RELAIONSHIP BETWEEN DEGLUTITION, ORAL REFLEXES AND ARTICUATORY ABILITY OF THE CEREBRAL PALSIED

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REGISTER NO.M92O7

A DISSERTATION SUBMITTED AS PART FULFILLMENT OF M.SC. (SPEECH AND HEARING) TO THE UNIVERSITY OF MYSORE

ALL INDIA INSTITUTE OF SPEECH AND HEARING, MYSORE - 570 OO6

1994

DEDICATED

TO

DADDY, MUMMY

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CERTIFICATE

This is to certify that the dissertation entitled : RELATIONSHIP BETWEEN DEGLUTITION, ORAL REFLEXES AND ARTICUATORY ABILITY OF THE CEREBRAL PALSIED is the bonafide work in part fulfilment for the degree of Master of Science (Speech and Hearing), of the student with Register No.M9207.

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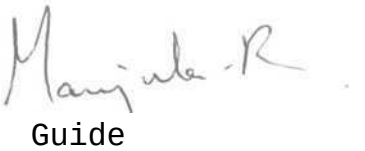
This is to certify that this dissertation entitled RELATIONSHIP BETWEEN DEGLUTITION, ORAL REFLEXES AND ARTICUATORY ABILITY OF THE CEREBRAL PALSIED has been prepared under my supervision and guidance.



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DECLARATION

This dissertation entitled RELATIONSHIP BETWEEN DEGLUTITION, ORAL REFLEXES AND ARTICUATORY ABILITY OF THE CEREBRAL PALSIED is the result of my own study under the guidance of Smt. Manjula, R. Clinical Lecturer, Department of Speech Pathology, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier at any University for any other Diploma or Degree.

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ACKNOWLEDGMENTS

I would like to express my deep sense of gratitude to my guide Mrs. Manjula, R. Clinical Lecturer, Department of Speech Pathology, All India Institute of Speech and Hearing, Mysore, whose guidance, concern and encouragement made this study possible.

I thank Dr.(Miss) S.Nikam, Director, All India Institute of Speech and Hearing, Mysore, for having given me the permission and opportunity to undertake this dissertation.

Thanks to all those kids from the Spastic Society of India, Bombay for being such co-operative subjects for the study.

I thank Mr. venkatesh, Dr. Basavaya and Dr. Doraswamy for all their help with the statistical analysis.

I thank Deepa, for being such a wonderful friend. Thanks for all the fun, friendship, encouragement, support and advice.

A special thanks to Bindu, Shubha, Yasmeen, Jayanthi, Rakhee, Swapna and Mini who are ever willing to help.

Thanks is the least I can express to you Akka for putting all this down in print, without your patient typing I wouldn't have been able to complete my dissertation in time.

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INTRODUCTION

Normal oral development involves a series of stages in which patterns of movement known as reflexes phase in and out as the oral musculature and the responsible nerves mature and strengthen (Gallender, 1979). For example, during the initial months of development, the neonate uses a pattern of sucking-swallowing reflex action to receive food through a nipple. Neurological structures or muscular disorders may cause an individual to become fixed or to regress to a lower level of oral development.

In studies carried out on cerebral palsied children, it has been shown that oral development and motor development of the body are closely linked (Gallender, 1979). Therefore positioning, central nervous system maturation, diet, muscle tone and reflexology are closely linked.

Mysak (1959, 1963) reported that dysarthria associated with cerebral palsy often included complicating infantile oropharyngeal reflexes. These reflexes contributed to the articulation problem seen in the cerebral palsied. It has also been believed that movements of the oropharyngeal musculature in feeding are related directly to speech movements (Love, Hagerman and Taimi, 1980).

Speech language pathologists interested in neuro developmental therapy have raised questions concerning the effect of abnormal cranial, oral and pharyngeal reflexes on the control of speech production in the cerebral palsied (Love, Hagerman and Taimi, 1980). They suggested that infantile oral feeding reflexes, if diminished or absent, may contribute to a long-standing dysphagia. If cranio oropharyngeal reflexes are persistent as sometimes is seen in neurogenic conditions the reflex patterns may interfere with speech production (Mysak, 1959, 1963, 1968).

However, a severe motor involvement of the oral musculature need not always be the basis for the existence of dysphagia and/or anarthria. It is highly likely that the lack of speech in some cerebral palsied children results from multiple handicaps involving more than severe oral motor deficits (Love, Hagerman and Taimi, 1980).

Sheppard (1964) and Love, Hagerman and Taimi (1980) studied the correlation between dysphagia, abnormal oral reflexes and poor speech performance. Sheppard's (1964) study showed that strong primitive cranio oropharyngeal motor patterns caused markedly abnormal speech and feeding patterns and facial grimaces. Love, Hagerman and Taimi's study (1980)

suggested that abnormal oral reflexes were not particularly predictive of lack of speech in their sample.

Oromotor training techniques are frequently employed with cerebral palsied children. Training is often aimed at reversing or reducing elements of dysphagia by instituting feeding facilitation programs to improve chewing, swallowing and sucking (Palmer, 1947; westlake, 1951; Westlake and Rutherford, 1961; Mueller, 1972; Morris, 1972). Precise criteria for developing feeding facilitation programs, however, are limited. This is because there is little or no systematic research on the relation between dysphagia and speech performance in cerebral palsy (Love, Hagerman and Taimi, 1980).

OBJECTIVES OF THE STUDY:

To study the extent of the relationship between deglutition, abnormal oral reflexes and speech skills in the cerebral palsied in the age range of 2—16 years.

HYPOTHESES:

1. There is no relationship between deglutition (oral and pharyngeal phases of deglutition) and speech skills in the cerebral palsied.

2. There is no relationship between the motor acts of deglutition and the presence of abnormal oral reflexes in the cerebral palsied.

3. There is no relationship between the presence of abnormal oral reflexes and speech skills in the cerebral palsied.

BRIEF PLAN OF THE STUDY:

1. Administration of the test
2. Rating the responses obtained
3. Analysis of the data.

1. Administration of the test:

The test format (developed by Jyothi, 1990 was administered to normal hearing spastic cerebral palsied subjects aged between 2-17 years.

2. Rating the responses obtained:

A semiquantitative scale was utilized to rate the performance of the subjects on the deglutition tasks (eating and drinking), abnormal oral reflexes and articulatory ability.

3. Analysis of the data collected:

The raw data obtained was subjected to statistical analysis and the results are discussed.

REVIEW OF LITERATURE

Credit for coining the term cerebral palsy' is given to Phelps (1947). As used in the term, the word cerebral' refers to the brain and the word palsy' describes a lack of muscle control. The American Academy of Cerebral Palsy, as reported by Cardwell (1956), defined cerebral palsy as "any abnormal alteration of movement or motor function arising from defect, injury, or disease of the nervous tissues contained within the cranial cavity.

Cerebral palsy refers to a nonprogressive central nervous system deficit. The lesion may be in a single or in multiple locations of the brain, resulting in definite motor and possibly sensory abnormality (Scherzer and Tscharnuter, 1979). Individuals with cerebral palsy thus may have a great variety of disorders and disabilities. These disorders and disabilities occur in different combinations and in different degrees of severity within individuals. They may or may not have an impact on the development of communication skills. As a result, the communication disorders within the population that has cerebral palsy are extremely heterogenous with respect to etiologies and characteristics (Hardy, 1983.

In addition to the motor deficits in cerebral palsy, other associated handicaps are frequently present. These include visual abnormalities (S5X) (Breaky, 1955), hearing and speech abnormalities (>50%) (Vernon, 1970), seizure disorders (/3rd) (Robinson, 1973), mental retardation (50-75%) depending on motor severity (Hopkins, 1954), learning disabilities among the vast majority, and frequently social, emotional and interfamily problems. Dysphagia is also one of the common associated problems in cerebral palsy (Gal lender, 1979). Vegetative therapy and dysphagia correction have thus become one of the primary forms in rehabilitation of the cerebral palsied.

Speech management of the cerebral palsied child, historically included oromotor training. This training was designed to improve the functioning of oral and pharyngeal muscles (Love, Hagerman and Taimi, 1980).

With the current emphasis on early intervention for infants at risk for cerebral damage, prespeech oromotor training is commonly used with cerebral palsied children (Love, Hagerman and Taimi, 1980). In prespeech stages, training is often aimed at reversing or reducing elements of dysphagia by instituting feeding programs to improve chewing, swallowing and sucking (Palmer, 1947; Westlake, 1951; Mestlake and Rutherford, 1961; Mueller, 1972; Morris, 1977).

SPEECH PERFORMANCE AND ITS RELATION TO DEGLUTITION : IN THE CEREBRAL PALSIED

Some speech-language pathologists have long believed that movements of the oropharyngeal musculature in feeding are directly related to speech movements. In a study of nonspeech and speech movements in cerebral palsied individuals, Hixon and Hardy (1964) postulated that these two movement patterns may have different neurologic organization and control. Summarizing the development of oral and pharyngeal function in normal infants Bosma (1975) concluded that "... early speech gestures are not directly related to the development of feeding in early infancy and childhood, although speech acquisitions of discriminate coordinations are analogous to motor discriminations of biting and front of the mouth feeding gestures". However, if oromotor activity in feeding has even a limited resemblance to motor patterns of speech a.rticulatory events, the goal of providing a feeding skills program as a possible prophylactic measure for dysarthria in the severely involved dysphagic cerebral-palsied child may prove useful (Love, Hagerman and Taimi, 1980). Facilitation of feeding may be one of the better methods of treating the impaired movement that is the basis of dysarthria in cerebral palsy. Precise criteria for developing feeding facilitation programs, however, are

limited because there is little or no systematic research on the relations between dysphagia and speech performance in cerebral palsy (Love, Hagerman and Taimi, 1980).

Speech language pathologists interested in neuro-developmental therapy in particular, have raised questions concerning the effect of abnormal cranial, oral and pharyngeal reflexes on the control of speech production in the cerebral palsied (Love, Hagerman and Taimi, 1980). They suggested that infantile oral feeding reflexes, if diminished or absent, may contribute to a long standing dysphagia. More importantly, they asserted that if other cranio-oropharyngeal reflexes are abnormally persistent, as sometimes is seen in neurologic diseases, the reflex patterns may interfere with speech production (Mysak, 1959, 1963, 1968; Sheppard, 1964).

Ingram (196S) has asserted that spontaneous feeding behaviour rather than the infantile feeding reflexes have diagnositc and prognostic importance in the child. Specifically he said, "abnormalities of spontaneous feeding are of the greatest diagnostic and prognostic significance in neurological disorders of infants. On the other hand, the artificial elicitation of individual feeding reflexes, the rooting, sucking and swallowing responses, is less informative". Ingram concluded that the infantile feeding

reflexes which normally disappear by four to five months, are primarily of limited neuro—diagnostic value because of their variability, eventhough they may be easy to elicit for longer periods in cerebrally damaged children. Hardy (1983) opines that the severity of dysphagia is not reflective of the severity of dysarthria.

To examine these controversial views as to what is the relation between dysphagia, abnormal oral reflexes and speech performance let us look at the studies that have been done to determine how these variable interact with and influence one another.

To date, only two studies in literature (Sheppard, 1964 and Love, Hagerman and Taimi, 1960) have presented data describing the possible relationship between infantile cranial and oropharyngeal reflexes, feeding patterns and with drawal patterns with speech performance in cerebral palsy. Sheppard (1964) reported an inverse relationship between the number of abnormal motor patterns elicited in her subjects and speech proficiency, feeding proficiency, speech remediation progress, and age.

Many speech-language pathologists found in Sheppard's research findings, a basis for advocating two types of

programs (1) selective facilitation of infantile feeding reflexes to enhance spontaneous feeding behaviour, and (S) inhibition and facilitation of abnormal cranio-oropharyngeal reflex patterns to assist more normal speech production in cerebral palsied (Love, Hagerman and Taimi, 1980). In addition, speech-language pathologists often advocate a feeding skills program of one form or another aimed at improving spontaneous feeding behaviour and control of the oropharyngeal muscles of the cerebral palsied. Love, Hagerman and Taimi (1980), in their study on cerebral palsied individuals reported that generally subjects with more frequent dysphagic symptoms tended to present lower scores in articulation and overall speech proficiency. However, they suggested that their data be cautiously interpreted ".. the assumption should not be made that a severe motor involvement of the oral musculature always is the basis for both a profound dysphagia and an anarthria. It is highly likely that the lack of speech of some of the subjects resulted from multiple handicaps involving more than severe oral motor deficits. Lack of expressive speech, inability to perform on a comprehension vocabulary test, and dysphagic symptoms frequently coexisted in the same subject, suggesting that cognitive deficits, as well as motor involvement of the speech musculature, contributed to lack of speech in subjects in this sample".

REHABILITATION IN THE CEREBRAL PALSIED:

Until recent years, cerebral palsy was primarily of professional interest to a limited number of specialists dealing with specific aspects of treatment, such as orthopedics and neurology. Intervention was frequently concerned with static neurologic assessment, and treatment often exclusively focused upon orthopedic surgery or a form of limited individual muscle therapy. The approach was to deal with specific functional deficits as they appeared (Thompson, 1983).

A much broader concept has subsequently emerged with the awareness that cerebral palsy represents a major multidisciplinary developmental disorder in which timely intervention by a variety of specialities is essential, and a coordinated, directed approach is required. Traditional therapy involving individual muscle training has given way - mostly through clinical work with cerebral palsy - to comprehensive and dynamic approaches (Thompson, 1983).

TECHNIQUES USED FOR SPEECH CORRECTION IN CEREBRAL PALSY:

In traditional methods of speech therapy for the cerebral palsied the speech pathologist works with the

physical therapist, in carrying out a prescribed program of general relaxation. This program aims at release from spasticity or involuntary motion, and a growing awareness and subsequent control of neuromuscular response patterns (Hoberman and Hoberman, 1960). The patient is taught to meet and deal with involuntary movement and spasticity which interfere with speech just as they interfere with physical activity (Hoberman and Hoberman, 1960). Passive relaxation techniques are sometimes used, wherein the child is instructed to let go' as the clinician rotates his head from side to side or opens and closes his mouth until abnormal responses are reduced. During this maneuver, the speech therapist observes the sternocleidomastoidous, and platysma muscles, among others, which in the cerebral palsied child are often tense and/or spastic and produce clavicular breathing. Cavicular breathing is shallow and irregular, making for a gasped tone which is unsustained, weak and dysarhythmic (Hoberman and Hoberman, 1960).

