] (1962) cephalometric study of Class II division 1 malocclusion causes during the production of 's' sound revealed that the maladaptive group or defective speakere fronted their tongue tip to a greater degree both at rest and during function, in comparision to the group that adapted to the malocclusion. In

the adaptive group, the tongue tip was related to the lingual surface of the lower incisor.

Newmann et al[62] (1963) estimated that an average individual swallows 1,600 to 2,000 times per day, whereas Flangen J. B. et al[19] (1963) estimated it to be 560 times per day.

Bella C. Cunvary[6a] (1963) calculated the force to be 2 to 5 pounds and the number of swallowing being 1,200 to 1,600 times per day in normal swallowers.

Kydd[50] (1963) showed by eleotromyographic studies in openbite cases that there was a definite imbalance of force between the tongue and oro-facial muscles and the force exerted on the teeth by tongue waa double and of longer duration in openbite cases than in the controle.

Graber[29] (1963) opinioned that the existing structural mal-relationship initiates the swallowing prooess of abnomal type. In some cases lip biting develops which leads to labial proclination of maxillary teeth and openbite.

Daniel Subtelay & Mamoru Sakoda[72] (1964) while finding out the incidence of openbite gives an incidence

of 4.2% of 6 year old children and 2.5% of 14 year old children having openbite malocclusion.

They also list three etiological fasters to be associated with openbite being, vertical growth deficiencies, dis—proportionate muccle groeth or abnormal muscle function and habits.

Milton P. Gellin [58] (1964) points out that probably conditions like tonsillitis or pharyngitis, tongue morphology, respiratory obstruction, long nursing period, inherent morphogenetic pattern of malocclusion, residum of digital sucking and/or imitation may be responsible for tongue thrusting habit.

Hapak F. M.[32] (1964) studied 52 openbite cases cephalometrically using Down's method and his sample revealed a Class II tendency. The total face height was greater in the sample studied.

Daniel Subtelny & Mamoru Sakuda [72] (1964) who studied openbite malocclusion extensively concluded that seldom one finds a single etiologic factor in the development of openbite, but a pattern of complexley arranged inter-related causal factors art projected as the best reference from which to diagnose. They feel that directly and indirectly the age gradient is an important factor in

the causation of openbite malocclusion as it was seen that the incidence of malocclusion was greater in thumb and finger sucking children who were youngsters. Also tongue is disproportionately large in relation to the skeletal jaws at the time of birth which may persist for a considerable period of time. Thus an openbite may be caused and maintained for a number of years. In such cases, until adequate growth occurs, the openbite condition persists.

Cineradiographic work by Cleall J.[13] (1965) confirmed the observation of Arden and Kemp.

Salzman[77], Graber[29] & Thoma[82] accounted macroglossia as an etiological factor for openbite. It is also an unusual symptom in cretinism, lymphangioma, hemangioma and mongolism.

Hackworth H. B.[31] (1965) noted that charecteristically the tongue thrusters displayed their tongue positions more anteriorly than normals during speech as well as during swallowing. They probably made lingual dental or tongue teeth contacts during the production of speech sounds Which normally require lingual alveolar contact or tongue tip oontaot with the anterior alveolar ridge. He found the speech sounds to be accoustically acceptable.

Kudd, Akamin, Mendel & Kraus[51] (1966) found that abnormal swallowers exerted more pressure upon the maxillary anterior teeth than the normal swallowers.

Keff & Kydd[60] (1966) found that the frequency of deglutition was double in normal swallowers than in atypical swallowers.

Munim K. R.[59] (1966) showed in a group of 15 openbite cases compared with normal occlusion cases, - both speech analysis and cephalometric study of tongue position - that there was articulation disorders of 's', 'z', 'sh', 'r' & '1'. His cephalometric analysis showed that maxillo-mandibular plane is longer, there was less depression of the mandible and a greater thrusting of the tongue tip during the production of the sound 's' in openbite cases. He also stated that sigmatism was of common occurance in cases of anterior openbite malocclusion.

Thus, there is complete agreement by most workers that the presence of tongue being thrust between the teeth prevents their full eruption causing an openbite of varying degreee.

The problem of openbite regarding etiology and speech disorders has drawn the investigators attention

from the beginning of this century. As the etiologic factors are many, it is very difficult to conclude what exactly causes openbite and speech defects. Even though there are good grounds to believe that the anterior teeth irregularities is caused by smoking habits, modern tendency is to attribute most malocclusions to hereditary factors. Many investigators have studied the tongue function and articulation of speech as tongue was found to be an essential organ for speech. It still requires much work to be done regarding speech and malocclusion in the field of orthodontics before substituting therapy in euch cases.

MATERIALS AND METHODS

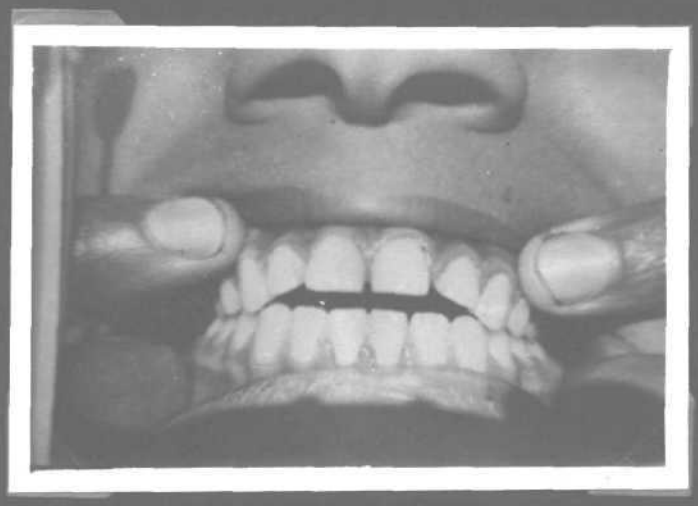


Fig. 1. a. Showing minimum openbite malocclusion.

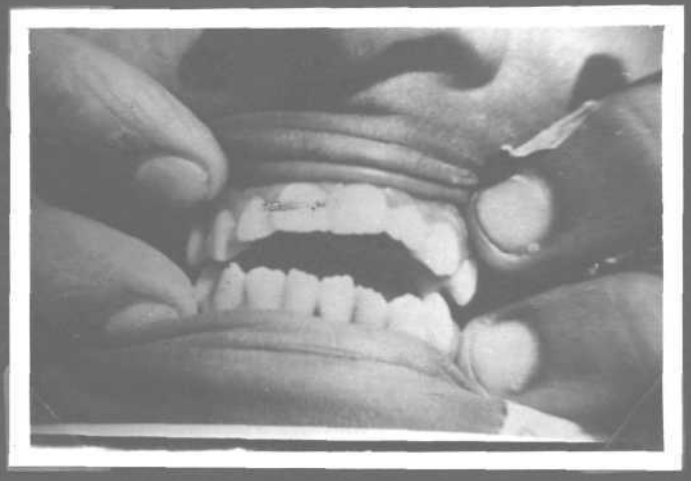


Fig. 1. b. Showing maximum amount of openbite malocclusion.

Fig. 1. c. Showing tongue thrusting into the space caused by openbite.

Fig. 2. Showing a case of normal occlusion.

