ASSESSMENT SCALE FOR CEREBRAL PALSIED

Rajashree S.

Reg.No.M89l4

A DISSERTATION SUBMITTED AS PART FULFILMENT OF FINAL YEAR M.Sc., (SPEECH AND HEARING) TO THE UNIVERSITY OF MYSORE.

ALL INDIA INSTITUTE OF SPEECH AND HEARING: MYSORE - 570 006

1991

****

" C.P."

(CUTIE - PIES)

****

CERTIFICATE

This is to certify that the Dissertation entitled: "Assessment Scale for Cerebral Palsied" is the bonafide work in part fulfilment for the degree of M.Sc., (Speech and Hearing) of the student with Reg.No.M8914.

Mysore

1991

Director
All India Institute
of Speech & Hearing
Mysore-6

CERTIFICATE

This is to certify that this Dissertation entitled: "Assessment Scale for Cerebral Palsied" has been prepared under my supervision and guidance.

Manjula. R

Mrs.Manjula, R
GUIDE

Mysore
1991

DECLARATION

This Dissertation entitled: "Assessment Scale for Cerebral Palsied" is the result of my own study undertaken under the guidance of Mrs. Manjula, R., Lecturer, Bepartment 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.

Mysore Reg.No.M8914

1991

ACKNOWLEDGEMENTS

My sincere thanks to my guide Mrs. Manjula, R., Lecturer, All India Institute of Speech and Hearing, Mysore who is - An ideal Model
who is very Amiable
with Novel ideas
and good Judgement
and who is very Understanding
Lustrous
and Approachable.

I am grateful to Dr.(Miss) S.Nikam, Director, AIISH, Mysore for permitting me to carryout this study.

"Homeliness is Godliness" and a standing example is the spastic society, Bangalore branch. If not for them this work wouldn't have reached its destination I had set. Thank you so much.

'Crunchie-munchie' went the cake, churnie-churnie came the cream, it was a fight between the cake and cream, and I got the cream on how they ate - Thank you 'cutie pies'.

I thank you Mr.P.Vidyasagar, Lecturer, Dept. of Clinical Psychology, AIISH, Mysore for having spent your invaluable time during the statistical analysis.

Mr.P.Kalaiah, Reader in Clinical Psychology, AIISH, Mysore "A concerned mentor".... that's what he was, he is and he will be through out. I thank you Sir,

A person - who is a part and parcel of me .. who knows in and out of me I have no words to express.....
- It is no one else but you Mythra.

Dizzy in a 'whirl pool'
there was I
With the figure rolling by,
and lot came a person
who set the figures
all upright.... the credit goes to Shankar;A million thanks to'U'.

A melting heart,
a thoughtful self,
and a helping hand,
whose love and care
makes him a brother
beyond compare.... Arun

Thank you so much Sowmya Narayanan and Hari for racking your 'Cortex' and coming up with wise and timely suggestions.

Thanks a million to all my classmates who stood by me during the entire course of my dissertation.

Akka.... I have no words to express my sincere gratitude to U for your patient transcription of my 'so called Graphemes' and apt 'tip-taps' without which my dissertation would not have seen light.

TABLE OF CONTENTS

INTRODUCTION

Human neuromotor system involves a complex act. For any motor act to take place a coordination in terms of muscle strength, speed of movement, appropriate range of excursion, accuracy of movement, motor steadiness and muscle tone is required. Damage that impairs one or more of these neuromuscular functions may affect motor production.

The speech, non-speech and feeding skills are motor acts. This fact is supported by many researchers such as Hixon and Hardy, 1964; Netsell, 1986 and few others for speech act? Gallender, 1979 for non-speech act and Guyton, 1986, Logeman, 1986 and others for feeding act. Apart from this, studies have been quoted stating the relationship between the speech as against non-speech and feeding skills. The former relationship was supported by Foerster way back in 1951 followed by Hixon and Hardy, 1964; Netsetl, 1986 and others as sharing a common system (as per Stark, 1985). The controversy is 'Green' even today.

Studies on the latter relationship (speech vs. feeding act) was conducted by Mysak, 1959; Sheppard, 1964; Fletcher, 1961 and others.