Very often uncontrolled spasticity of the masseter muscle results in a tightly clamped jaw, or spasticity of the supra and infrahyoids, the platysma and lateral pterygoids causing a widely open and, sometimes, locked jaw. Too wide a mouth opening causes hypertension in the throat area, and therefore concentration is centered upon relaxation of the

involved muscles. followed by assisted raising of the mandible. Assistance is decreased as the patient begins to take over and the muscle begins to function more normally. Emphasis is then placed upon gradation of mouth opening and closure. In this type of therapy the emphasis is to: let go' as the therapist puts the muscles through a passive range of movement, 'feel it' as the child is urged to become kinesthetically aware of what is being done by the therapist, help me' as stimulation of voluntary movement and control is attempted and finally, take over' or hold' (Hoberman and Hoberman, 1960).

Progressive relaxation as taught by Jacobson (1929) is sometimes helpful. Relaxation is attained by first achieving a forceful contraction against resistance of the jaw muscles or of the neck for about 4 or 5 seconds, followed by complete relaxation for five to ten seconds. This contrast from forceful contraction,increases the consciousness of complete relaxation in a muscle or group of muscles.

Some of the techniques proposed by Westlake (1951) are still proving useful. A rubber block is placed between the teeth of a subject who cannot voluntarily tighten his lips. If asked to bite hard upon this block, his lips will involuntarily tighten, providing the patient again with the

kinesthetic sensation of firm lip closure. A chircradle strapped to a headband limits mouth opening in patients who with any voluntary effort fling their mouths widely open and thrust out their tongues. This device helps to break up accessory tongue movements and facilitates learning of useful tongue, jaw and lip patterns.

NEWER TECHNIQUES

Some new techniques are presently being used and evaluated in the field of physical therapy and, to a lesser extent, in occupational therapy for the treatment of the cerebral palsied child. These are based on concepts of neurological deficits resulting in the persistence of abnormal reflex patterns and abnormal neuromuscular patterns of movement. Each technique has distinct merit, provided that there is proper selection of the patient and the technique to be used with that patient (Hoberman and Hoberman, 1960).

In all these techniques there is an awareness of the imbalance of inhibition and facilitation, the deficient or inappropriate response to proprioceptive stimuli, and the deficient sensory self-regulatory feedback mechanisms. Each technique actually attempts to restore all these imbalances

and deficiencies but usually stress one factor over the other two as being more important (Hoberman and Hoberman, 1960).

For the Bobaths (1954), the inhibition of the abnormal, tonic neck and labyrinthine reflexes is most important. Hence, their primary concern is with the development of proper positions and attitudes which inhibit these abnormal states. when a proper position is found, an attempt is made to teach the child to stay in that position. Later, the child is taught how to move into the inhibiting' attitude. During these various stages certain proprioceptive stimuli (rocking, vibration) are used to further enhance the desired inhibition of abnormal reflex patterns (Seamons, 1958). In some instances tapping' is performed to facilitate joint movement, possibly by increasing muscle tone (Bobath, 1954). If the basic abnormal reflex is one of extension, the clinician will gradually reverse this over all pattern to reflexion. Inhibition, it is felt, occurs when the entire body relaxes, hypertonus subsides, and the child becomes comfortable and adjusted to the new posture. Gentle rocking, or vibratory movements are sometimes used to help the patient adjust to, and become comfortable in, the new position. After relaxation (inhibition of hypertonus) has taken place, the patient is gradually taught to stay in this position by himself (Seamons, 1958). w'hen relaxation of the neck and

throat have been attained and any jaw deviation relieved by these methods, the speech clinician works for mouth closure and easy, relaxed phonation. The mouth is held closed to insure nasal breathing and to facilitate bilabial consonant formation. Some clinicians work from here on isolated sound formation (Parker, 1957), but meaningful speech has been found more apt to provide carryover in these children (Hoberman and Hoberman, 1960). The patient gradually learns to recognize, meet and control hypertonicity in various parts of the body, including the speech musculature. This technique has proven especially helpful with patients who have spasticity and hyper extension in the upper trunk, neck and laryngeal area. Breathing difficulties are sometimes overcome by the clinician vibrating on the diaphragm, ribs, spine, upper chest and/or larynx depending upon the particular breathing difficulties (Parker, 1957).

When the reflex inhibiting' posture can be maintained for a suitable period of time, Hoberman and Hoberman (1960) advocate training in sustained phonation with vocalization.

Proprioceptive neuromuscular facilitation techniques used by Kabat and Knott (1953) have been helpful in obtaining control of desired patterns of movement. These techniques utilizing mass movement patterns have been defined as

methods of prompting or hastening the response of the neuro-muscular mechanism through stimulation of the proprioceptos (Kabat and Knott, 1953). Proprioceptive stimuli such as stretch maximal resistance, pressure, traction and patterns of coordination of synergistic muscles, are used for the development of movements which approximate the normal. Kabat (1953) states that the motor cortex, the spinal cord and subcortical motor centers are stimulated by these techniques. resistance applied to motions of the lateral chest walls upper chest, sternum and diaphragm stimulate the muscles of respiration and make for increased range of motion of the chest. Stimulation of the diaphragm involves placing the hands along the costal cartilages of the lower ribs. Pressure and stretch is applied with the thumb pushed up and under the rib cage as far as possible without producing pain (Knott and Voss, 1956). Other techniques such as rhythmic stabilization are also used to stimulate the diaphragm. Mouth opening is found to be related to neck flexion patterns and mouth closing to neck extension. In order to facilitate these mouth movements, the clinician uses neck flexion and extension against resistance. Neck flexion also reinforces elevation of the tongue, and neck extension reinforces depression of the tongue. In patients who are unable to protrude or elevate their tongue on request, strengthening tongue protrusion and elevation is worked upon. The

clinician may grasp the tongue with a piece of gauze, and push back and downward, instructing the patient to pull it back. Then the patient is instructed to push his tongue out and up as the clinician resists this movement. The instruction is repeated as the effort is sustained. The patient with a hyper extended, rotated head is given resistance to a voluntary motion which places the head in the opposite direction to that in which it is habitually held.

In cases where a strong contraction is obtained in the desired muscle, relaxation occurs in the spastic muscles, allowing for a more normal positioning of the head and neck and a resultant readiness for relaxed phonation and speech training (Knott and Voss, 1956).

Some of Rood's therapeutic techniques are used to provide proprioceptive stimuli for the establishment of proper breathing patterns and for the stimulation of tongue and velar action (Rood, 1954). A cube of ice placed in an area above the diaphragm may produce a change of breathing patterns from the thorax or clavicular region to that of the diaphragm by causing contraction of the diaphragm and reciprocal relaxation of the abdomen. The effect is short lived but sometimes long enough to give the patient the kinesthetic feel of a normal breathing pattern. Gentle

stroking of isolated areas on the surface of the tongue or velum using either a finger or a small dry brush will often stimulate these areas to respond appropriately (Rood, 1954).

The stimulation-development principle' of emergent reflexes is that upon which an understanding of reflex therapy may best be based (Mysak, 1963). This principle applies to the excitation of desired reflexes which have not developed or have disappeared, as well as to the suppression of abnormally released reflexes. According to this principle, reflexes which emerge as a function of maturation may be facilitated by proper provocation unless the type and extent of nervous system damage precludes it. Extinction of undesired reflexes, on the other hand, is accomplished basically by applying adequate stimulus and then aborting the expected response. Certain primitive reflexes can be suppressed in affected children in this manner. This has been demonstrated in a pilot study (Mysak, 1963).

REFLEX STIMULATION:

In cases of congenital problems where essential feeding reflexes are weak or absent - (eg. rooting, lip reflex, mouth opening, biting, sucking, chewing, swallowing) - these

should be excited. Such reflemes form the background for the emerging movements which are necessary for complex articulatory activity (Mysak, 1963). Excitation of feeding reflexes is done by applying the appropriate stimulus and then, whenever possible, initiating and guiding the expected response. In this way it is hoped that the particular chain synaptic pathway necessary for the motor activity being sought can be established and developed: the results of a pilot study (Mysak, 1960) and a subsequent follow-up study (Mysak, 1963) appear to indicate that this concept is tenable.

In accordance with the natural sequence, these infantile reflexes, after being stimulated and serving their vegetative functions, should eventually be suppressed and replaced by higher forms of oroneuro motor activity (Mysak, 1963).

Procedures have been designed to counteract drooling, the often encountered jaw-droop' (both of which may be hampering articulation), and hypernasality (Mysak, 1963).

In instances associated with dysphagia, attempts at exciting a more normal rate of swallowing (about two swallows per minute) may be made by : (a) stimulating the back of the tongue or palate with a small tongue depressor. <b) directing

a stream of water from an eyedropper against the posterior pharyngeal wall while the head is in moderate dorsiflexion, and (c) encouraging gentle token coughing. Efforts at relieving hypernasality, due to a lack of velar elevation associated with a disturbed palatal reflex, maybe made by regular, periodic attempts at stimulating the palatal, pharyngeal and yawning reflexes. Velar stroking accompanying these efforts may be found to be of assistance. Finally the jaw-droop' condition may be helped by making use of the mandibular reflex.

Reflex suppression

Involuntary movements of the head and articulators in response to chest, neck, jaw, and cheek stimulation are often seen in affected individuals. These involuntary movements may be triggered inadvertently causing further interference with articulatory efforts. Attempts at weakening these responses should be made (Mysak, 1963). Similarly, since the frequently overactive smiling and laughter reflexes often complicate athetotic dysarthria, these reflexes should also be desensitized. Stimulation, tolerance and eventual adaptation maybe gradually attained by regular, periodic handling and later self—handling of sensitive thoracic, head and neck areas as well as by stimulating affected areas and

subsequent resistance of the accompanying involuntary movement.

Retained or released cephalic, rooting, lip, mouth opening, biting and suckling reactions which are considered to be compounding an articulatory problem should be suppressed. Excitation in combination with the prevention of reflex emergence is the chief means of eventually inhibiting infantile oral activity. For eg. (a) if the lower lip depresses and the jaw deviates when the angle of the mouth is stimulated (rooting reflex), the clinician should apply the stimulus and physically prevent the response from taking place, (b) if the mouth opens in response to a visual stimulus, the clinician should provide adequate stimulation and hold the mouth closed. Whenever possible the client himself should carry over the therapy; two or three periods daily of such attempts at reflex weakening is desirable.

Thus we can see how the emphasis in therapy has shifted from improving the functioning of oval and pharyngeal muscles (Love, Hagerman and Taimi, 1980) to vegetative therapy, reflex inhibition and training aimed at reducing the elements of dysphagia (Palmer, 1947; Westlake, 1951; Westlake and Rutherford, 1961; Mueller, 197E; Morris, 1977).

Abnormal oral reflex behaviour and deprivation:

To a greater extent perhaps than any other initial neurological deficit, abnormalities of primitive and postural reflexes may have the most limiting influence on development (Scherzer and Tscharnuter, 1982). The child who roots and sucks poorly will feed poorly. Indeed, a first indication of deficit may be expressed as "colic" and irritability associated with the feeding process related to poor sucking and swallowing, with air trapping and inadequate intake. A strong asymmetric tonic neck reflex will limit reaching out, having contact with textures, shapes and objects in the environment. Rolling from supine will be delayed or difficult and progression to sitting, crawling and ambulation will be greatly impeded. Similarly, persistence of the tonic labyrinthine reflex, with associated trunkal extension, will delay and limit sitting. Crawling will be restricted by a persistent symmetric tonic neck reflex in which tone of head and upper extremities correspond so that extension of the head will result in extension of the upper limbs and distrubt movement.

For the older children similar concerns relate to delayed or incomplete appearance of the postural reflexes. Late neck and body righting restricts rolling, sitting, and

crawling. Limited or incomplete righting reactions affect trunk control, weight bearing, and walking. Here too, delayed expression of reflexes occurs in conjunction with other functions. Thus restricting neurological deficits which impair the ability to interact and participate in the environment (Scherzer and Tscharnuter, 1982).

These deficits have an immediate and continuing impact on the child's ability to learn actively from the environment and participate in the process of socialization. Hence the neurologically impaired child may remain passive, dependent, and out of active contact unless his or her specific developmental needs are recognized and an active stimulation process individually constructed. Implications for both education and socialization of the affected infant relate directly to the inherent restriction from the very beginning of development (Scherzer and Tscharnuter, 1982).

Mysak (1959, 1963) reported that dysarthria associated with cerebral palsy often includes complicating infantile oropharyngeal reflexes which may contribute to the articulation problem. He described these motor patterns as positive symptoms - involuntary movements, as opposed! to negative symptoms of loss or defect of function or of brain damage caused by the release of certain lower brain centres

from the inhibitory influence of higher centers. Similar patterns have been discussed by Andre-Thomas and Dargassies (1960), Illingworth (1965), Dekaban (1959), Richardson (1953), and others as normal infantile feeding and withdrawal reflexes.

Hooker (195S) found that cranio-oropharyngeal patterns, similar to those above can be elicited through perioral stimulation. Hooker describes this activity as reflexive, resulting from excitation of the trigeminal nerve, which synapses with the effector at no higher than the pontine levels. These patterns appear in an orderly progression as the fetus develops.

Ingram (1962) found that in cortically diseased infants, feeding reflexes could be elicited easily beyond the age where they could be elicited in normal infants. It is possible, therefore, that stereotyped, cranio-oropharyngeal postural or movement patterns, similar to those seen in embryonic and infantile development. Sheppard's, (1964) study showed that stimulation of one of the primitive cranio-oropharyngeal motor patterns, brings on a sequence of patterns as they might appear in normal infantile feeding activity, though to varying degrees. Often the component patterns of the sequence appeared stronger than when elicited

by themselves. Patterns appeared as part of these sequences when they could not be selectively elicited. In some cases the beginning movements of one pattern were interrupted by movements of another pattern which seemed dominant. The latter pattern was apparently triggered by the movements of the former . It seemed that successful elicitation of one pattern lowered the latency period for any of the other primitive patterns associated with infantile feeding which had been retained by the individual. Either the movements of one pattern act as a stimulus for the succeeding pattern, or facilitate it. If the latter pattern is dominant it will interrupt the movements of the former, if it is not, it will follow in sequence and in turn might elicit another pattern.