The material for the study was drawn from a sample of 47 cases, 23 having normal occlusion and 24 cases having anterior openbite malocclusion. The age group was between 12 to 16 years for both types. The selection of these children were made from the High schools of Bangalore City. Both the groups had Angle's Class I molar relationship. In the case of normal occlusions, an overbite of two to 3 mm. and an overjet of 2 to 3 mm. with a slight overlapping of a single tooth in the arch if present was accepted as normal for the present study. Any Class I case with anterior spacing was not included. The opanbite group had Class I molar relationship. The minimum openbite was 2 mm. and maximum being 7 mm. Anterior openbite cases with Class II molar relationship was not included.

The three phonemes ಸ, ಜ, ತ /s/,/dz/ & /t/ were need for the present study.

Test sentences and some non-sense syllable consisting of the above three phonemes /a/,/dz/,/t/ were constructed in consultation with the speech pathologist. Simple words without any blends and words below their understanding level were chosen. These words were of common usage in the daily life. The 3 phonemes occured either in the initial, medial end final positions of the test words.

The sentences and the non-sense syllables used are as follows :

ಸ /s/

ಸರಸ ಮೊಸರನ್ನು ತಿಂದಳು

Sarasa mosarannu tindalu.

ಸರಳನ ಕೆಲಸ ಅರಸನಿಗೆ ಸರವನ್ನು ಪೊೀಣಿಸುವುದು.

Saralana kelasa arasanige saravannu ponisuwudu.

ಅರಸ, ಸಾವಿರ, ಸಿರಿ, ಸುಲಿಗೆ, ಸೇವಂತಿಗೆ, ರಸ, ಆಸೆ, ಈಸೆ

Arasa, Savira, Siri, Sulige, Sevantige, Rasa, As, Is, ಊಸ್, ಈಸೀ, ಕೂಸು.

Us, Isi, Kusu.

ಜ /dz/

ವಿಜಂತುನಗರದ ರಾಜ ಜಂತುಸಿದನು.

Vidzyanagarada radza dzyisidanu.

ಭೊೀಜರಾಜ ವಿಜಂತುನಗರದ ಜನಪ್ರಿಂತು ಪ್ರಜೆ.

Bhodzaradza Vidzayanagarada dzanapriya pradze.

ತ /t/

ತಗಡು, ತಾಂತಿತ, ಅತನು.

Tagadu, Tayita, Atanu.

ಅತನ ತಗಡಿನ ತಾಂತಿತ ತಳತಳನೆ ಹೊಳೆಂತುತ್ತಿದೆ.

Atana tagadina tayita talatalane holeyuttide

A detailed examination of each case was done, and the findings recorded ia an examination chart shown below.

Examination Chart

Sl. No. Code No. Age.
Name. Date of Birth.
Address. Sex.
Case examined on.

General History and Examination :

Built.
No. of brothers/Sisters,
Any of them having similar conditions.
Mother tongue and second language.

Examination of face:

Morphological.
Type.
Profile.
Physiological.
Lip seal.

Examination of Ear, Nose and Throat:

Hearing. Nasal passage. Tonsils/ Adenoids.

Speech :

Swallowing pattern.
Oral habits, duration, intensity.
Previous treatment - Dental/E.N.T./Speech therapy.

Detailed Examination:

Condition of the mucosa in different regions, Buccal/Lingual, Anterior/Posterior.

Teeth present:.....

Arches in occlusion :

Antero-posterior molar relation.
Vertical relation of incisors.
Amount of openbite as measured with a pair of dividers.
Transverse relation of posterior teeth.

The amount of openbite was measured from the mesio-inoiso-labial point angle of upper central incisor to the corresponding point in the lower central incisor.

None of the children used for the study either had orthodontic treatment or speech therapy.

Each case was given a copy of the test sentences and was asked to read in their method of daily reading without giving any prior training regarding the passage reading. It was recorded on a COSSOR, 4 track tape recorder at 3 and 3/8 speed. Also each case was given a code number. The cases of openbite and normal occlusion were mixed up during recording.

The sibilants /s/ & /z/ are the phoneme which are said to be defective in anterior openbite cases, In the study, स /s/ was evaluated in detail by the speech analysis, oscillographic and by visible apeeeh apparatus, whereas त /t/ & ड /dz/were included for analysis only with the help of speech pathologist for articulation disorder.

The analysis of the data was carried out in the following manner.

1. The speech samples were evaluated by a group consisting of a speech pathologist and some final year students of the Logopaedics course, at the All India Institute of Speech and Hearing, Mysore. The above group had a fairly good knowledge of the language used for the study.

2. A spectral analysis of the recordings was carried out at the Postgraduate & Research Institute, Deocan College, Poonn-6, (Phonetice Laboratory), with the help of an Ocscilloscope for the phoneme /s/ for 5 random cases, three of which wore opeabites and two were nornal occlusion cases.

3. A spectral analysis of the whole recorded data was also carried out at the above laboratory with the help of visible speech apparatus - type SR-l.

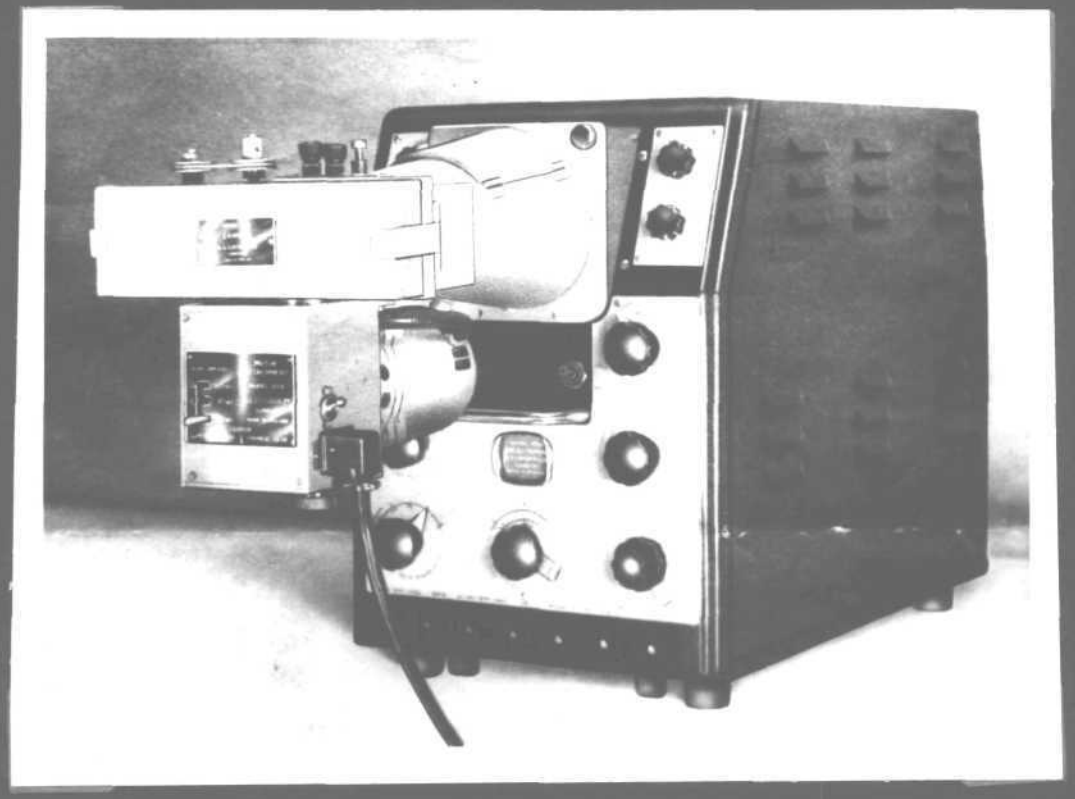
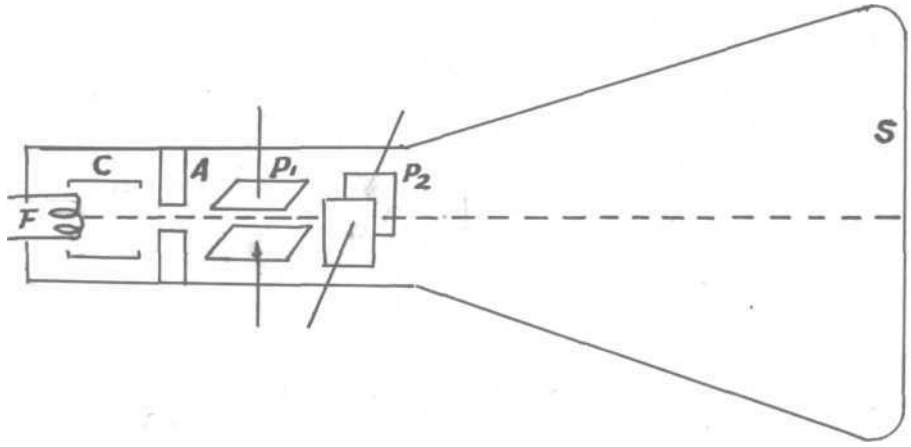