They reveal that although individuals with feeding problem exhibit speech problems, either speech/feeding defect cannot be held as a causative factor for the improper functioning of the other act. Instead, it may be considered as being contributory.

The relationship between feeding and non-speech was not evident in the literature. Emphasis on the feeding and vegetative function in Cerebral palsied (CP) children have been placed by many researchers namely Scherzer and Tscharnauter (1982), Hixon and Hardy(1964) and many others. According to them CP children face difficulty at various stages of deglutition with varying degrees depending on the severity of involvement.

A summary of the developmental trend as seen in normals for the speech, non-speech and feeding act, enable the clinician to compare the skills as exhibited by a CP individual to that of his normal peers. This boosted the idea of scrutinizing the relationship between the three motor acts in CP population in the form of an assessment scale.

An assessment scale encompassing all the 3 acts has not been deviced till now. Such a scale will lay the foundation for the related professionals to construct the therapeutic program.

OBJECTIVES:

Major objectives of this study include (a) Comparison of the performance of CP population as against normals for developmental trends in feeding speech and non-speech skills. (b) To assess the status of the 3 skills in theCP types (namely spastic, athetoid and mixed) and rate them in the heirarchy of severity.

BRIEF PLAN OF THE STUDY:

a) Development of the test protocol:

Based on the literature and the format available for testing normal children (ie. Kavitha (1989); Jyothi,(1990); and Vitali test (1986) a new format will be constructed to assess the feeding speech and non-speech skills. The speech activities include production of all the speech sounds which require the active articulators such as lips, jaw, tongue and velum. Apart from these the test will also tap the efficiency of the respiratory and laryngeal systems to some extent.

Non-speech activities include the active participation of the above mentioned articulators, while performing non-speech movements such as lip protrusion, retraction flapping the tongue and other movements. To tap the feeding act the food items will be chosen so as to satisfy the following criteria:

(i) Incorporate a range of consistency from liquids to solids to check on the intra oral bolus manipulation,

(ii) Be easily accessible for testing.

b) Administration of the test:

The test will be administered on CP population with age ranging from 4 years to 17 years.

c) Development of semi-quantitative scale:

A semiquantitative scale will be utilized to rate the performance of the subject on all the three tasks(speech, non-speech and feeding).

d) Analysis of the data collected:

The raw data so obtained will be subjected to statistical analyses and the results discussed.

e) Implications:

i) The abilities of the CP children in performing the speech, non-speech and feeding acts can be assessed to evaluate the basal age of the children in these 3 skills. . This can further act as a baseline for diagnostic evaluation and therapeutic assessment.

ii) Extent of correlation between the speech, non-speech and feeding skills within the different groups of CP population can be studied.

REVIEW OF LITERATURE

Section-I:

1.1 Speech as a motor act:

Language is said to have evolved as a communication system to interfere "man's intellect with his peripheral apparatus" (Studdert-Kennedy, 1980). Speech is the motor acoustic expression of language and speech motor control is the motor afferent mechanisms that direct and regulate speech movements. The afferent mechanics essential to normal speech motor control are auditory and somato-afferent. Somatoafferent includes all informations arising from the musculoskeletal system during posture and movements.

Speech motor control being an acquired motor skill is learned through the imitation of acoustic patterns provided by an "adult model" of the language.(Netsell, 1986).

In speech, as with other motor control skills, the most fundamental questions are "what is being directed?" and "what is doing the regulating"?

Concerning the latter combinations of "elementary units of behaviour (like reflexes, servo mechanisms and oscillators) have been used to describe the apparently complex behaviours in lower animals. A central regulated issue concerns the

extent to which different "units of behaviours" are recruited for the various speech and vegetative motor tasks of the same musculoskeletal structures. For eg. the gag and swallow reflexes are inhibited or suppressed during speech production and it is doubtful that elements of these are somehow selectively recruited for speech purposes (Scheibel, 1979). It is hypothesized that specialized neuronal connections and patterns of muscle activation are developed for the motor skill of speech (Hixon and Hardy, 1964; Netsell, in press).