Sheppard (1964) also observed that any voluntary activity may also elicit these patterns. The patterns, in turn, would interfere with the voluntary activity making it difficult or impossible. Sheppard (1964) described a subject from her study, who on eating showed very extensive primitive cranio-oropharyngeal motor patterns. When the subject opened her mouth to receive food she hyper-extended her mandible (mouth—opening pattern); in closing her mouth she bit or chewed the spoon before it could be withdrawn. In manipulating the food in her mouth and swallowing a sucking pattern began and the food was ejected by the sucking movements of her tongue.

Kabat (1961) states that "Reflexes can inhibit as well as facilitate voluntary motion and voluntary motion can inhibit as well as facilitate reflexes".

Sheppard's (1964) study indicates, however, that in the absence of normal, voluntary movements the facilitating effect of voluntary motion on reflex activity and the inhibitory effect of reflexes on voluntary motion are the stronger. The reflex activity may be dominant. Ingram (1962) found that in hemiplegic infants, lip and sucking reflexes are elicited more easily on the hemiplegic side and "may be demonstrated only on that side in older children".

Observations (Sheppard, 1964) showed that strong, retained primitive cranio—oropahryngeal motor patterns alone do not cause sufficient disability to prevent speech or to create severely defective speech or feeding problems. However, they may cause markedly abnormal speech, feeding patterns and facial grimaces. The latency of the cranio-oropharyngeal patterns appears to be crucial in determining the effect of these primitive cranio-oropharyngeal motor patterns on voluntary activity. When the latency period is short, the individual is actually a victim of the patterns and pattern sequences. Every attempt at voluntary activity, especially that involving the oropharyngeal area, can elicit

a pattern or pattern sequence which inhibits or distorts the intended movement.

Jyothi (1988), studied the realtionship between deglutition and speech performance in seven cerebral palsied children in the age range of 3.5 to 13.5 years. She found a close relationship between deglutition and articulation.

NEED FOR THE PRESENT STUDY:

Provided with a variety of several oromotor training techniques aimed at preventing or improving speech problems in cerebral palsy, speech language pathologists should attempt to ascertain which of these will be the least disappointing and the most effective. This study is among one of the few attempts to evaluate two sets of oromotor behaviour viz. deglutition and oral speech reflexes that are frequently modified during speech management programs for cerebral palsied individual.

Several investigators (McCall, 1964; Solomon, 1965; Rutherford and McCall, 1967) have indicated that oral sensory deficits may play a role in the speech performance of the cerebral palsied.

Studies by Sheppard (1964) and Love et al. (1980) support the idea that dysphagia and abnormal oral reflexes exist along with poor speech performance, Sheppard's (1964) study reports a very strong correlation between abnormal oral reflexes and speech performance, Love et al.'s study (1980) suggests that abnormal oral reflexes are not particularly predictive of lack of speech in their sample.

This study therefore aimed to find out the relationship if any between the presence of dysphagia and/or abnormal oral reflexes and speech performance in the cerebral palsied children.

METHODOLOGY

AIM:

1. To compare the performance of spastic cerebral palsied children on (a) deglutition of liquids and (b) deglutition of solids.

S. To test the oral speech reflex profile in the cerebral palsied.

3. To test the relationship between deglutition patterns and the oral speech reflex profile in the cerebral palsied.

4. To test the relationship between deglutition patterns and articulatory ability at the phoneme level in the cerebral palsied.

5. To test the relationship between abnormal oral speech reflexes and articulatory ability at the phoneme level in the cerebral palsied.

SUBJECTS:

The subjects in this study consisted of 51 verbal, normal hearing, spastic cerebral palsied children. The

subjects were chosen from the aage range of 3 to 17 years with a mean age of 10.3 years. The upper limit of 17 years was chosen since adult patterns of deglutition would be present in this group (Jyothi, 1990). The lower limit of 3 years was chosen after taking into consideration the ease of instruction and coopertion for testing.

SUBJECT SELECTION CRITERIA:

The subjects fulfilled the following criteria:

1) They had no significant mental retardation ie. they were of average intelligence or had borderline to mild mental retardation.

2) They had no history of otological abnormalities.

3) They were able to follow oral instructions and perform the tasks as requested.

4) They were all verbal and were able to speak in English.

- MATERIAL SELECTION :

A. Deglutition :

Easily accessible food items were choen. Items ranged in consistency from liquids to solids. This enabled

comparison of deglutition patterns employed by the subjects across different food items. The items included:

a) Solids:

1) Cooked rice - a common item included in the regular diet.
2) Biscuits - which could be softened quickly by saliva.
3) Rusk - which required increased masticatory force for fragmentation, posing a problem in cohesive bolus formation if there was decreased salivation.
4) Chocolate - which required exaggerated mandibular motion for chewing to facilitate observation of mandibular arc traversed.

b) Liquids:

Only water was selected, owing to accessibility and ease of observation of oral maneuvering. Performance on deglutition tasks was assessed using the scale developed by Jyothi (1990).

B. The oral speech reflex profile:

Both positive and negative oral speech reflexes were tested. Positive oral speech reflexes are generally inhibited by the time a child is three years old (Mysak,

1763). For eg. facial response. Negative oral speech reflexes are those that are generally lost or weakened (Mysak, 1963). For eg. swallowing reflex. These positive and negative oral speech reflexes were chosen in accordance with (1) their ease of elicitation, (2) relevance to the speech act (3) age at which these oral speech reflexes mediate and disappear, (4) unambiguity to environmental stimuli.

C. Speech performance:

Traditionally phoneme accuracy has been employed as a direct measure of the degree of severity of dysarthria in cerebral palsied individuals (Love, Hagerman and Taimi, 1980). Isolated phonemes were used as a measure of the articulatory ability.

Subjects were asked to repeat after the investigator the phonemes and responses were noted down. Responses were analyzed in terms of substitution, omission, distortion and addition errors.

TEST ADMINISTRATION:

a) Test environment - The subjects were seated comfortably and they were tested individually by the examiner in an isolated room with minimum distraction.

Table-1: Test protocol for evaluation of deglutition, oral speech reflexes and articulatory abilities.

Sr.No.	Parameters evaluated	Subtests
1	History, extra and intra oral examination.	- History pertinent to feeding. - Routine extra and intra oral examination.
II	Speech performance Articulation	- English speech sounds in isolation. - Screening articulation test (NIHH, 1986).
III	Deglutition	
A	Eating	
i)	Natural eating	- Imbibition - Matication - Biting — Chewing - Swallowing - oral - pharyngeal
ii)	Simulated, interrupted condition	- Imbibition: Maneuver employed. - Biting: a) dentition used b) reflexive/voluntary. - Chewing: a) Chewing sound b) Labial movements c) Detection of food position d) Spillage e) Mandibular arc traversed, f) Lingual movements g) Masseter contraction h) Chewing efficiency i) Food clearance from labial surface

	- Swallowing a) Anterior and posterior seal - cohesive bolus. b) layngeal elevation c) Masseter contraction d) Circumoral tension e) Lingual positioning f) Mandibular stability g) Gulp h) Others.
Post swallow intra oral examination.	- Imbibition : a) Through pouted and unpouted glass.
B. Drinking - Natural - Simulated and interrupted condition	b) Position - Lip protrusion — Amount of water consumed in three trials. - Others c) Through straws - Position - Angling - Tongue thrust observation - Others - Swallowing: (a)Anterior and posterior seal (structure and adequacy) (b)Swallowing reflex (c)Laryngeal displacement (d)Circumoral tension (e)Lingual positioning (f)Mandibular stability (g)Gulp.

11. Reflexes

Sr.No.	Reflex	Manner of eliciting	Response
1.	Swallowing reflex	Stimulation of palate, posterior pharyngeal wall and back of tongue.	Swallowing activity,
2.	Pharyngeal reflex	Touching the posteior pharyngeal wall or stimulation of fauces	Contraction of constriction muscle of phafynx or gag reflex.
3.	Palatal reflex	Touch the palate	Elevation
4.	Cephalic reaction	Simultaneous stimulation of the right corner of the mouth and right ear	Depression of the right half of the lower lip while the tongue moves to the right and head turns to the left.
5.	Facial response	Sharp tapping around the mouth.	Immediate, fleeting symmetrical or asymmetrical pouting of lips.
6.	Cardinal points reaction	Lightly stroking the angle of the mouth.	Lowering of the respective half of the lower lip.
		Finger is moved away but keptin contact with the cheek.	Tongue will move toward the stimulus and head will follow
		Stimulation of the middle of the upper and lower lip.	Lip and tongue raising or depression respectively.

	The finger is moved upward or downward toward the chin.	The head will extending, the mouth will opening and head flexing respectively.
7. Mandibular or Jaw-Jerk Reflex	Tapping the chin while it hangs passively open.	Brief reflex elevation or clonic movement of the jaw.

INSTRUCTIONS TO THE SUBJECTS:

(1) Subjects were familiarised with the nature of testing.

(2) They were instructed to remain relaxed and not to speak during the testing for oral speech reflexes.

(3) Responses were elicited in the sequence as listed in the test format (Appendix—C).

(4) They were instructed to repeat each phoneme after the examiner during the testing for articulation.

RESPONSE RATINE CRITERIA:

Subjects responses were noted on a 3 point rating scale as given below:

RESPONSE RATINE SCALE:

(1) Deglutition of liquids and solids

0 - Total loss of function
1 - Severe impairment
2 - Moderate impairment
3 - Normal

The zero rating of this section does not exist for all practical purposes. As no function or 0 performance in this skill, is only a hypothetical postulation. Moreover the population tested were verbal cerebral palsied's who did not have profound impairments on all three tasks.

To equalize rating scales across all three tasks and for statistical purposes, 0 was retained while scoring a response.

(2) Positive reflexes (degree of presence)

0 — Normal
1 - Mild
2 - Moderate
3 — Moderately severe
4 - Severe

(3) Negative reflexes (degree of presence)

0 - Weak
1 - Moderately
2 - Strongly
3 - Normal

(4) Articulation

0 - Severe impairment
1 - Moderate impairment
2 - Mild impairment
3 - Normal.

NEED FOR THE RATING SCALE:

(1) To establish a hierarchy in manner of appearance of oral speech reflexes, deglutition patterns and articulatory skills.

(2) To compare the performance of subjects across different age groups in terms of magnitude of oral speech reflexes, deglutition patterns and articulatory abilities.

Testing on all the sub-types of deglutipn - eating and drinking was done a minimum of three times to typify the patterns of response obtained from the client accurately. Individual testing sessions lasted from 45 mins. to 1 hour depending on the sample group. Similarly after teting for the oral speech reflex profile, the test was repeated, to differentiate a reaction from an oral speech reflex. Increased complexity and inconsistency of response distinguished a reaction from an oral speech reflex (Mysak, 1963).

Raw scores were tabulated and entered as per the test format (Appendix-C).

RESULTS AND DISCUSSION

The data on the different parameters of dentition, oral speech reflexes and articulation were subjected to principal component analysis and the findings discussed under eight major sections.

I Deglutition patterns in cerebral palsied children

a) for liquids
b) for solids

II Oral speech reflex profile in cerebral palsied children

III Articulatory abilities of cerebral palsied children

IV Relationship between deglutition of liquids and articulatory ability.

V Relationship between deglutition of liquids and oral speech reflexes.

VI Relationship between deglutition of solids and articulatory ability.

VII Relationship between deglutition of solids and oral speech reflexes.

VIII Relationship between deglutition of oral speech reflexes and articulatory ability in the cerebral palsied.

DEGLUTITION PATTERNS

a) Deglutition of liquids

The different parameters of deglutition of liquids are discussed in Table 2 and depicted in graph 1 and 2 under the sections of: (1) Imbibition and (2) Swallowing. Mean scores of the 51 cerebral palsied subjects on deglutition of liquids are furnished in Table 2.

In Table 3 the data obtained in the present study were compared with normative data (Jyothi, 199O).

Principal component analysis test was administered to reduce the dimensionality (number of variables), while retaining as much of the information (variation) as possible.