Fig. 3. Oscilloscope with camera attachment.

DESCRIPTION OP THE APPARATUS USED ..

Cathode ray oscillograph.- Principles :

The properties of the cathode rays which can produce oscillations on a flourescent screen whan deflected by an electric or magnetic field are used in the construction and action of the cathode ray oscillograph. The spot of light produced by the cathode ray on a fluorescent screen can be made to follow faithfully and instantaneously even extremely rapid changes of current or voltage in a circuit.



Ordinarily a cathode ray tube consists of a conical long glass tube having a filament 'F' at the narrow end and the screen at the other end. Usually, a tube about 10 inches long with a screen of 3 to 4 inches in diameter and operating at about 1,000 volts

gives satisfactory results. The cathode rays are obtained by heating the tungsten filament 'F' coated with an oxide of alkaline earth. The filament serves also as the cathode. 'A' is the anode which is in the form of a disc with a hole in the center. The electrones emerging from the central hole in the anode form a narrow pencil of cathode rays which travel in straight lines and strikes the screen 'S'. Zinc silicate is commonly used as a fluorescent material for coating the inside of the screen and it gives a bright green spot. A certain amount of focusing is obtained by using a Wehnelt cylinder 'C' also called as 'Shield', which is a metal cylinder surrounding the filament and maintained at a negative potential. This is to repel the electrone which leave the cathode in diverging directions and thereby concentrate the stream along the central axial line, so that an intense beam of electrons are shot out. By uaing electrostatic fields between the two pairs of plates, 'p_1' and 'p_2' disposed in mutually perpendicular planes or by magnetic fields, the cathode ray can be deflected vertically or horizontally. Horizontal defleotion producing plate ie called 'X-plate' or horizontal deflection plate and vertical deflection producing plate is called as 'Y-plate' ; even though they are disposed vertically or horizontally respectively.

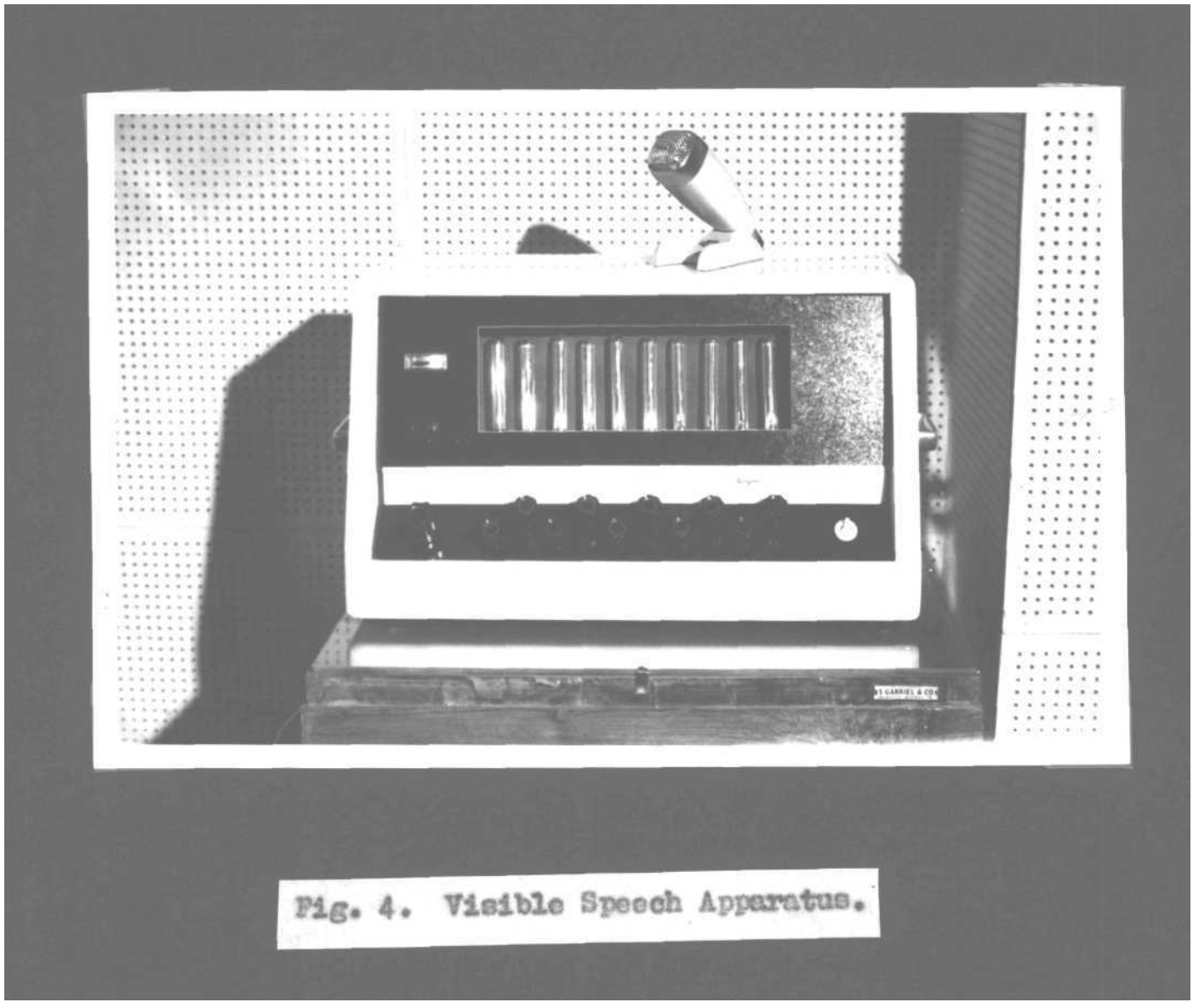


Fig. 4. Visible Speech Apparatus.