A corollary of this hypothesis is that speech movements must be practiced in order that these neuronal and muscle activations be realized. Contrary to certain clinical practice, there presently exists no experimental evidence that vegetative patterns are pre-requisites for speech motor control or that their practice will facilitate the emergence of speech movements (Hixon and Hardy, 1964).

Concerning, what is being controlled or directed, it is also likely that the mode, or strategy of control to the same musculoskeletal structures varies with the movement requirements ie the goal being demanded (Granit, 1977 and Levik, 1979).

Researchers like Netsell,(1984); Folkins and Abbs, (1982); Folkins and Abbs, Kent and Forner (1980); Thomas and Hixon (1979), Hixon and Hardy (1964) and a few others view speech activity as a motoric phenomenon. This implies that this speech motor behaviour can be placed in a similar developmental schedule, just like the developmental milestones of other general motor behaviour.

This is logical enough because the two of them have a few traits in common. For instance speech is probably evoked by well established patterns of CNS due to repeated reinforcing and maintenance of reiterated pattern (Hixon and Hardy,1964) like in other motor movements. Both become automatic with establishment of such neuronal patterns (Palliard, 1960). Both are made up of complex set of strategies to transform discrete input into continuous movements (Stevens, 1973). Both have a feed forward system which ensures efficient use of the movement patterns (Humphrey and Reed, 1973).

Like any other motor behaviour speech too develops from a relatively rigid primitive pattern to more variable ones. It is seen that as a child grows there is improved control and he/she develops the ability to vary the motor processes in order to meet the specific needs of the task (Starkey, 1985).

Speech production meets the general requirements of a fine motor skill viz; it a) is performed with accuracy and speedy (b) uses knowledge of results; (c) is improved by practice; (d) demonstrates motor flexibility in achieving goals; and (e) relegates all of this to automatic control, where'consciousness' is freed from the details of action plans (Wolff, 1979).

As a motor skill, speech is goal directed and afferent guided. The goal is to produce the appropriate acoustic patterns via flexible motor actions that are formed and maintained by 'auditory images'. These auditory images inturn become yolked to the motor and somato afferent patterns used to generate them.

1.2 Non-speech as a motor act:

Non-speech activities are otherwise termed as vegetative activities. Based on the evidence as supported by Abbs, (1982); Netsell (1984) and others who consider speech activity as a motor act because speech is placed in a developmental schedule, the non-speech activities too show a developmental trend. Sucking and swallowing reflexes that appears soon after birth, comes under voluntary control by 6 months of age. Sucking action follows the primitive sucking process. The movements of sucking involve the manipulation of

the circumoral musculature or muscles surrounding the mouth, and all structures within the mouth.

Sucking is a coordinated effort involving the rhythmical pumping and squirting actions of the tongue, mandible and soft palate muscles (Gallender, 1979).

In sucking, the facial nerve responds by setting up reflexes that involve the circumoral muscles. This action correlates and combines all movements within the mouth which enables the swallowing pattern to occur.

Biting act follows the primitive reflex. This reflex is present at birth and is generally under voluntary control by 5 months of age. It is one of the sequential stages in oral development. The biting reflex precedes the chewing movements. It is described as an immediate shap ing or sudden closure of the mandible when anything is placed in the mouth. This is a reaction to stimulation which causes the masseter muscles to contract without any warning.

As a normal process biting follows imbibition where in after food intake the food is placed between the incisors, and later between the molars especially for hard food substances. This process is required to break the food into smaller pieces in order to carryout the next activity which is chewing.

Chewing is a learned and acquired skill. Initial attempts to chew are usually up and down movements which only helps in compressing the food against molars and palate but later to permit griding of particles to facilitate swallowing and digestive process, rotatory chewing or side to side is developed which is mastered by 3 years of age.

Unlike speech, non speech activity cannot be considered a goal directed act. On the other hand, it can be considered as a continuous activity with sucking,biting, chewing and swallowing following in a heirarchy of learnt activities.

1.3 Feeding process as a motor act:

Removing food from the container and transfering it to the mouth is feeding. Gallender, (1979) defines feeding as a series of sequential steps necessary to get the food to the mouth. Eating is the process of receiving the food in the mouth, processing it by mastication and preparing it for swallowing, thus completing the swallow pattern. The former is called imbibition while latter is deglutition.