TABLE 2

MEAN SCORES OF SUBTESTS ON SWALLONING OF LIQUIDS

VARIABLE	MEAN
1. Imbibition - position of the glass	2.47
2. Imbibition - degree of lip protusion	2.50
3. Imbibition - cheek indrawing	2.50
4. Imbibition - position of the straw	2.60
5. Imbibition - degree of lip closure	2.23
6. Swallowing - lingual/labial seal (Anterior)	2.43
7. Swallowing - adequacy of posterior lingual seal	2.01
8. Swallowing - swallow reflex	2.64
9. Swallowing - extent of laryngeal displacement	2.68
10. Swallowing - degree of tension	2.43
11. Swallowing - positioning of tongue	2.60
12. Swallowing - extent of mandibular displacement	2.50

TABLE 3: DE6LUTITI0N OF LIQUIDS

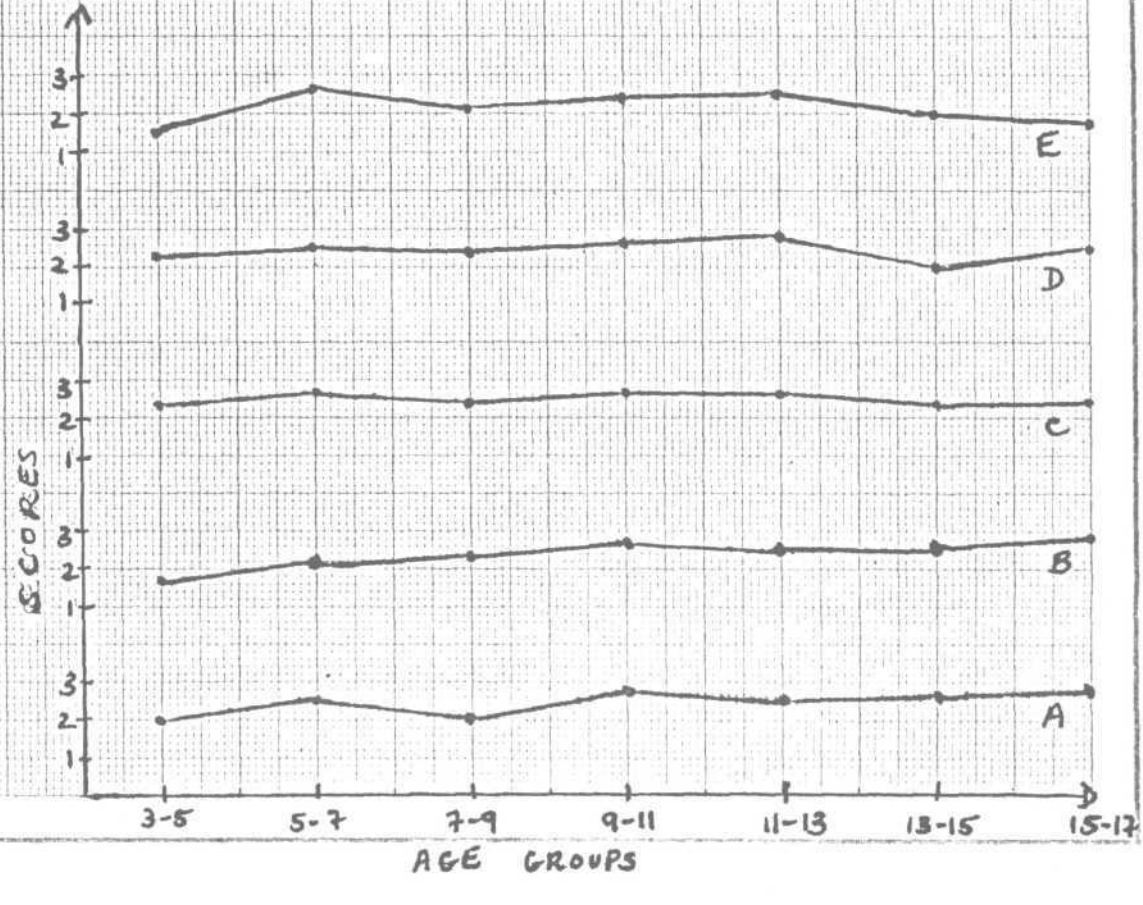
Deglutition Parameters	Age at which pattern is attained		Sigmficant diagnostic feature for cerebral palsied	Observation of different patterns	Remarks
	Data obtainted on normal children.	Data on cerebral palsied children (present)			
1.	2.	3.	4.	5.	6.
Imbibition a)F'osition of glass	6-7	9-11	✓	Developmental trend is seen with appropriate positioning of the glass in the cerebral palsied after 9 years and in normals after 6 years.	Cerebral palsied children like normals show a developmental trend with respect to correct placement at a later age than normals.
b)Degree of lip protrusion	7-8	9-11	✓		
c)Degree of cheek indrawing	4-6	All cerebral palsied subjects showed minimal to no cheek indrawing		All cerebral palsied individuals tend to show minimal to no cheek indrawing across all age groups. In normal subjects cheek indrawing is seen in subjects less than 4 years.	Cerebral palsied individuals across all age groups tended to show weak atasseter contraction also. Thus absence of cheek indrawing injthe younger age groups of cerebral palsied individuals might be related to restricted movement due to neuroauscular involvement.
d)F'osition of the straw	6-7	Majority of cerebral palsied subjects tend to place the straw either between the lips or between the lips and teeth.	X	Cerebral palsied individuals across all age groups tended to place the straw between the lip or between the lip and teeth. Normal chidlren over 6 years were seen to place the straw appropriately between the lips.	This parameter does not appear tobe significant since all age groups of cerebral palsied children tend to place the straw between the lips or' between the lips and teeth and in normals only those subjects above 6 years tended to place the straw appropritely between the lips. Since there is considerable overlap between the scores obtained m both these groups of subjects. No clear cut difference between these two groups can be seen

1.	2.	3.	4.	5.	6.
e)Degree of labial tention	4-7	5	✓	A developmental trend is seen in cerebral palsied subjects over 5 years of age and in normal subjects over 4 years of age.	This parameter is a significant diagnostic feature as cerebral palsied subjects exhibit a delay in acquiring appropriate values of lip tension when compared to normal subjects.
Swallowing 1. Anterior seal	2-3	11-13	✓	Developmental trend is seen with adequate anterior seal attained only after 11 years in cerebral palsied. In normials a developmental trend was adequate anterior seal used observed right from 2 years.	In cerebral palsied chidlren attainment of adequate anterior seal is delayed. It is attained after 11 years of age. In norma subjects, right from 2 years adeuate anterior seal was observed.
2.Posterior seal	2-3	11-13	✓	A developmental trend is seen with adequate posterior seal attai-ned only after 11 years in cerebral palsied subjects. In normals a developmental trend was seen with adequate posterior seal was-observed right from 2 years.	In cerebral palsied children attainment of adequate posterior seal is dealyed. It is attained after 11 years of age. In normal subjects, right from 2 years adequate posteior seal was seen.
3.Swallow reflex	2-3	Most cerebral palsied sub-subjects reach a ew without attaining normal scores	X	In the cerebral palsied, subjects acoss all age groups tend to show a weak swallow reflex but normal subjects after 2 years show an adeauate swallow reflex.	The weak swallow reflex across all age groups in cerebral palsied subjects may be attributed to neuro muscular involvement.
4.Laryngeal elevation	2-3	2-3	X	Cerebral palsied subjects as well as normal subjects show adequate laryngeal elevation after 2-3 years of age.	This parameter is not a significant diagnostic feature, since both groups of subjects adequate laryngeal elevation. This will cause considerable overlap in the scores obtained actoss these 2 groups groups of subjects.

1.	2.	3.	4.	5.	6.
S.Circumoral tension	4-7	In majority of cerebral palsied mdi viduas mini- mal! to negligible circumoral tension is seen	✗	In cerebral palsied individuals across all age groups negligible to minimal circumoral tension was seen, whereas in normals a developmental trend was seen with only subjects after 4 years exhibiting negligible circumoral tension.	This parameter is not a significant diagnostic indicator as there is considerable overlap between the scores obtained across both groups of subjects. Thus there is no dear demarcation between scores obtained by cerebral palsied subjects and the scores obtained by normal subjects.
6.Lingual positioning	6	13-15	✓	In cerebral palsied children, only after 13 years was the posi- tioning of the tongue not visually evident. In normal subjects after 6 years posi- tioning of tongue was not visually evident.	In cerebral palsied subjects appropriate lingual positioning is delayed although adevelopmental trend was seen in both cerebral palsied subjects and normal subjects. It was attained ony after 13 years in the cerebral palsied as compared to & years in normal subjects.
7.Mandibular stability	8-?	Majority of cerebral palsied sub jects reach on plateau without attaining normal scores.	✓	In a majority of cere- bral palsied subjects minimal mandibular instability is seen whereas in normal subjects a develop- mental trend was seen with mandibular stabi- lity reaching normal values after 8 years.	Since there are observable distinguishing features seen in cerebral palsied subjects and normal subjects, this parameter appears to be of significant diagnostic importance.

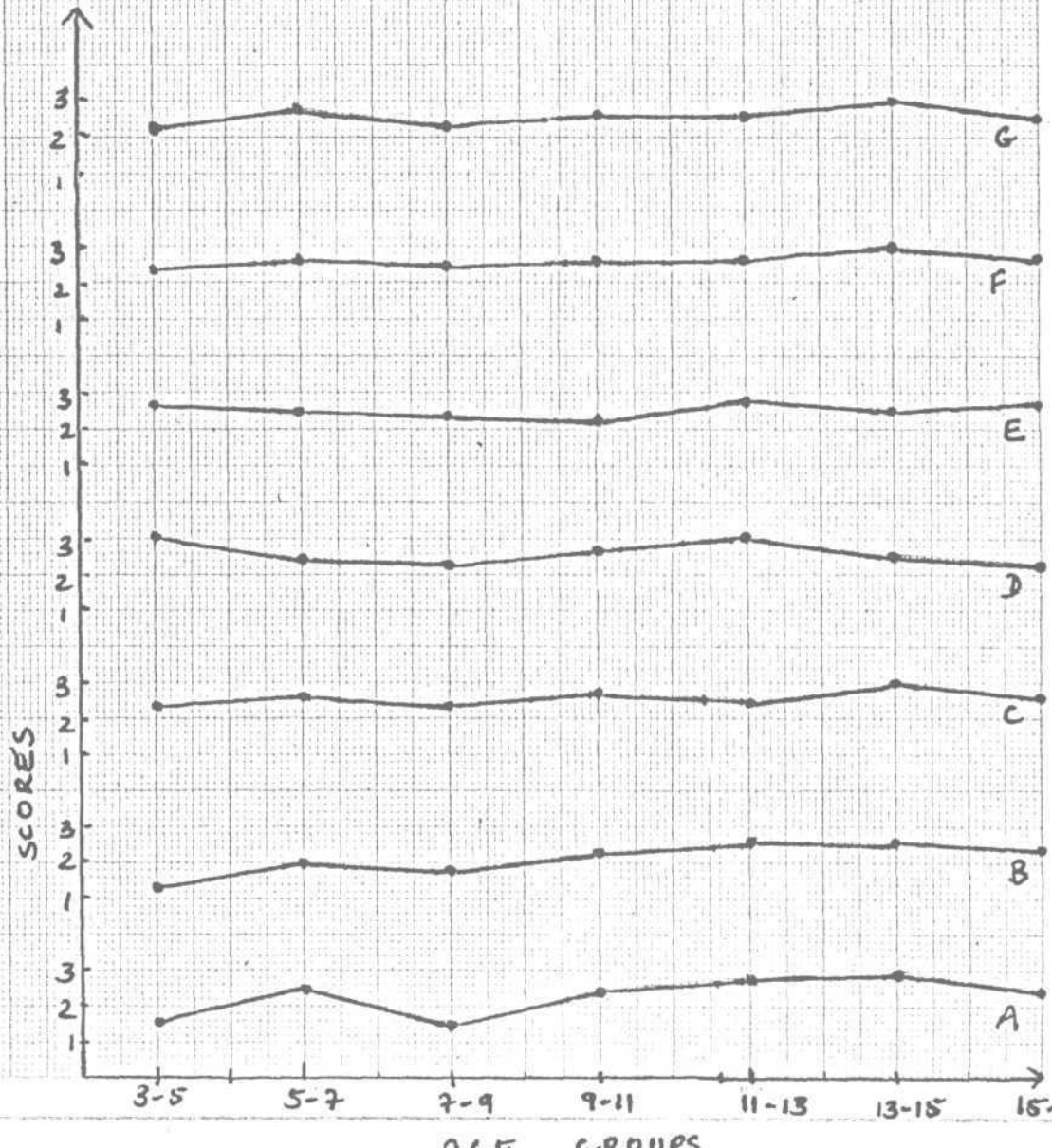
GRAPH 1 - MEAN SCORES ACROSS AGE GROUPS ON DEGLUTITION OF LIQUIDS - ON IMBIBITION TASKS

A - Position of the glass
B - Degree of lip protrusion
C - Cheek indrawing
D - Position of the straw
E - Degree of lip closure



GRAPH 2 - MEAN SCORES ACROSS AGE GROUPS ON DEGLUTITION OF LIQUIDS - SWALLOWING TASKS

A - Lingual / Labial Seal (Anterior)
B - Adequacy of Posterior lingual seal
C - Swallow reflex
D - Extent of laryngeal displacement
E - Degree of tension
F - Positioning of tongue
G - Extent of mandibular displacement



Deglutition of liquids

In deglutition of liquids, 2 factors can be said to account for most of the variance. Five variables are found to correlate most highly with these factors. All other variables are negligible.

1. Posture: 1) Position of the straw
   2) Anterior seal
   3) Extent of mandibular displacement

2. Valving: 2 variables are found to correlate most highly with this factor. All the other variables are negligible .
   1) degree of lip protrusion
   2) posterior seal

Thus under deglutition of liquids we have 2 main factors that account for most of the variance. All other factors are negligible. The first factor accounts for 52.92% of the total variance and is represented mainly by 3 variables. The second factor accounts for 10.63% of the total variance seen and is represented mainly by 2 variables.

Principal component analysis therefore gives an idea of exactly which variables account for most of the variance seen and only these variables need be tested for. This will facilitate assessment of deglutition of liquids and reduce testing time.

From Table 5 and results obtained on the principal component analysis test we can see that the same variables that appear to be of diagnostic importance on qualitative analysis also appear to be of diagnostic importance on principal component analysis i.e. quantitative analysis.

Thus in testing for deglutition of liquids only those variables which on principal component analysis correlate very highly with (1) posture and (S) valving need be tested for. This will facilitate assessment of deglutition of liquids and help in reducing assessment time.

b) Deglutition of solids:

The different parameters of deglutition of solids are discussed in Table 4 and 5 and depicted in graphs 3, 4, and 5 under the sections of (1) Imbibition (5) Mastication and (3) Swallowing. Mean scores of the 51 cerebral palsied subjects on deglutition of solids are furnished in Table 4.

In: Table 5 the data obtained in the present study were compared with normative data (Jyothi, 1990).

TABLE 4

Mean Score on subtests for deglutination of solids.