Cathode ray tube in used to determine the amplitude of a variable quantity such as oscillatory current, voltage or sound vibration, etc.

The recorded speech sample was fed to the COSSOR model 1429 oscilloscope which had a camera attachment to facilitate the filming of the oscillations seen on the fluorescent screen. (Fig.3). The oscillation pattern of /s/ phoneme was photographed in the initial and final positions. (sarasa) . The camera was a 35 mm. movie camera operating at 6 ft. per second. The oscillograph recorded in the film was later developed and its print man taken. The oscillographs of openbite and normal occlusion speech sample was compared.

As the process of getting the oscillograms being too complicated and as the same data could be obtained readily without any difficulty on a 'Visible Speech Apparatus', the analysis for the entire data was done with visible speech apparatus type SR-1.

Visible Speech Apparatus: Type SR-1

Th$ apparatus shown in the figure 4 has ten indicating tubes or filters, showing the spectrun with the central frequencies of 150, 250, 350, 480, 700,

1,000, 1,400, 1,750, 2,400 and 4,000 cycles per second. (cps.) The filter widthe are approximately half octave. The length of the discharge of the glow tube will be proportional to the frequency component of the speotrum corresponding to the filter. The apparatus is hence working as a frequency analyser, carries out an instantaneous Fourier analysis and shows the results by means of the tube. There are ten potentiometers for adjusting the sensitivity of the corresponding filters. On the left ie a potentiometer adjusting the input microphone amplifier, amplyfying the total spectrum. There in an indicating meter, beneanth of which is the adjustment of automatic volume control (A.V.C.) . On the rear side are the connections for microphone, power supply, switch and fuse. The main switch is on the front panel.

Adjustment of the apparatus :

The apparatus will only work correctly under the conditions that the input potentiometers and the A.V.C. as well ae the 10 filter potentiometers are adjusted correctly.

First both the input potentiometers and the A.V.C. are tuened fully to the right, after which the A.V.C. will automatically adjust the microphone amplifier correctly. The microphone distance is to be kept constant

from the source of the sound. The adjustment of each filter potentiometer is then carried out phonetically pronouncing a sound and toning the potentiometer until the light in the tube is glowing full up.

The sounds used for adjusting are :

Filter	1.	...	Vowel (i) .. with male voice.
"	2.	...	" (i) .. with female voice.
"	3.	...	(ɸ) or (ɣ)
"	4.	...	(ʊ) or (o)
"	5.	...	(o) or (ɑ)
"	6.	...	(ʊ) or (ɯ)
"	7.	...	(ɶ)
"	8.	...	(ɸ)
"	9.	...	(ɣ)
"	10.	...	(ɨ)

The symbol ( ) indicating the international Phonetic Association (IPA) phonetic notations.

The recorder was played at a fixed distance from the microphone of the apparatus. The A.V.C. ie adjusted such that an unifom frequency of sound will be fed to the apparatus. The frequency response as shown in the different tubes - by glowing – were recorded in the initial, medial and final positions of /s/ and interpreted.

FINDINGS

History did not reveal any familial tendency for openbite. All the openbite cases had tongue thrusting habit during swallowing. 19 eases were severe tongue thrusters and 4 cases were mild tongue thrusters. One case of the normal ooclusion group was also thrusting the tongue during swallowing. The amount of open bite measured varied from 2 to 7 mm. The openbite cases were also observed to thrust their tongue during speaking. Among the other habits elicited by the subjects, 10 1 openbite cases and 6 normal occlusion cases were still nail biters.5 openbite cases gave the history that they were, sucking their thumb till 5 to 6 years. One case still continued to suck the thumb during sleeping and after school hours, which had left a callous formation on her right thunb. One case in the normal occlusion group said that she was sucking her right finger till 7 years. outh breathing was present in 5 openbite cases and in 3 normal occlusion cases.

The E.N.T. report given by the E.N.T. surgeon was as follows :

All the 47 cases examined had normal hearing. In cases which had openbite deformity, 2 children were found to have large adenoid masses. One child had chronic sinusitis and significantly large adenoid mass. 2 children had moderately enlarged adenoid masses. One

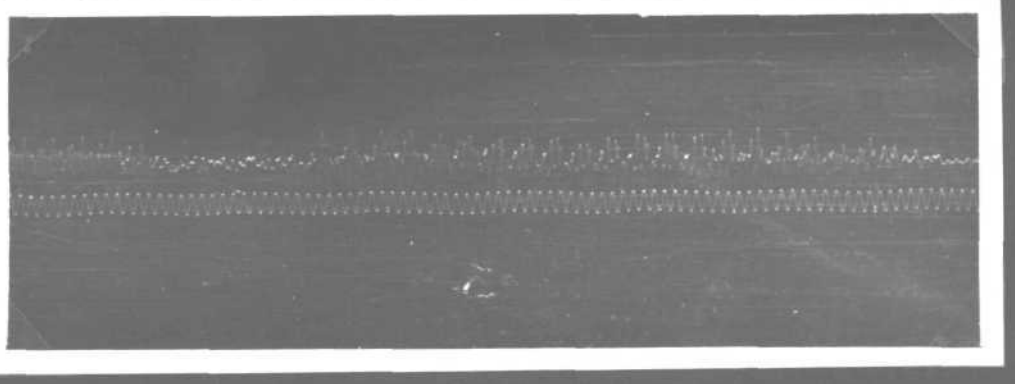


Fig. 5. a. Oscillogram of openbite case in the initial position of /s/.

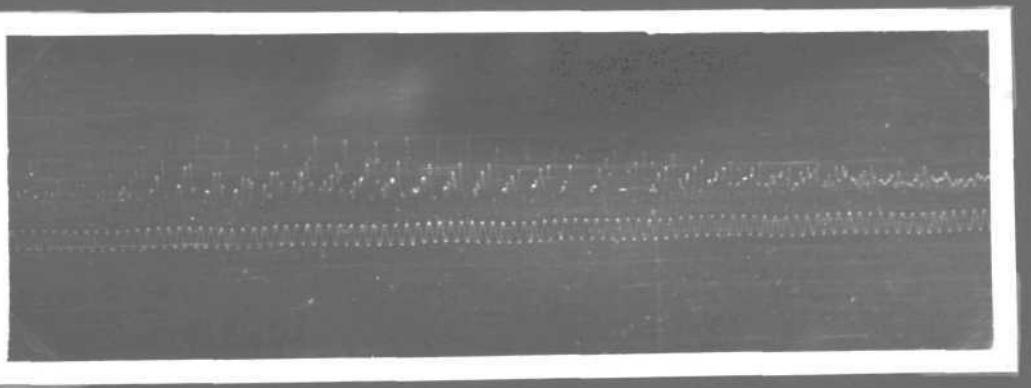


Fig. 5. b. Oscillogram of openbite case in the final position of /s/.