During the act of imbibing, the lips are used to transfer fluid and solid food into the mouth and to retain the food in the oral cavity during mastication (Guyton, 1986; Lund, 1987). The lips and cheeks assist the tongue in ensuring the

replacement of food between the teeth during chewing. Normally, as the food is placed in the mouth,the lips close and remain closed during all phases of swallowing to keep the food in the mouth anteriorly (Logemann, 1986).

Deglutition is the process whereby a bolus, liquid or solid is transferred from the buccal cavity to the stomach (Lund, 1987). This complex continuous act integrates motor performance from several cranial somatic system and coordinates autonomic systems within the eosophagus and stomach. It directly incorporates the aspect of tone, posture and reflex behaviours of head and oral mechanism (Scherzer and Tscharnuter, 1982). Thence, deglutition aids in - (a) transporting food to stomach, hence being significant for nutrition; (b) the subsidiary functions include disposal of dust and bacteria lader mucus conveyed by ciliary action to the pharynx from nasal passages and sinuses, tympanic cavities, larynx and tracheobronchial tree: (c) the opening of the pharynx or the pharyngo tympanic tubes accompanying deglutition serves in pressure equalization of the middle ear cavity (Jones, 1979).

Deglutition act was assessed through techniques such as direct observation, cineradiographic studies as conducted by Saunders, Davis and Miller,(1951); Ardran and Kemp,(1955);

Sloan, Brummett and Westover,(1964); Cleall (1965); Moll, (1965) and radiographic studies by Alkinson et al (1957); Sokol et al (1966); Vldeoflurographic technique by Logemann (1986) etc. These have aided in demarcating the three stages of deglutition (Magendie (1816); Weinberg (1970) and Jones (1979); Lund (1987) on the basis of anatomical land mark through which they pass namely - The oral stage; - the pharyngeal stage; and -esophageal stage. In the forth-coming topic the relationship between each process against the others shall be described.

1.4: Relationship between the speech, non-speech and feeding process (in normals):

There is a sustained interest directed towards rehabilitating the multiply handicapped CP children from the past few decades. The program includes the use of oro-neuromotor training techniques. This calls for attention towards the statement which becomes a question, "Is speech an overlaid function?" and "what is its relationship with non-speech and feeding activities.

1.4.1: Speech vs non-speech activity:

If we trace back the literature, we come across several evidences speaking for and against this relationship ie to say speech and non-speech are -

- Parallel and subserved at least in part by different neuronal structures (Netsell, 1986).
- Share a common system (stark, 1985).

When we consider the central and peripheral structures such as the neuronal vascular and musculoskeletal system, the speech and non-speech activities are found to have identical connections. For instance we find that larynx was initially developed in terms of evaluation to serve as a sphincter to protect the respiratory trait from aspiration of food. It subsequently serves as a secondary structure in phonation (Stark, 1985). The lower portion of precentral gyrus regulates the chewing and speech movements. In patients with lesion in this region have found to exhibit both dysarthria and dysphagia. Foerester (1951) proved that electrical stimulation of the lower third of the precentral gyrus of man ie area 66, results in - rhythmically coordinated movements of lips, tongue, jaw and soft palate - rhythmical chewing, licking movements and loud smacking, grunting and groaning. Miller and Hardy (1962) have shown marked differences in motor control of the tongue for speech and non-speech movements in children with cerebral palsy.

In terms of Embryonic differentiation Yakovlev (1962) used the principle of three layered structure in his discussion

of human embryological development. The body representation in the two week embryo in is 3 layers viz. the ectoderm, mesoderm and endoderm. Yakovlev (1962) surmises that the vegatative movements have their musculoskeletal origin in the mesoderm and endoderm. The neural controls for speech are said to arise from the Mantle and marginal layers. While the neural mechanism for vegetative movements originate primarily in the matrix and mantle layers.