Variable	Mean
1. Imbibition - oral structures employed for spoon clearance.	2.52
2. Imbibition - efficiency	2.50
3. Biting - structured maneuver employed	2.80
4. Chewing — sound	2.56
5. Chewing - accompanying labial movements	2.27
6. Chewing - detection of food position	2.41
7. Spillage	2.80
8. Mandibular are traversed	2.74
9. Chewing - accompanying lingual movements	2.80
10. Chewing - maseter contraction	2.70
11. Chewing - efficiency	2.52
12. Chewing — labial surface clearance	2.45
13. Swallowing - cohesive bolus formation	2.49
14. Swallowing - laryngeal elevation	2.66
15. Swallowing — masseter contraction	2.62
16. Swallowing - circumoral tension	2.56
17. Swallowing - lingual position	2.54
18. Swallowing - mandibular stability	2.72
19. PostSwallow - Intraoral examination	2.66

TABLE-5 : DEGLUTITION OF SOLIDS IN THE CEREBRAL PALSIED

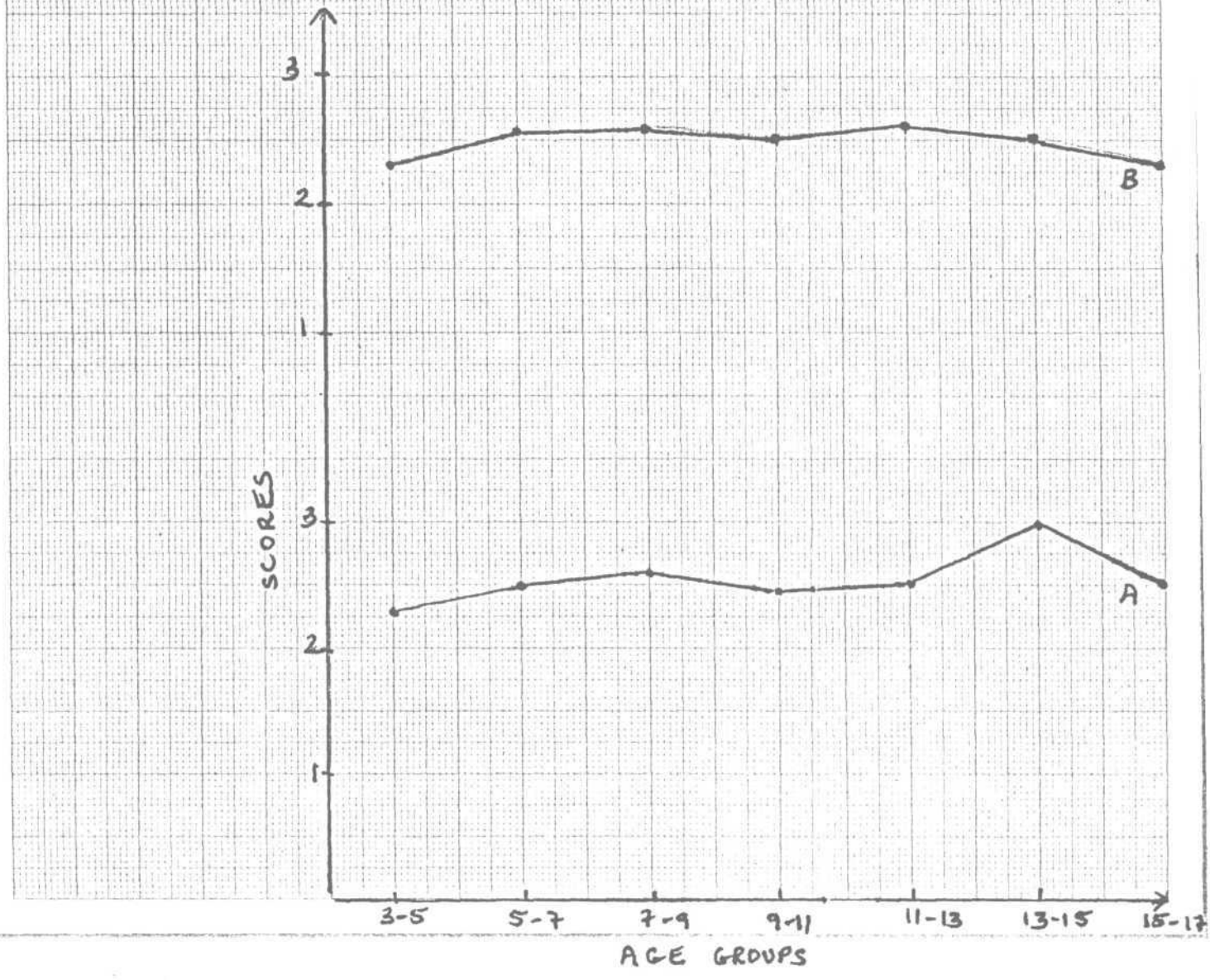
Deglutition Parameters	Age at which pattern is attained		Significant diagnostic feature for cerebral palsied	Observation of different patterns	Remarks
	Data obtained on normal children.	Data on cerebral palsied children (present study)			
1.	2.	3.	4.	5.	6.
Imbibition					
1.Oral structures employed in spoon clearance	6	Majority of cerebral palsied subjects reach a plateau before attaining normal scores.	✓	In cerebral palsied subjects a developmental trend is not seen. However in normal subjects a developmental trend is seen for both these tasks.	These parameters appear to be a significant diagnostic features for cerebral palsied ~~spoon reach a normal~~ subjects, since majority of them never attain normal scores, whereas normal subjects attain normal scores above a certain age level.
2. Efficiency	2				
Mastication					
1.Chewing sound	8	13	✓	A developmental trend is seen for both cerebral palsied and normal subjects. However, in cerebral palsied subjects normal patterns for these parameters is seen at a later age and is thus delayed.	These parameters therefore appear to be a significant diagnostic feature for cerebral palsied subjects because of the delay they show in normal acquisition of these parameters.
2.Mandibular arc traversed	2	9	✓		
3.Accompanying lingual movements	5	9	✓		
4.Labial movements accompanying chewing.	7	Majority of cerebral palsied subjects reach a plateau before attaining normal scores.	✓	In cerebral palsied subjects a developmental trend is not seen. However for normal subjects a developmental trend is seen for all these 4 tasks.	These parameters seem to be a significant diagnostic feature for cerebral palsied subjects since majority of them never attain normal scores ~~which~~ but normal subjects attain normal scores above a certain age level.
5.Detection of food position	5		✓		
6.Spillage	4				
7.Masseter contraction	2		✓		
8.Mode of labial clearance during chewing.	7		✓		

8.Chewing efficiency	Majority of normal subjects showed fair-good chewing efficiency	Majority of cerebral palsied subjects showed fair-good chewing efficiency	X	No developmental trend is seen for both cerebral palsied as well as for normal subjects. Scores for both groups of subjects show considerable overlap.	This parameter does not appear to be a significant diagnostic feature for cerebral palsied subjects since the scores obtained for cerebral palsied subjects and normal subjects show a considerable amount of overlap.
Swallowing 1.Cohesive bolus formation	4	11	✓	A developmental trend is seen for both cerebral palsied and normal subjects. However in cerebral palsied subjects normal patterns for this parameter is seen at a later age.	This parameter therefore appears to be a significant diagnostic feature for cerebral palsied subjects because they show a delay in normal acquisition of this parameters.
2.Mandibular stability.	4	All cerebral palsied subjects show either normal scores or mild mandibular instability.	X	A developmental trend is not seen for normal subjects with majority of the subjects demonstrating normal mandibular stability or mild mandibular instability. In normal subjects a developmental trend was observed.	This parameter does not appear to be a significant diagnostic feature for cerebral palsied subjects since the scores obtained for cerebral palsied subjects and normal subjects overlap a great deal. Thus there is no clear cut demarcation between these 2 groups of subjects.
3.Laryngeal elevation	Majority of normal subjects show either	Majority of cerebral palsied subects show	X	No developmental trend is seen for both cerebral subjects as well as for normal subjects. Scores for both groups of subjects show considerable overlap.	This parameter does not appear to be a significant diagnostic feature for cerebral palsied subjects since the scores obtained for both cerebral palsied subjects and normal subjects show a considerable amount of overlap. Thus there is no clear cut difference between these 2 groups.
4.Masseter contraction	normal scores or mildly	either normal scores or mildly	X		
5.Circumoral tension	impaired scores for these 5	impaired scores for these 5	X		
6.Lingual positioning	parameters	parameters	X		
7.Postswallow intraoral examination					

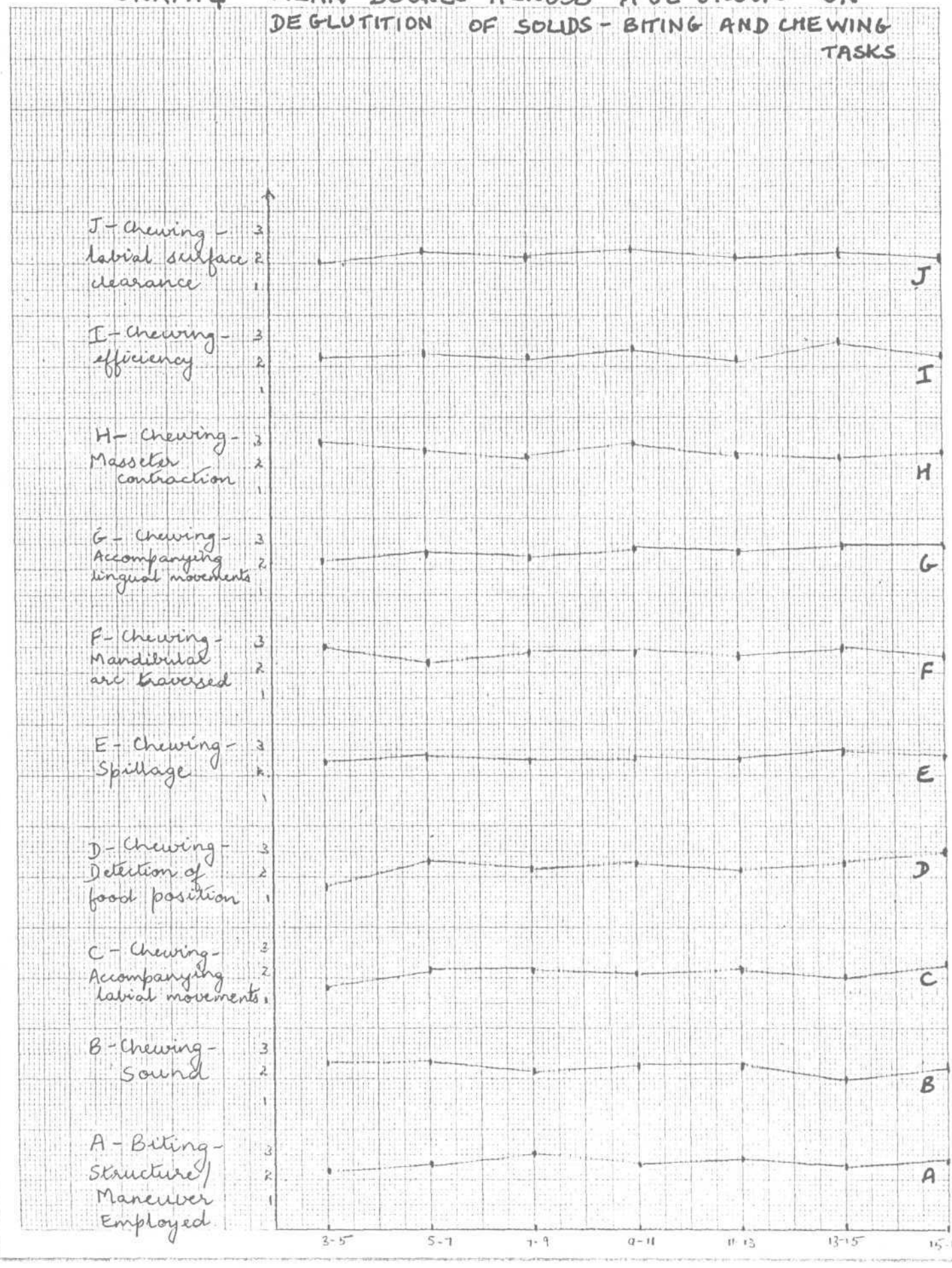
GRAPH 3 - MEAN SCORES ACROSS AGE GROUPS ON DEGLUTITION OF SOLIDS - IMBIBITION TASKS

A - Oral structures employed for spoon clearance

B - Efficiency

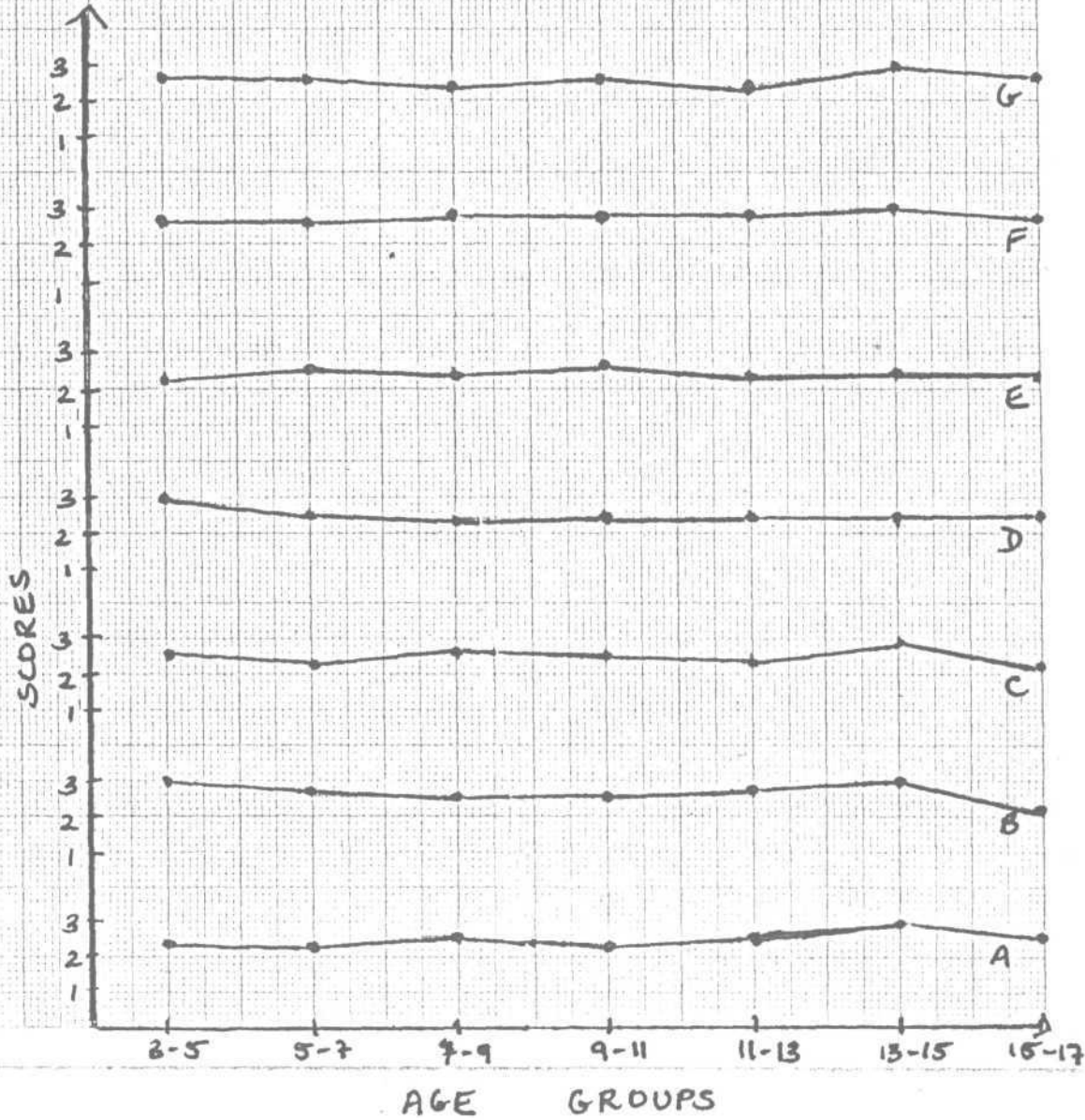


GRAPH 4 - MEAN SCORES ACROSS AGE GROUPS ON DEGLUTITION OF SOLIDS - BITING AND CHEWING TASKS



GRAPH-5 - MEAN SCORES ACROSS AGE GROUPS ON DEGLUTITION OF SOLIDS - SWALLOWING TASKS

A - Cohesive bolus formation
B - Laryngeal elevation
C - Masseter contraction
D - Circumoral tension
E - Lingual position
F - Mandibular stability
G - Post swallow intraoral examination



Deglutition of solids:

Principal component analysis reveals that 5 factors account for most of the variance in this function.