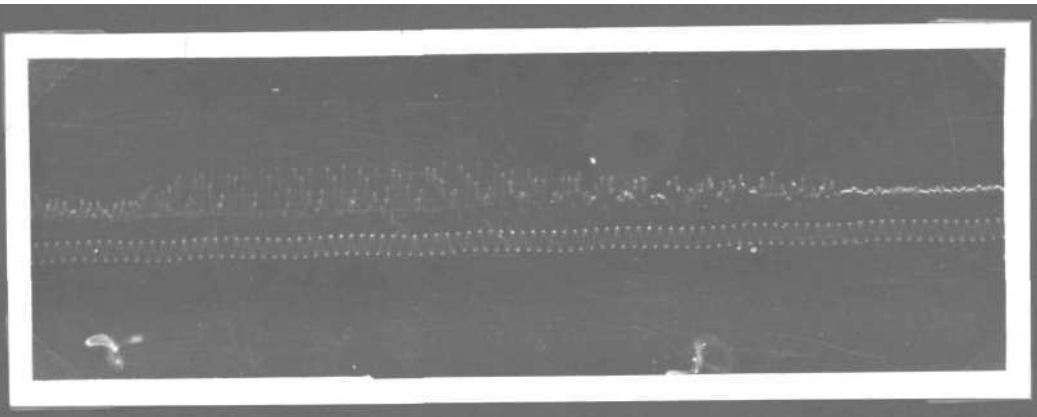


Fig. 5. c. Oscillogram of openbite case in the initial position of /s/.

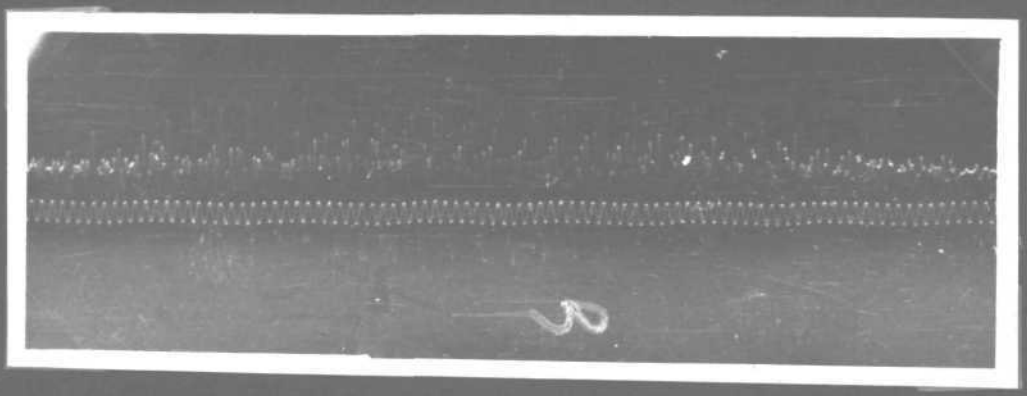


Fig. 5. d. Oscillogram of openbite case in the final position of /s/.

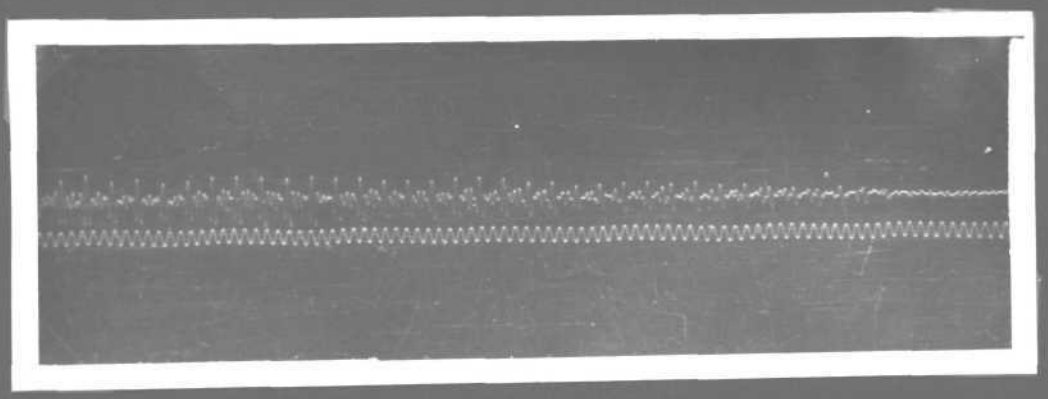


Fig. 5. e. Oscillogram of openbite case in the initial position of /s/.

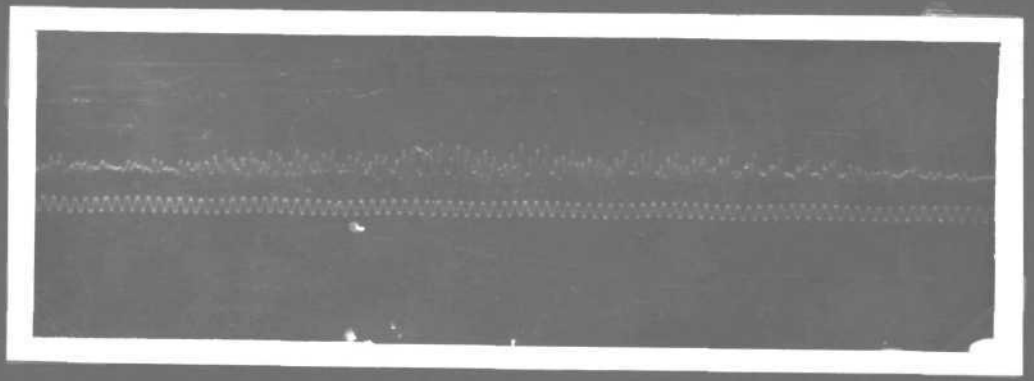


Fig. 5. f. Oscillogram of openbite case in the final position of /s/.

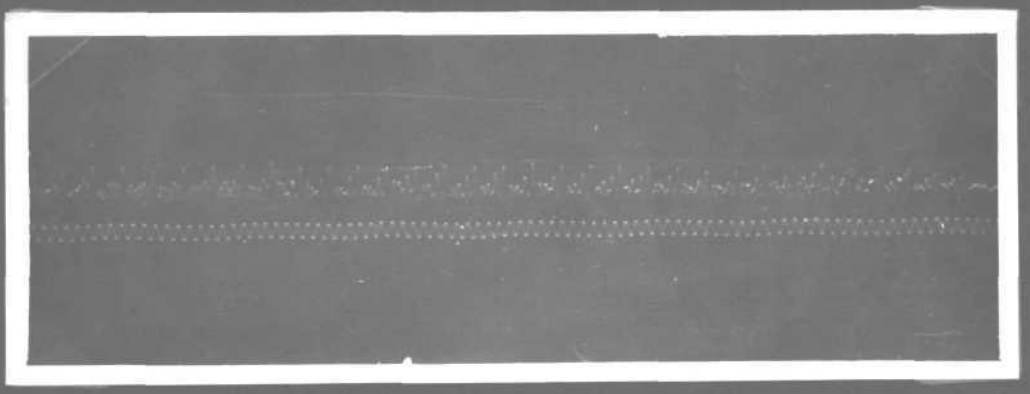


Fig. 5. g. Oscillogram of normal occlusion case in the initial position of /s/.