In short, although speech and non-speech activities may share certain embryonic origins, they also have separate body and nervous systems origins in the embryo. Hixon and Hardy (1964) postulated that the relation between restricted mobility of articulatory structures during non-speech movement and the severity of speech physiology problems of children with CP was not sufficiently strong to use non-speech movements as firm predictors of speech physiologyproblem* in such children. Hixon and Hardy (1964) hypothesised that the most appropriate test of speech mechanisms was to observe vocal tract movements during the production of speech. The lumping of all vocal tract movements other than speech into the "non-speech" category represents a semantic and conceptual hazard. The nauronal machinery and/or patterns of activation responsible for sucking, chewing, swallowing, blowing, imitating orofacial movements, rapid alternating movements (with or without

sound production) and isometric muscle contractions are hypothesized to be different from those used for speaking (Dubner, Sessle and Storey, 1978; Netsell, 1980). The non-speech behaviours are often useful in determining the lesion(s), locus and general pathophysiologic consequence but the activation of the speech neural mechanisms with meaningful speech may be the only valid test of function for the speech motor system.

Whitaker (1976) found a centrifugal growth pattern of the myelin (beginning in utero) that progresses headward and footward mostly along a vertical axis.

Life begins with the sub-cortical substrate for the vegetative survival functions. As myelination proceeds to the head and feet, the beginnings of talking and walking appear around the end of the first year of life.

Growth and maturation of the cerebral cortex proceeds in a centrifugal pattern and at different rates in particular areas (Milner, 1976). The primary areas of the visual, motor, somatosensory and auditory cortices became myelinated to complete a vertical hard wiring (longer larger axons that connect various centers of the neurons) of the long loop, fast acting pathways toward the end of the first year.

Secondary areas and association areas myelinate in a horizontal direction as zones around these primary centers.

These horizontal developments are regarded as critical to the essential development of speech and language and have no known role in the regulation of vegetative movements.

Smitheran and Hixon,(1981) state that even in normal speakers laryngeal airflow during sustained vowels is generally lower than in C-V syllables.

Shaughnessy, Lotz and Netsell (1981) stated that laryngeal resistance to airflow during nonsense syllables can be dramatically different from that recorded during meaningful words.

As against Foerester (1951) and stark (1985) findings Netsell in 1986 stated that speech commands originate in the cerebral cortex and non-speech activities are triggered from stimulation of subcortical neurons.

1.4.2: Speech vs feeding activity:

Many speech pathologists are of the opinion that infantile oral feeding reflexes, if diminished or absent, may act as a contributing factor for long standing dysphagia. Abnormal persistence of cranio-oesophageal reflexes as seen in neurological conditions, may interfere with speech production (Mysak, 1959, 1963, 1968; Sheppard, 1964). Sheppard

in 1964 assessed the primitive oral reflexes affecting oral and pharyngeal areas . The effect of ATNR and Moro reflex on infantile oral reflexes was also studied. In subjects with adequate feeding skills although not systematic, a high level of speech proficiency and articulatory competency was observed. This result partially supported the prescription of feeding management in cerebral palsied. There have been studies conducted to know the relationship between tongue thrust and speech activity. Basically during normal swallow, a vigourous pressing of the tongue either against or through the teeth anteriorly or laterally occurs. The tongue makes a sweeping movement against the palate such that the food gets mechanically injected into the pharynx and subsequently into the oesophagus. Whereas, during tongue thrust swallow, an insufficient elevation of the tongue occurs. Here the tip and the anterior third of the tongue do not approach the palate during any part of deglutition. Instead, the deglutition act involves sucking movement which is made possible by a tight oral closure or seal.

Thus we find that tongue thrust act is more of a vegetative or non-speech act. To gain evidence regarding the relationship between tongue thrust and speech defect there were several studies conducted. Wayback in 1961, Fletcher, Casteel and Bradley studied the relationship between tongue thrust

swallowing pattern and associated speech distortions in a total of 1615 children, with age ranging from 6-18 years. In this group the incidence of tongue thrust swallow was 668, that of sibilants was 230 and that of simultaneous visceral swallow and sibilant distortion was 180. It was also noted that the incidence of visceral swallow decreased with increase in age.