1. Post-imbibition process: Five variables are observed to correlate most highly with this factor.
   - Detection of food position
   - Masseter contraction
   - Chewing efficiency
   - Mandibular stability
   - Post swallow intra oral examination

S. Muscle contraction: Three variables are observed to correlate most highly with this factor
   - Masseter contraction on chewing
   - Chewing efficiency
   - Masseter contraction on swallowing

3. Swallowing: Two variables are observed to correlate most highly with this factor.
   - Cohesive bolus formation
   - Laryngeal elevation.

4. Chewing sound: One variable is observed to correlate highly with this factor.
   - Chewing sound

5. Oral tension: One variable is found to correlate most highly with this factor.
   - Circumoral tension

6. Circumoral movement: Three variables are observed to correlate with this factor.
   - Imbibition efficiency
   - Laryngeal elevation
   - Masseter contraction

Thus under deglutition of solids we have 6 main factors that account for most of the variance. All other factors are negligible.

The first factor accounts for 35.49% of the total variance and is represented mainly by 6 variables. The second factor accounts for 1.75% of the total variance and is represented mainly by 3 variables. The third factor accounts for 1.53% of the total variance and is represented mainly by 2 variables. The fourth factor accounts for 1.26% of the total variance and is represented mainly by 1 variable. The fifth factor accounts for 1.14% of the total variance and is represented mainly by 1 variable. The sixth factor accounts for 1.11% of the total variance and is mainly represented by 3 variables.

Thes comparing the results tabulated in Tables 4 and 5 with the results on principal component analysis, we can see that on qualitatively analysing the data, some variables do not appear to be significant diagnostic indicators. For example, chewing efficiency, mandibular stability, post swallow intra oral examination and circumoral tension. However, majority of variables which appeared to be of diagnostic significance on principal component analysis also appeared to be of diagnostic significance on qualitative analysis.

Thus on assessing deglutition of solids only those variables which correlate very highly with (1) chewing (2)

muscle contraction (3) swallowing (4) chewing sound (5) circumoral movement need be tested for.

II. Oral speech reflex profile in cerebral palsied children.

Mean scores for the oral speech reflex profile are furnished in Table 6 and depicted on graph-6.

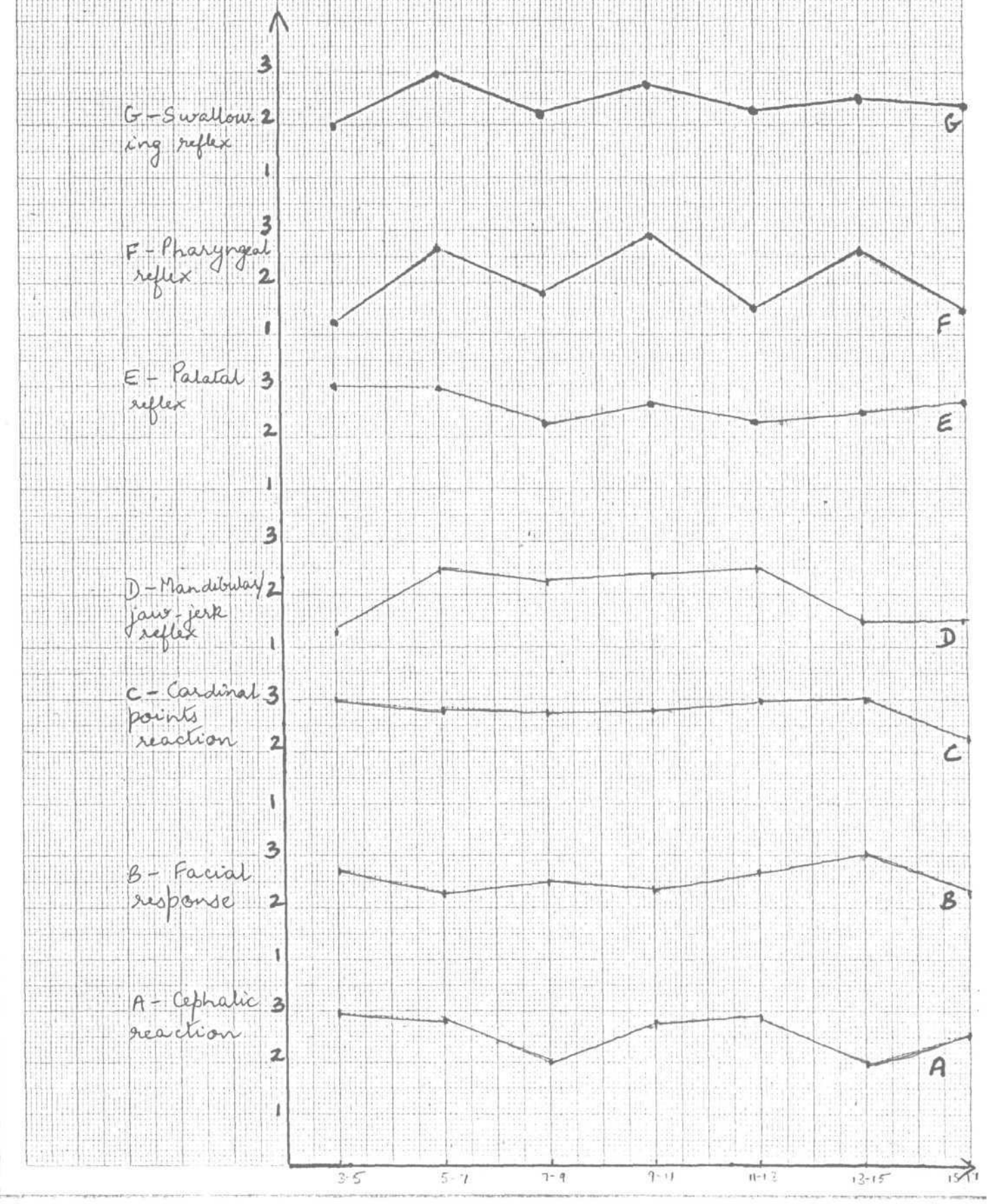
TABLE 6

Mean scores of subtests on reflexes.

	Mean
1. Cephalic reaction	2.67
2. Facial response	2.57
3. Cardinal points reaction	2.86
4. Mandibular/jaw jerk reflex	2.25
5. Elevation of soft palate	2.65
6. Gag reflex	2.14
7. Swallow reflex.	2.70

From the mean scores we can infer that all the reflexes appear to. be mildly abnormal. Among the positive reflexes, the mandibular/jaw-jerk reflex appears to be the most impaired with mean score of 2.25 a cardinal points reaction appers to be the least impaired with a mean score of 2.9. Among the negative reflexes the gag reflex appears to be the most affected with a mean score of 2.1 and palatal elevation appears to be the least affected with a mean score of 2.7.

GRAPH 6- MEAN SCORES ACROSS AGE GROUPS ON THE ORAL SPEECH REFLEX PROFILE



From Figure 6 we can see that there is no developmental trend seen in the appearance of these reflexes across all the age groups. However abnormal presence of these reflexes appear to be related to degree of severity of oral involvement.

C. Oral speech reflexes:

On subjecting the data to principal component analysis the following three factors were evident and they can be said to account for the total variance.

Factors

1. Limited movements of lips and jaw.	—	Facial response
	-	Mandibular/jaw jerk reflex.
2. Restricted movement of lips, tongue, head and neck	—	Facial response
	-	Cardinal points reaction
	-	Mandibular/jaw jerk reflex
3. No movements of lips tongue and head.	-	Cephalic reaction

Factor 1 accounts for 31.88% of the total variance and is represented mainly by 2 variables.

Factor 2 accounts for 21.84% of the total variance and is represented mainly by 3 variables.

Factor 3 accounts for 14.46% of the total variance and is represented mainly by 1 variable.

On principal component analysis facial response and mandibular/jaw jerk reflex appear to be correlated to restricted movments of lips and jaw. On qualitative analysis, however, mandibular/jaw jerk reflex would appear to be most highly correlated with restricted movement of lips and jaw. This additional information obtained on princpal component analysis could be accounted for by individual variations seen. However, principal component analysis gives us a quantitative and more reliable analysis. Thus in assessing oral speech reflex profiles only those reflexes which correlate highly with the following need be tested for:

1. Retricted movement of lips and jaw
2. Restricted movement of lips, tongue, cheek, jaw and head, and
3. Restricted movement of lips, tongue and head.

This will facilitate assessment and help in reducing testing time.

The mean scores on deglutition tasks of liquids and solids were found to have no correlation with oral

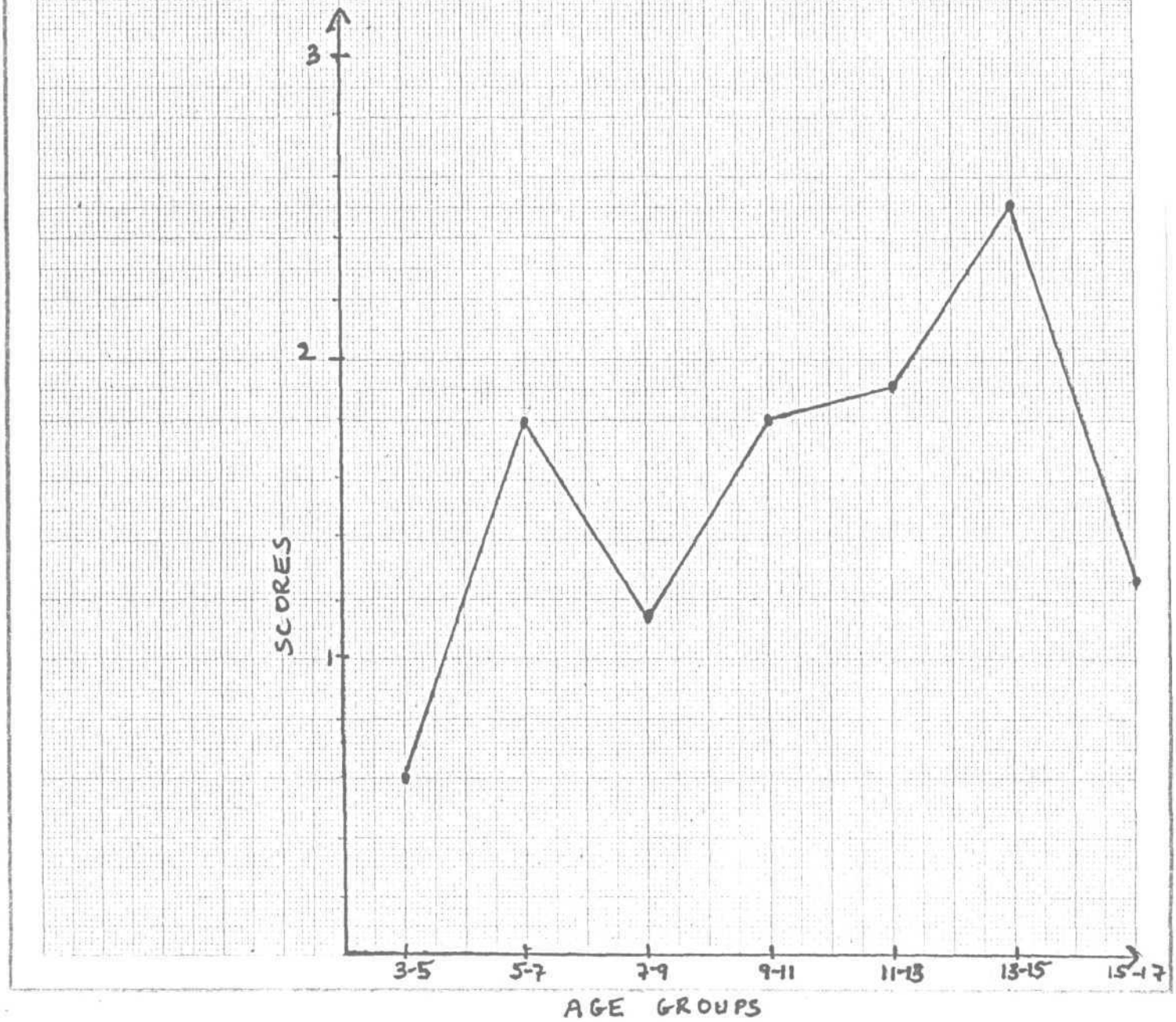
speech reflexes and articulatory ability. However, a significant difference was found exist between oral speech reflexes and articulatory ability, thus implying that a correlation existed between oral speech reflexes and articulatory ability. From these results we can infer that therapies aimed at improving abnormal oralreflexes might prove useful in facilitating speech, whereas dysphagia therapy or vegetative therapy would not seem to facilitate speech.