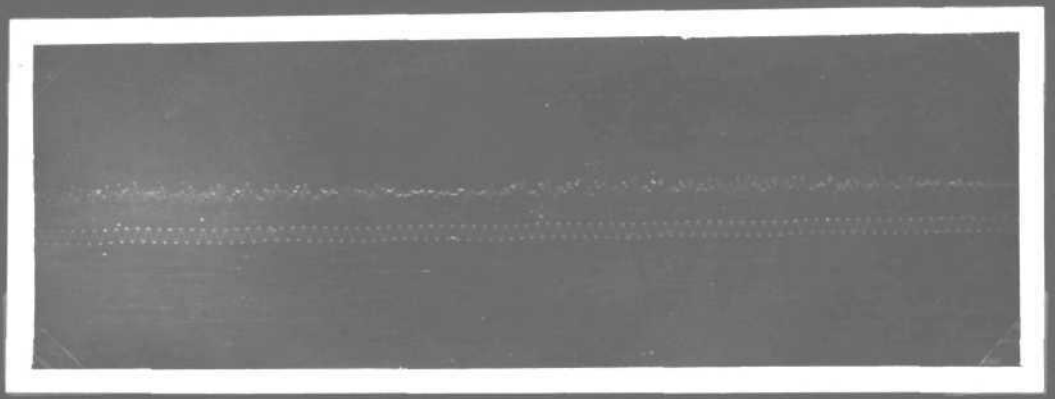


Fig. 5. h. Oscillogram of normal occlusion case in the final position of /s/.

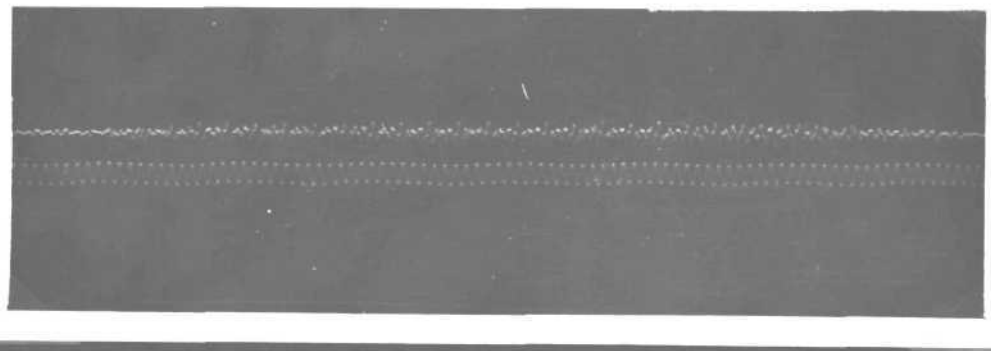


Fig. 5. i. Oscillogram of normal occlusion case in the initial position of /s/.

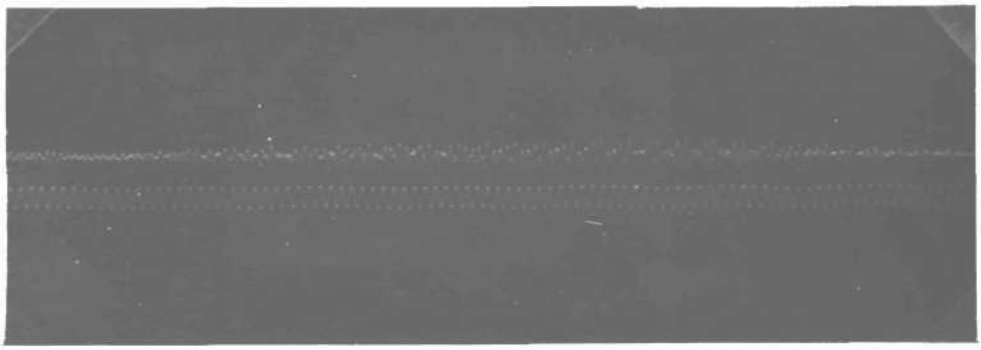


Fig. 5. j. Oscillogram of normal occlusion case in the final position of /s/.

child had chronic toncillitic but not hypertrophied. Out of the normal occlusion cases examined, 2 had significantly large adenoid masses and one case had nasal septal deviation with adenoid mass. Two had chronic tonsillitis without hypertrophy.

The panel of speech pathologists who listened to the coded speech sample of 47 cases, were of the opinion that all the sounds /s/,/dz/,/t/ in the speech samples are articulated normally, that articulation of the sounds in the 3 positions in the words, initially, medially and finally, and in the 3 positions in the nensense syllables ; initially, medially and finally to fall within the normal range of articulation. Also they could not notice any sound that was misarticulated.

The oscillograms sample - two of the normal occlusion cases and three of the openbitc cases - for the phonemes /s/have not indicated differences in the high frequencies of the sound recorded. However, relatively less strident charecteristic of /s/ in general may be emphasised.

The visible speech apparatus evaluation of the phoneme /a/ recorded for both the normal and openbite cases is showen in the table - 1.

TABLE-1

Showing the frequency response for the phoneme /s/as recorded in the Visible Speech Apparatus.

Frequency c.p.s.	Normal			Openbite		
	Initial	Medial	Final	Initial	Medial	Final
700-1750	7	6	5	6	12	11
700-2400	6	7	7	9	5	5
700-4000	10	10	11	9	7	8

/s/ being a high frequency sound, the electrical response or the energy distribution should have been up to 4,000 c.p.c. but a variation was recorded in both the groups.

1. Visibility of sound waves between 700-1,750 on the visible speech apparatus :

25% of the openbite cases lighted the tubes in the above frequency range in comparision to the 30.4% of the normal occlusion group in the initial position of/s/.

In the medial position, 50% of the openbite cases lighted the tubes in comparision to 26.09% of the normal occlusion cases.

In the final position, 45.8% of the openbite cases lighted the tubes in comparision to 21.7% of the normal occlusion cases.

2. Visibility of sound waves between 700-2,400 c.p.c. on the apparatus :

37.5% of the openbite cases lighted the tubes in the above frequency range in comparision to the 26.09% of the normal occlusion group in the initial position of /s/.

In the medial position, 13.66% of openbite cases lighted the tubes in comparision to 29.2% of the normal occlusion cases.

In the final position, 20.83% of openbite cases lighted the tubes in comparision to 29.2% of the normal occlusion cases.

3. **Visibility of sound waves between 700-4,000 c.p.c. on the apparatus:**

31.5% of the openbite cases lighted the tubes in the above frequency range in comparision to 43.47% of normal occlusion cases in the initial position of /s/.

In the medial position, 29.2% of the openbite cases lighted the tubes in comparision to 43.47% of the normal occlusion cases

In the final position, 33.4% of openbite cases lighted the tubes in comparision to 47.% of the normal occlusion cases.

The data recorded on the visible speech apparatus for the phoneme /s/was tested statistically to find out whether there is any association between the normal and openbite cases with that of the above three categories of the frequency range.

X^2 test was used to test these differences with respect to the initial, medial and final positions of /s/ respectively.

$$X^2 = \sum^{n} \frac{(Oi - Ei)^2}{Ei} \quad \text{Where } i = 1.$$

In all these three cases, the result was found to be "not significant" at 5% level of confidence.

For the initial, medial and final positions of /s/, the X^2 value was 0.2535, 2,8455 & 5.4678 respectively.