III. Articuatory ability

A developmental trend was seen across the age groups as seen in Figure 7. Lower scores in age groups 7-9 years and 15-17 years may be attributed to individual variations. Mean score obtained on articulation testing was 1.55 (See Graph 7).

Common articuatory erros seen across all age groups involved fricatives /f, v/, affricates /t/ , dq/ sibilants /s, s / and the lateral /r/. No specific pattern of articualtory errors was seen across age groups or at any particular age group.

GRAPH 7 - MEAN SCORES ACROSS AGE GROUPS ON SPEECH PERFORMANCE



Discussion

The findings in Table 3 and 5 implicate that the deglutition parameters showing a developmental trend may be subject to maturational influences. Although these parameters tend to show a developmental trend, their appearance in cerebral palsied children is delayed when compared to normal children. -"-Principal component analysis test was used to identify those parameters which showed maximum variance and thus could be said to represent the entire sample.

A signiicant difference was found to exist when the mean scores on deglutition tasks of liquids and solids were compared with the mean scores on oral speech reflexes and articulatory ability significant at P=.O (See Table 7A and 7B). This result implies that no correlation exists between deglutition and oral speech reflexes and, deglution and articulatory ability.

This finding is in agreement with Hardy (1983) who opines that the severity of dysphagia is not reflective of

* Principal component analysis is a computerised statistical data analytic tool that is used to reduce the dimensionality while retaining as much of the information as possible.

the severity of dysarthria. The result also supports the view of Ingram (1962) who asserted that spontaneous feeding behaviour rather than the infantile feeding reflexes may be of diagnostic importance. The results are similar to that of Hixon and Hardy (1964), who postulate that speech and non-speech movements may have different neurologic organization and control. The study also supports Bosma (1975) who reports that early speech gestures are not directly related to feeding.

This result is in constrast to the views held by Gal lender (1979), Sheppard (1964) and Love et al. (1980) who report that a correlation exists between dysphagia and speech performance.

A significant difference between mean scores of oral speech reflexes and articulatory abilities was not observed ($p = 0.01$) (See table 7A and 7B). Thus implying that a correlation exists between oral speech reflexes and articulatory abilities. This result is supported by Mysak (1963) and Gal lender (1979), Love, Hagerman and Taimi (1980) and Sheppard (1964) and is in contrast to the view held by Ingram (1965). However no specific articulatory error/errors was observed to exist along with the presence of a certain abnormal oral speech reflex/reflexes.

TABLE 7A

Mean scores on deglutition, oral reflexes and

Deglutition		Deglutition of solids		Oral speech reflexes		Articulation	
Mean	SD	Mean	SD	Mean	SD	Mean	SD
5.47	0.624	2.60	.540	1.156	0.793 i	1.55	0.911

TABLE 7B

Tests For	Significant difference between means found	No significant difference found between means
a) Deglutition of liquids and deglutition of solids		
b) Deglutition of liquids and oral speech reflex		
c) Deglutition of liquids and articulatory ability		
d) Deglutition of solids and oral speech reflexes		
e) Deglutition of solids and articulatory ability)		
f) Oral speech reflexes and) articulatory ability		

These results therefore support the idea that therapy aimed at improving abnormal oral speech reflexes will prove more useful in facilitating speech than vegetative therapy or therapy aimed at improving dysphagia.

The results of this study do not support the basic hypothesis of speech being an overlaid function. Thus facilitation of speech by therapies aimed at reducing dysphagia and other vegetative therapies does not seem to be promising and will serve only to reduce elements of dysphagia or to improve vegetative functions without improving speech skills.

SUMMARY AND CONCLUSION

There are controversial views regarding the relationship between deglutition, oral speech reflexes and articulation in the cerebral palsied. Some authors are of the view that there is no relationship between these 3 variables (Hardy, 1933; Ingram, 1962; Hixon and Hardy, 1964; Bosma, 1975). However others opine that these 3 variables exhibit some inter-relation (Mysak, 1959; Sheppard, 1964; Gallender, 1979; and Love, Hagerman and Taimi, 1980).

The current study was carried out in an attempt to resolve this controversial issue, since actual research on the relation between deglutition, oral speech reflexes and articulatory ability is very limited.

AIM:

1. To compare the performance of spastic cerebral palsied children on (a) deglutition of liquids and (b) deglutition of solids.
2. To test the oral speech reflex profile in the cerebral palsied.
3. To test the relationship between deglutition patterns and the oral speech reflex profile in the cerebral palsied.

4. To test the relationship between deglutition patterns and articulatory ability at the phoneme level.
5. To test the relationship between abnormal oral speech reflexes and articulatory ability at the phoneme level in the cerebral palsied.

Methodology

The study was staged in the following steps.

1. The test format (See Appendix C) included Deglutition of liquids - imbibition (5 parameters) and swallowing (8 parameters).
2. Deglutition of solids - imbibition (2 parameters) mastication (9 parameters) and swallowing (7 parameters).
3. Oral speech reflex profile (7 parameters).
4. Articulatory ability at the phoneme level.

Administration of the test : The test was administered to a group of 51 cerebral palsied subjects, age ranging from 3-17 years. All subjects were otologically normal with no significant mental retardation, otological abnormalities, could follow oral instructions and were verbal and could speak in English.

The transcribed data were analyzed for patterns, if any across the age groups studied in different parameters of deglutition.

Table-8 parameters of deglution of liquids their corresponding trends seen and diagnostic significance

Deglutition	Developmental trend seen	No developmental trend seen	Significant diagnostic indicator
Imbibition	-Position of glass		X
	-Degree of lip protrusion		
	-Degree of labial tension.		X
		-Degree of cheek indrawing	X
		-Position of the straw	
Swallowing	—Anterior seal		
	—Posterior seal		
	—Laryngeal elevation		X
	—Lingual positioning		
		-Swallow reflex	X
		-Circumoral tension	X
		-Mandibular stability.	

Table-9 Parameters of deglutition of solids, their corresponding trends and diagnostic significance.

Deglutition	Developmental trend seen	No developmental trend seen	Significant diagnostic indicator
Imbibition	-Oral structure employed in spoon clearance. -Efficiency.		X
Mastication	-Chewing sound		
	-Mandibular arc traversed		X
	-Accompanying lingual movements.		X
		-Labial movements accompanying chewing	X
		-Detection of food position	
		-Spillage	X
		-flasseter contraction	
		-Mode of labial clerance during chewing	X
		-Chewing effi ciency.	
Swallowing	Cohesive bolus formation.		
		-Mandibular bi1ity.	sta- /
		-Laryngeal elevation	
		-Masseter contraction	
		—Circumoral tension	
		-Lingual positioning	X
		—Post swallow intraoral examination.	

Table-10 : Oral speech reflexes and their diagnostic singnificance

Reflex	Significant diagnostic indicator
Cephalic reaction	
Facial response	
Cardinal points reaction	
Mandibular/jaw jerk reflex	X
Palatal reflex	X
Pharyngeal reflex	X
Swallowing reflex	X
Orticulatory ability	
No specific articulatory patterns of errors were observed.	

Implications;:

1. Screening tests for deglutition may be devised using only those parameters that seem to best represent the subtests on deglutition.

2. A more intensive study,on the presence of abnormal oral speech reflexes and specific articulatory patterns,needs to be carried out. This will help in establishing the relationship between certain specific types of articulatory errors and abnormal oral speech reflexes.

3. Therapy aimed at modifying or eliminating abnormal oral speech reflexes will prove more useful in facilitating speech than vegetative therapy or therapy aimed at improving dysphagia.

Limitations:

Interjudge reliability and test-retest reliability were not carried out due to time constraints.

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APPENDIX-A

Evaluation of deglution - eating; simulated interrupted condition.

In this, the food placement in the oral cavity was made by the tester, the client being instructed to cease the deglutition act at different sequential steps. Oral cavity was examined under sufficient illumination for the corresponding response in that stage. Responses were recorded in the data sheet.

Deglutition act	Testing procedure	Pertinent observation	Observation modality	Rating scale used
Imbibition	Standard ice-cream spoon and teaspoon filled with cooked rice was offered to the subject seated in normal eating posture presented in the horizontal position.	* Maneuver employed was noted. Whenever possible, client's subjective report on this activity was also recorded.	Visual + audition (If imbibed with the aid of teeth)	3 = Clearance with lips alone. 2 = Clearance with lips and teeth. 1 = Clearance with teeth with lips apart or inability to clear the food mateial in pathological condition.
	Subject was required to clear the material off the spoon.	* Efficiency in task performance was noted.		3 = Good, with no remanant food material on spoon clearance. 2 = Fair with minimal remanant of food material on spoon clearance. 1 = Poor with residue present on spoon or inability to clear the food material off the spoon.
Biting	The food materials were offered to the client and the biting act was observed.	* The dentitation between which the food material was interspered during the up and down mandibular movement against the maxilla was noted.	Visual	3 = Biting with incisors or canine (speculating on cuspid or premolar biting in presence of diastema) with employed voluntarily in the initialphase of mastication
			Tactual	2 = Weak bit with either indent formation or minimal pulverization, delayed response post bolus placement.

				1 = Biting at a reflexive level (bite reflex) in the initial masticatory phase, this being continued into the chewing phase.
Chewing	Chewing act of the bitten material, once placed on the grinding surface of the teeth was noted.	* Chewing sound accompanying pulverization of rice.	Audition	3 = No accompanying sound. 2 = Minimal accompanying sound. 1 = Marked sound.
		* Labial movement accompaying chewing with the required circumoral tension to ensure food placement within the oral cavity was noted.	Visual	3 = Predominantly closed. 2 = Both labial opening and closure. 1 = Marked labial opening +/- clumsy labial movement.
		* Detection of food positioning: External cues in the buccolabial area in detection of food position during mastication was noted. This was further verified by instructing the client to open his oral cavity and checking for the food position.	Visual Inspection.	3 = Difficulty in detection to very minimal labial pursing to retraction. 2 = Minimal cheek bulge + minimal labial pursing + detction through open mouth. 1 = Bucco labial tension + lip purse + cheek bulging + through open mouth.
		* Spillage - during mastication, presence or absence of spillage and the predominant side on which it occurred was noted.	Visual inspection	3 = Absent 2 = Minimal spillage 1 = Marked spillage.
		* Mandibular arc traversed-tactual information (together with visual supplementation) with tester's hand placed externally across the mandible upto the region of mandibular condyl aided in estabishing consistency in the	Visual + tactual inspection.	3 = Rotatory/side to side 2 = Minimal deviation from the above 2 types, with increased range of movement. 1 = Marked deviation from the above 2 types including deviation to one side during chewing, jaw thrusting, bite etc.

arc traversed --
rotatory/side to side/
others ++

++ Rotatory movement implied mandicular motion, antero - inferiorly -> laterally -> postero-superiorly and back to the position of centric occlusion. Side toside movement implied a consistent patternof movement in the rotatory ~~rotary~~ fashion with mandible moving to right/left -> centric occlusion -> left/right -> centric occlusion with cycle repeating.

Consistency implies predictability of direction of jaw movement in relation to food placing and inconsistency implies inability to do so.

* Lingual movements in the act of mouth opened chewing were noted.	Visual	3 = Tongue placement within the oral cavity with no deviations visually noted.
- Dissociation of lingual from mandibular movement, variations in tongue positioning etc. were noted.		2 = Tongue fronting with dissociation from mandibular movement. Bolus placed anteriorly in the oral cavity (closed to incisors and canine) without or with minimal spillage.
		1 = No lingual dissociation from mandibular movement, marked lingual protrusion, variation in lingual placement (high vs. low between right and left half) or no lingual maneuvering toshift food to grinding surface of the dentition.
* Masseter contraction Masseter was palpated to note the degree of contraction.	Tactual (palpation) + visual supplementation if indicated by masseter prominence.	3 = Normal masseter contraction (subjective) 2 = Weak contraction 1 = Absent masseter contractor.

		* Chewing efficiency was established based on the degree of pulverization (particle size) post chewing.	Visual inspection of the chewed food.	3 = Good (with fine particle size). 2 = Fair (with medium sized particles). 1 = Poor (with large sized or nonpulverized particles).
		* Labial surface clearance while chewing in presence of spillage was noted; in its absence, jam was smeared on the lips and the client was required to clear it off withno prior directions regarding the same.	Visual	3 = Labial pursing +/- minimal lingual protrusion +/- hand usage. 2 = Lip versus teech +/- lingual protrusion. 1 = Lip vs. teeth + hand/finger usage +/- tongue protrusion. Underlined items are the predominant observation occuring in atleast 2 out of 3 trials.
Swallowing	* Anterior seal was checked by parting the clients lips (when circumoral tension was less) and observing through diastema or employing slight mandibular depression with instruction to maintain tongue posture (Fig.7-Appendix-A).	* Cohesive bolus formation implicating lingual maneuvering efficiency was noted ie. whether the bolus was compact or diffuse.	Visual	3 = Cohesive bolus formed 2 = Contours of bolus is not marked,with minimal spreading of food material close to the main bolus. 1 = Bolus present elsewhere (sublingually, adhered to palate, in the anterior/lateral sulcus) on posterior pharyngeal wall (Fig.8 Appendix-A).
	* Laryngeal elevation during the act of swallowing was observed placing the ring and little finger in the region of thyroid cartilage (Fig.7 Appendix-A)	Extent of laryngeal displacement at the moment of swallow.	Tactual + visual	3 = Detectable (visual + tactual) 2 = Minimal laryngeal elevation. 1 = No detectable laryngeal elevation.

* Masseter contraction Masseter was palpated, placing index finger in the region of masseter muscle (Fig.7 Appendix-A).	*Degree of masseter contraction.	Tactual+visual indication if any	3 = Present 2 = Weak 1 = Absent masseter contraction
* Circumoral tension- lips were separated using the thumb to observe for circum oral tension during the act of swallowing (Fig.7 Appendix-A.	* Degree of tension based on the amount of pressure required in parting the lips at the moment of swallowing.	Kinesthetic+ visual supplementation	3 = Negligible circum-oral tension with extreme ease in labial parting. 2 = Minimal tension, with slight difficulty in parting the lips. 1 = Marked tension with extreme difficulty to inability in labial parting to no tension owing to flabby lip musculature.
* Lingual position during the testing for circumoral tension together with laryngeal elevation and masseter contraction, tongue position was noted.	* Positioning of tongue in relation to other structures	Visual	3 = Not visually evident. 2 = Placed immediately behind incisors or between the dentition without food spillage. 1 = Placed between the dentition with food spillage.

The above 5 parameters of swallowing were tested as per the directions in testing for tongue thrust provided by Fletcher, Casteel and Bradley (1961).

* Mandibular stability - Mandibular displacement was noted with the middle finger placed beneath the mandible during swallowing.	* Extent of mandibular displacement	Tactual + visual	3 = No detectable mandibular displacement (with only muscular movementin the sub-mandibular region) 2 = Slight mandibular displacement. 1 = Marked mandibuar displacement.
* Post-swallow intra oral examination - Immediate post swallow	* Full meal or piece meal swallow (for limited food material	Visual, aided with tongue depressor	3 = Clear, with no residual food in the oral cavity — full meal swallow. 2 = Minimal residue (full-

- One minute after swallow	* Presence and location of residual material post swallow	meal swallow). 1 = Marked residue/piece meal swallow for the limited quantity of food provided.

APPENDIX-B

Evaluation of deglutition - drinking, simulated interrupted condition

Deglutition act	Testing procedure	Pertinent observation	Observation modality	Rating scale used
Imbibition *Through pouted and unpouted glass	Both pouted and un pouted glass filled with 60 ml of water was brought close to the client's lips by the tester and the client was required to drink the water provided. Subject was seated in the normal eating posture of slightly forward bent position (about 80-85° with respect to the horizontal plane).	*position of the glass	Visual	3 = Rim of the glass placed between the lips. 2 = Rim of the glass placed between lips and teeth +/- on tongue. 1 = Rim of the glass placed between teeth with lips parted or unable to imbibe.
		*Degree of lip protrusion	Visual	3 = No protrusion 2 = Minimal protrusion 1 = Marked protrusion or no protrusion owing to restricted labial mobility.
		*Cheek indrawing	Visual	3 = No cheek indrawing 2 = Minimal cheek indrawing 1 = Marked cheek indrawing or no cheek indrawing owing to restricted bucco labial mobility.
		*Additional features like tongue thrusting biting movements etc. were looked for.		
		*Amount of water consumed in 3 trials (in ml) was noted.		This was quantitatively analysed.
*Through straw- standard cellophane straw -Straws of diameter 1.3 cm and 1.8 cm of	Standard straw was placed at an angle of 45° with respect to horizontal (based on pilot data), in the subject's mouth, permitting self manipulation. Client was instructed to	*Position of straw and degree of lip closure was noted. Clients report on straw placement was also noted whenever possible.	Visual	Position 3 = Between lips 2 = Between lips and teeth 1 = Between teeth with lips parted. Degree of lip closure 3 = No labial tension 2 = Minimal tension

the same length as the standard straw.	draw in water. In presence of strong bite, an in-compressible plastic straw of the same dimension as the standard straw was used. For the larger diameter straws angle with respect to horizontal was varied from vertical to horizontal till a marked ease inflow with increase in speed and decrease in physical effort was enunciated.	*Angle at which ease ~~visual~~ of sucking was enunciated was noted. *Tongue thrust if present during the continuous sucking act was noted (which was exaggerated using the wide mouthed straw).		1 = Marked labial closure or in pathological condition, no tension in presence of flabby lips. The data was quantitatively analysed.
Swallowing	*Anterior seal lips were parted to check whether anterior seal was labial/ linqua dental or lingua alveolar, with head tilted downward to check lingua seal adequacy with forced lip parting.	*Lingual/labial seal *Adequacy of lingual seal (anterior implicated by liquid expression outside the oral cavity) was noted together with the amount of liquid (in ml) sustained without leakage.	Visual	3 = Adequate seal 2 = Minimal fluid leakage 1 = Absent to inadequate lingua dental/alveolar seal with fluid loss.
	- Amount of water in ml for which anterior seal could be obtained was noted. This was tested by presentation of graded quantity of water from 20 ml. decreasing in 5 ml steps till the quantity for which seal could be effectively obtained.			
	* Posterior seal - Subject was instructed to maintain lingua velar contact for 1 minute, sustaining 20 ml of water (owing to ease of	Adequacy of posterior seal implicated by liquid loss or retention was determined.	Visual	3 = Adequate seal 2 = Minimal fluid leakage 1 = Inadequate seal with fluid loss.

observation of liquid loss) with head tilted slightly backward.			
* Swallow reflex. This was tested with head held straight and mouth open. Water was directed into the oral cavity using a standard cellophane straw held horizontally, by releasing the thumb at the other end of the straw.	*Presence or absence of swallow reflex was noted.	Visual, under adequate illumination	3 = Present(normal) 2 = Weak 1 = Absent
Laryngeal elevation was observed placing the ring and little finger in the region of thyroid cartilage.	*Extent of laryngeal displacement.	Tactual+visual	3 = Detectable 2 = Minimal laryngeal elevation. 1 = No detectable laryngeal elevation.
* Circumoral tension lips were separated using the thumb to observe for the degree of circum oral tension.	*Degree of tension based on difficulty in labial parting.	Kinesthetic + visual supplementation	3 = Negligible, with extreme ease in labial parting. 2 = Minimal tension, with slight difficulty in parting the lips. 1 = Marked tension to inability in parting the lips.
* Lingual positioning - tongue position during testing for circum oral tension was noted.	*Positioning of tongue in relation to other structures.	Visual	3 = Not visually evident 2 = Placed immediately behind incisors, or between the dentition without food spillage. 1 = Placed between the dentition with food spillage.
* Mandibular stability displacement was noted with middle finger placed beneath the mandible during swallowing.	*Extent of mandibular displacement.	Tactual+visual	3 = No detectable mandibular displacement with submandibular muscle movement being present. 2 = Slight mandibular displacement. 1 = Marked mandibular dis-

			placement.
*Gulp: Minimum quantity of water(in ml) required to elicit an audible gulp was noted.	*Presence/absence of gulp.	Audition	Only the pattern of response was noted. No rating scale was applied.

APPENDIX-C

Name: Savita Age: 6 years Sex: Female.

TEST FORMAT

1. Deglutition of liquids

Parameters	Score
1. imbibition - position of the glass	2
2. Imbibition - Degree of lip protrusion	3
3. Imbibition — Cheek m drawing	
4. Imbibition - Position of the straw	2
5. Imbibition - Degree of lip closure	2
6. Swallowing - Lingual/labial seal (anterior)	2
7. Swallowing - Adeguacy of posterior lingual seal	2
8. Swallowing - Swallow reflex	3
9. Swallowing - Extent of laryngeal displacement	2
10.Swallowing - Positioning of tongue	2
11.Swallowing - Positioning of tongue	2
12.Swallowma — Extent of mandibular displacement	2

II. Deglutition of solids

Parameters	Scores
1. Imbibition - Oral structures employed for spoon clearance.	2
2. Imbibition - Efficiency	3
3. Biting — Structured/mane	2
4. Chewing - sound	2
5. Chewing - aommpanying label movements	2
6. Chewing - detection of food position	2
7. Spillage	
8. Mandibular are traversed	3
9. Chewing - accompanying lingual movement	1
10. Chewing - Masseter contraction	2
11. Chewing - efficiency	3
12. Chewing - labial surface clearance	3
13. Swallowing - cohesive bolus formation	3
14. Swallowing - laryngeal elevation	1
15. Swallowing - Masseter contraction	3
16. Swallowing - Circumoral tension	2
17. Swallowing - lingual position	2
18. Swallowing - Mandibular stability	2
19. Fost Swallowing - Intra oral examination	2

III. Oral speech reflexes

Reflex	Score
1. Cephalic reaction	3
2. Facial response	1
3. Cardinal points reaction	2
4. Mandibular/jaw ink reflex	1
5. Palatal reflex	3
6. Pharyngeal reflex	3
7. Swallowing reflex	3

IV. Articulation

	Errors of		
Substitution	Distortion	Omission	Addition
/R/ -> /t/	/p/		
/v/ -> /b/	/b/		
	/m/		
	/w/		
	/g/		
	/d /		
	/s/		

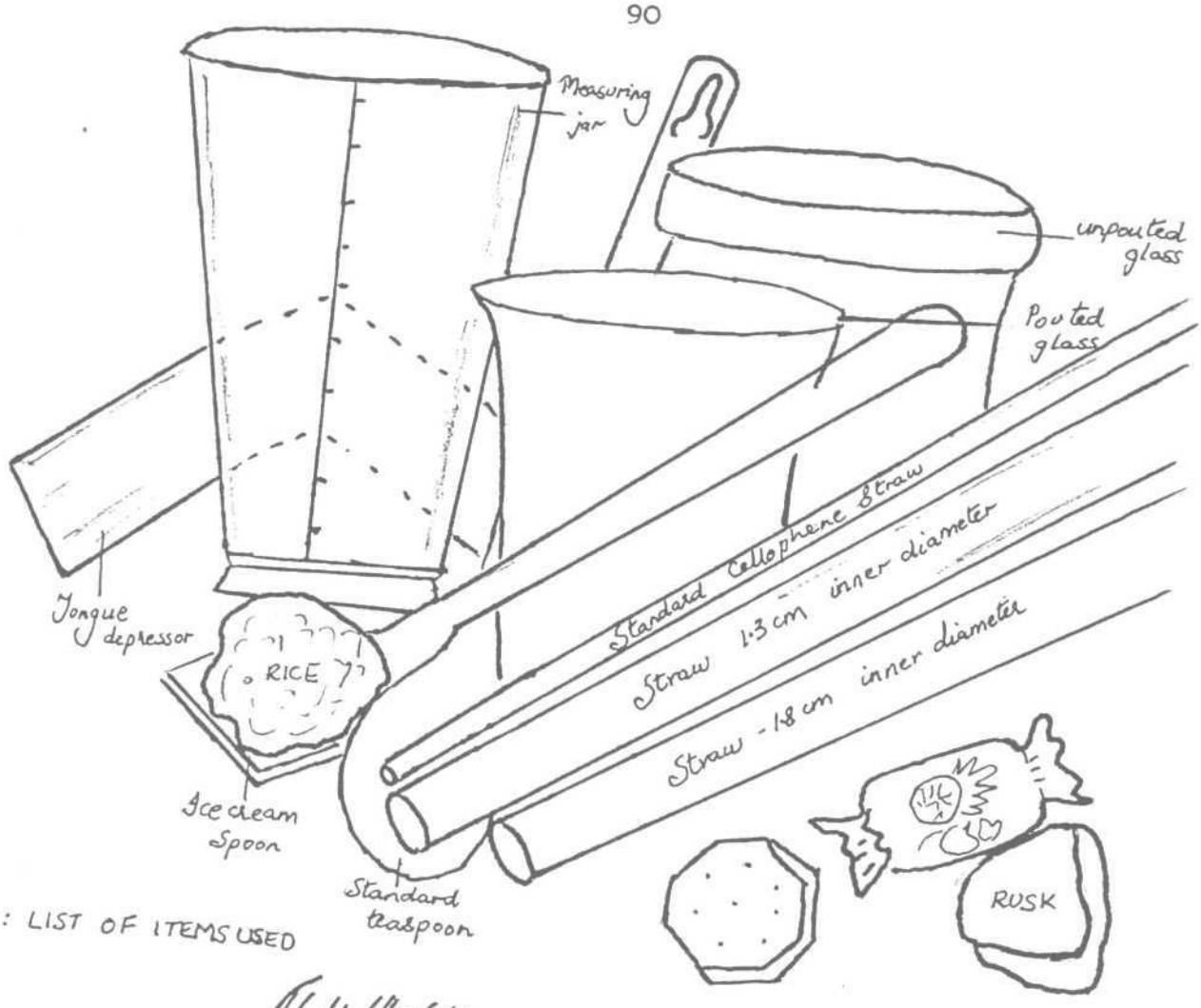
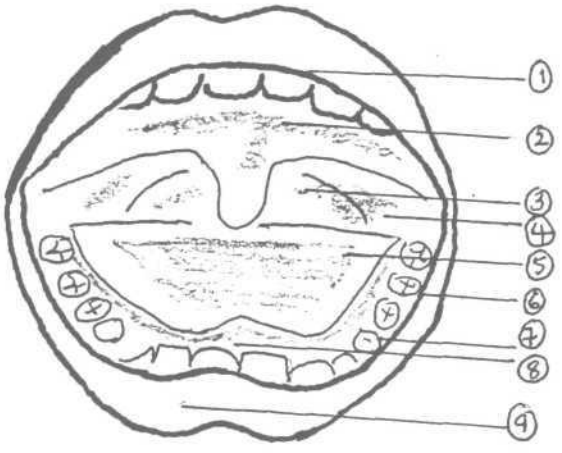


FIG: LIST OF ITEMS USED

FIG : TESTING FOR LINGUAL POSTURE CIRCUM ORAL TENSION MASSETER CONTRACTION AND LARYNGEAL ELEVATION

FIG: COHESIVE BOLUS IN PIT

FIG BOLUS SPREADOUT



BOLUS PRESENT ELSEWHERE 1 = ANTERIOR SULCUS 2 = PALATE
3 = POSTERIOR PHARYNGEAL WALL 4 = FAUCES 5 = TONGUE
6 = DENTITION 7 = LATERAL SULCUS 8 = SUBLINGUAL REGION

APPENDIX - I

· POSITIVE SYMPTOMS

(THESE REFLEXES ARE GENERALLY INHIBITED BY THE TIME A CHILD IS THREE YEARS OLD)

REFLEX	MANNER OF EUCITING	RESPONSE
1. CEPHALIC REACTION		
2. FACIAL RESPONSE	 (SHARP OBJECT)	 (POUTING)
3. CARDINAL POINTS REACTION		
4 LIP REACTION	 (SHARP OBJECT)	INVOLUNTARY MOVEMENTS OF THE LIPS
5. MANDIBULAR / JAWJERK REFLEX	 (SHARP OBJECT)	 (UPWARD MOVEMENT OF THE JAW)