Table - 2

Showing tho frequency response in the nomal and openbite cases for /s/ in initial position

Category	Normal	Openbite	Total
0	7	6	13
1	6	9	15
2	10	9	19
Total	23	24	47

X^2 - 0.2535

Not significant

Table - 3

Showing the frequency respones in the normal and openbite cases for /s/ in medial position

Category	Normal	Openbite	Total
0	6	12	18
1	7	5	12
2	10	7	17
Total	23	24	47

X^2 . 2.8455

Not significant

Table - 4

Showing the frequency response in the normal and openbite cases for /s/ in final position

Category	Normal	Openbite	Total
0	5	11	16
1	7	5	12
2	11	8	19
Total	23	24	47

$X^2 = 5.4678$

Not significant

In all the above tables, the category refers to the frequencies in cycles per second.

0 = 700 - 1,750 c.p.s.,

1 = 700 - 2,400 c.p.s.,

2 = 700 - 4,000 c.p.s.

DISCUSSION

The problem dealt with in the present study is of Clinical interest to both the orthodontist and the speech pathologist, the previous studies in India on anterior openbite and speech articulation used the English language for studying the articulation disorders.59 If it ie true that openbite malocclusion causes lisping, - the articulation disorder - then, speech therapy is to be given in Kannada, the mother tongue, to the Mysorean children. The present study was taken up to test a few sounds in that language.

The material for the study is the speech sample recorded fron 24 anterior openbite cases and 23 normal occlusion cases. The study was done ia the local language - Kannada - with an idea that to the Mysoreans, this being their mother tongue is used maximum in their daily life. Secondly, English becomes a foreign language to them and at the same time it ie taught only in schools sparingly. The child hardly uses thie language outside his class room, thus the difficulty in pronounciation of words which are new to the child may be a factor in the production of articulation disorders, and therefore wrong conclusions can be drawn.

All the cases belonged to Angle's Class I. Cases with Angle's Class II division 1 malocclusion with

anterior openbite were not included ia the study as some defects in speech articulation are associated with Angle's Class II division 1 malocclusion. [79],[64]

The children selected were between the age group of 12 to 16 years. This particular age range was selected because it is said that after 8 years all the consonant sounds will be mastered by the child. [45] Also children below 12 years may have some spaces left in between the teeth during the change over period from deciduous teeth to the permanent teeth. These spaces themselves may cause some speech defects[38] .

Hence, in the present sample children above the age of 12 years with full complenent of teeth - except the 3rd molars - were chosen.

The average age of the openbite cases were 14.4 years and that of normal occlusion were 13.5 years.

All the children had Kannada as their mother tongue, that is, spoke Kannada at home and also as their second language of choice in their respective classes. This was done ia order to eliminate the errors in articulation of words of a language for which the child is not accustomed to. For instance we can anticipate a misarticulation of the word 'school' as 'eschool' from a

person whose mother tongue is other than English like a Muslim boy whose mother tongue is Urdu.

A detailed history of each case was recorded in a chart. Particular emphasis was given to the habit - tongue thrust swallowing. To eliminate the possible defect in speech due to hearing disorders, all the cases were examined by an E.N.T. Surgeon for acuteness of hearing. Children having hearing defect were not included in the study. The E.N.T. Surgeon also examined for the presence of infected or enlarged tonsils or for the presence of adenoids to ascertain whether these factors were responsible for anterior openbite condition and thus the speech defect.

The cases of normal occlusion and openbite were mixed up during recording. Also, each case was coded before hand. This was done in order as not to give any idea or indication to the speech pathologist about the condition of the case while evaluating the articulation disorder. If the speech pathologist Known that the speech sample he is evaluating is of openbite case, he may look in for an articulation disorder. To avoid this type of error, coding was done and also both type of cases were mined up. It was disclosed only at the end of evaluation which of the speech samples belonged to openbite and normal occlusion cases.

In an earlier study done in India in anterior openbite cases, Munim K. R.[59] had used children who belonged to different language speaking communites like Gujaratis, Muslims, Maharashtrians, etc., as it is well known that these above communities have their mother tongue which differs from one another. Secondly, English words were used for testing purpose which was surely not the children's mother tongue. Thirdly, blends and not simple words were tested. He concluded that the openbite causes articulation error. Finally, some of the words tested were outlandish, for instance, "Azores" which is definitely rare word to be used in daily practice by an Indian child.

Keeping all these factors in mind and avoiding any bias as far as possible, the present study was done to avoid as far as possible the influence of factors other than the openbite condition.

The three phonemes ಸ, ಜ, /s/, /dz/,/t/ in Kannada were selected and used for testing. She reason for selecting /s/& /dz/ arc that in cases of anterior openbite English speaking children, the phonemes /s/& /z/ are said to be defective. The three phoneme are not available ia isolation in Kannada. Also the phoneme /s does not exist in Kannada. The nearest equivalent ಜ /dz/

is selected for it is closest to the English affricate /dz/as in 'judge'. Most of the Indians use this /dz/ instead of /a/. Finally, /t/ ತ was selected as it ie a pure dental sound wherein a proper relationship between the tip of the tongue and the palatal surface of the upper anterior teeth ie required. Also ತ/t/is most frequently used in the local language as a substitute for ಥ /th/ As /th/is said to be defective in anterior openbite cases , then /t/ ತ should be defective in Kannada. These were selected in consultation with the speech pathologist and the simple sentences without blends constructed by hint were tested. These sounds occured in all the three positions namely initially, medially and finally. A panel of speech pathologists evaluated the speech sample for articulation disorders. Later, the phoneme /s/ was evaluated in detail by spectral analysis.

History did not reveal any familial tendency for the openbite cases to say that openbite is caused by heredity.

That the imbalance of muscle force by thrusting of the tongue during swallowing and speaking may cause or exaggerate openbite ie confirmed.73,79,51,84,14,21. Almost all the cases of openbite were thrusting their tongue during swallowing. It was also observed to be

thrust during speaking in soms cases. One case of the normal occlusion group also showed the tongue thrusting during swallowing for which it can only be said that the lip muscles had sufficient tonicity to resist the tongue force.

That 10 openbite cases and 6 normal occlusion cases were nail biters ie of not much significance when compared to the other deleterious habits. That five openbite cases were thumb suckers till 5 to 6 years and that these also had tongue thrusting during swallowing and speech indicates that these habits are of significance in the production of openbite. Ruttle et al[68] had reported an incidence of 28% of openbite cases in children with sucking habite.

The E.N.T examinations were carried out with an idea to find out Whether a causative factor for openbite could be elicited. The E.N.T. Surgeon was of the opinion that as the excellent occlusion cases also had more or less same complaints as the other group but with less severity, hence it ie not certain that the cases who had adenoids or any other pathology was the cause of openbite deformity. Moreover the adenoid starte to regress after the age of 12 to 13 years. The cases examined belonged to thie age group.

Strang [73] stated that the presence of scar tissue resulting from operations on the enlarged tonsile and adenoide causes difficulty ia normal swallowing. MOyers describes that enlarged and hypersensitive tonsils perpetuates abnormal swallowing and thus causes openbite. Also this habit often accompanies or is said to be a residuum of thumb sucking. In the present study conducted, no definite conclusion be drawn that the habits could be the cause of openbite since the normal occlusion cases also showed some of these habits.

The panel of speech pathologists who evaluated the coded speech sample of 47 cases, found that all the three sounds studied namely /s/, /dz/& /t/ in the three positions namely initially, medially and finally in both words and in non-sense syllables were within the normal range of articulation. As far as perception of these sounds was concerned, they were all normal.

The earlier studies done to evaluate articulation disorders in openbite cases [59] and the statement of many more investigators that openbite causes speech disorder - lisping - 45,4,79,46. was not agreeing with the present findings.

This could only be explained by the fact that in Kannada language, all the consonant sounds are followed

by a vowel /s/. In words during speaking or reading, even the sibilants are pronounced with the mouth slightly open in the anterior region of the oral cavity. That means, a narrow slit in the front region of the oral cavity is not required between the tongue blade and the incisors as is necessary in producing the English /s/. Thus the Kannada /s/ may not be defective in open-bite cases, who cannot form such an environment due to anatomical defect, /dz/ & /t/ were also found to be acceptable. This could be explained by the fact that all these cases had either adapted their tongue to the malocclusion or there is some inherent feature in the language itself which is not affected by the malocclusion.

In order to study in detail the sound /s/ was analysed by two methods. One method used was Oscillographic - wherein only sample oscillograms were taken. The other method was by means of frequency analysis carried out using the Visible Speech Apparatus.

The oscillograms were taken at Deccan College, Poona in the Phonetics laboratory. The oscillograns of normal as well as openbite cases have not indicated difference in the high frequencies of the sounds recorded. However, relatively less strident charecteristic of /s/ in general may be emphasized.

From the frequency response of the visible speech apparatus in Table - 1, it can be seen that both normal and openbite cases are almost equally distributed except in two places in the three categories of responses for the frequencies, that is, free 700-1750 cps, 700-2400 ops. and 700-4000 cps.

In the medial and final positions of /s/ for frequencies of 700-1750 cps., there was slight difference between the two groups. And a difference was also noted for the frequency of 700-4000 cps. in the same position. Whan these findings were put to statistical evaluation - X^2 test - the values were found to be not significant.

In order to discuse the results/analysis obtained, it io necessary to know the articulatory variables and its likely effect. The main articulatory variables are :

1. Location.
2. The degree of constriction of the main narrowing between the tongue and the opposite wall of the vocal cavities, and
3. The degree of constriction and lengthening of the lip passages.

The generalised relation suggested in older Phonetice literature, that F_1 is due to the cavity behind the

tongue constriction and F_2 is due to the cavity in front of the tongue constriction is an impermissible ever simplification, sometimes contradicting actual relations. All parts of the vocal cavities have some significance on all formants and each formant is dependant upon entire shape of the complete articulatory system.

The general rules are that a tongue constriction located in the middle of mouth cavity is optimal for high F_2 and that a maximally high F_1 requires the main constriction to be located just above the larynx and the mouth cavity to be wide open.

A decrease of the lip opening area or increase of length of the lip passages ceuses a lowering of the frequencies of all formants, F_1 is maximally low when the mouth cavity is conetricted and F_2 is maximally low when the tongue constriction is in the upper part of the pharynx.

Considering the articulatory variables, the normal position for the vowel /e/ (ten) will almost be equivalent to the 'anterior openbite position', that is, acoustically speaking /e/ has frequency region between 500-700 cps. and 1750-1950 cps. Thus an expected accuetic effect is the modulation of the above frequencies in openbite cases.

Overall effects of these frequency modulation

will be, - compact vowels will be relatively less compact and diffuse vowels will be less diffuse, except for the above frequency regions and strident charecteriotlocs of /s/ will be less strident.

Analysis of /s/ indicates that it is a very high frequency sound. Normally the frequency region in which the energy for /s/ is spread will be between 2000-4000 cps.

Whereas when we find that energy is present in the lower region of frequency (1750 cps.), may be dug to - openbite or modulation of frequency region 1750-1950 cps. Thus this accounts for the difference in the number of openbite cases in the medial and final positions of /s/ from the normal occlusion cases.

The second effect which one would accept from the openbite cases is the mellowness in /s/, that is, oscillograms will be more periodic, however, no such difference in the oscillograms was observed or this effect an well will be well marked in visible speech - by difference of intensity in the frequency region of the spectrum /s/, that is, one or more of the tubes might glow with different length (indicating intensity) or might not glow at all. This Characteristic is termed as strident/Mellow distinctive feature in the acoustic phonetics.

When a word is pronounced, it is recognised by ears through its 'sound shape'. The question arises as to how many significant units that is, units relevant for the discrimination of the samples, do the sound shapes of the sample contain ?

This problem has been successfully tackled by Jackobson & others [47]. They have studied spectrum of speech sounds and made fundamental contributions towards the study of speech sounds as follows.

The phonemes - discriminatory speech sounds - may be broken down into the inherent distinctive features which are the ultimate discrete signals.

These distinctive features are nothing but a combination and permutation of energy spectrum of discriminatory speech sounds, that is, the energy spectrum of one speech sound may differ from another speech sound in one or more ways.

When phonetics of Kanaada is studied, mellow characteristics is not found. Thus, whatever minor distortions in the strident Characteristic of /s/ may be, will not be observed by the native hearer in spite of an energy distribution difference. Thus this difference may not be phonetically significant.

The subject of distinctive feature of Kannada is new and some more studies are necessary in this field as well as in cases of speech and malocclusion.

SUMMARY AND CONCLUSIONS

SUMMARY :

A comparative study by speech analysis of certain sounds in Kaanada. /s/, /dz/, /t/, in cases of anterior openbite malocclusion and normal occlusion was done to evaluate the articulation disorder, if any, due to the malocclusion.

A brief literatute review on speech and open-bite malocclusion iS presented.

24 cases of anterior openbite malocclusion between the age group of 12 to 16 years and 23 normal occlusion cases of the same age group were selected for the study.

The mean age group of openbite cases was 14.4 years and that of normal occlusion case was 13.5 years. Only Angle's class I cases with anterior open-bite ware included in the study.

Simple teat sentences without blende were constructed and the speech sample was recorded. The tested sounds occured in the three positions namely, Initially, Medially, and Finally. Speech analysis was carried out by a panel of speech pathologiets.

One particular sound /s/, waa evaluated in

detail by spectral analysis.

Sample Oseillogroms of /s/ were taken and analysed at the Phonetics Laboratory. Deccan College, Poona.

The sound /s/was alao evaluated using the "visible speech apparatus" and the findings were statis-tioally tested of the openbite and normal occlusion group.

CONCLUSIONS :

Tongue thrusting was observed in all the open-bite cases during swnllowing aad speaking.

The three sounds /s/, /dz/and /t/ were found to be within the normal range of articulation in the 47 cases evaluated by the panel of speech pathologists.

The oscillograms of normal as well as openbite cases did not show difference in the high frequencies of the sounds recorded. But relatively less strident charecteristic of /s/ in general could be emphasized.

The observations of the frequency responses of /s/ sound of both normal and openbite cases with the help of visible speech apparatus was found to be statistically not significant.

Mellow characteristic is not found when phonetics of Kannada is studied. So any minor distortions in the strident characteristic of /s/ if present, will not be observed by the native hearer in spite of an energy distribution difference. This difference it appears, to be phonetically insignificant.

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