Barrett in 1961 reported of persistent lateral lisping in tongue thrusters. The sibilant distortion especially in /s/ appeared to approach the sound of a lisp, but was only minimally observable, though clearly identifiable as an articulatory deficit.

Subtelny, Mestre and Subtelny (1964) report that subjects with class II division I maloeclusion and tongue thrust during swallow were more likely to have an associated lisp than subjects with the same type of malocclusion who did not have tongue thrust swallow.

The proportion of lisping however was not significantly high in the sample with tongue thrust. Nearly 17% of the sample with malocclusion and tongue thrust had normal speech and 17% with malocclusion without tongue thrust had defective speech.

The above study reveals that although speech defect is evident in tongue thruster in other words, tongue thruaters way exhibit speech defects but it is not necessary that tongue thrust should act as a causative factor though it can act as a contributing factor.

Rusell (1984) reports that by stimulation and resistance excercises, weak and uncoordinated perioral muscles show improvement in multiply handicapped ehildren and adults having functional problems in eating and speech as a result of anatomical and neurological deficits.

Most of the studies reviewed so far highlight the relationship of speech activities with the non-speech vegetative activities and the feeding activities. The literature available to the investigator however, does not provide any reference to the relationship between feeding activities and non-speech activities in normals.

Section-II:

2.1: Feeding and vegetative function in C.P. children:

The vital behaviour of successful feeding is insured from the onset through strong feeding reflexes, the rooting, suck-swallow, bite and gag reflexes (Gallender, 1979). They are already developed in foetus and are active in utero. From the beginning the normal baby demonstrates some flexibility

in this highly reflexive behaviour and the capability to adjust to a variety of feeding situations. Infantile feeding becomes modified and mature in the growing infant.

CNS impairment frequently causes disturbances in this highly coordinated and complex behaviour and abnormal oral development is found at a very early age. Choking and aspiration may result when coordination between the different feeding reflexes and breathing is disorganized and may be life threatening (scherzer and Tscharnauter, 1982). Adaptability of feeding behaviour is often poor. Hence infants with restricted feeding habits and limited diets, often experience nutritional deficits (Stark, 1985).

If primitive and exaggerated feeding reflexes persists, it results in stereotyped feeding behaviour which interferes with normal function as a child grows older. Feeding sessions may become unreasonably long while much food is lost due to uncoordinated and abnormal swallowing patterns.

The current section will review the three stages of feeding in CP population.

A) Oral phase involvement includes

A.1: Food imbibition and buccal closure Mavinakere and Sivanathan (1986) stated that anterior seal of the lip is essential

in skills of ingestion, retention, communication, transportation and swallow. These skills act as foundations in the development of feeding skills in CP (Treharne, 1980).

Labial involvement in this group would include the following deviancies -

(i) Normal lip movement is deviant with labial immobility or protrusion and retraction (Hixon and Hardy, 1964; Hardy, 1983).

(ii) Inadequate lip closure (Hoberman and Hoberman, 1960; Rutherford, 1961; McDonald and Chance, 1964).

(iii) Excessive habitualized mouth opening (Crickmay, 1981).

(iv) Tense and retracted lips (Crickmay, 1981)

(v) According to Stark (1985) inability to form labial closure during feeding or at rest after six months of age may be suggestive of labial weakness and may predict difficulty in the production of bilabial stops/labiodental fricatives.

A.2: Involvement of masticatory system: In C.P. population the involvement of the masticatory system may range from minimal to severe degree. As in Leve's et al. 1980 study on severely handicapped spastics and athetoids 'biting and swallowing offered almost no hazards to the majority -

chewing a soft and firm bolus of food was accompanied by well over 4/5 of the sample".

Masticatory involvement may include -

i) Malocclusion - An impaired set of teeth in terms of condition and shape, accompanying tongue thrust and abnormal sucking patterns gives May to malocclusion tongue thrust and abnormal sucking patterns gives way to malocclusion in the CP such as open bite, over bite and cross bite. These in turn aggravates the abnormality that exists in biting and chewing pattern (Crickmay, 1981).

ii) Problems with lingual movement - Deviancies in terms of lingual movement in the CP include the following:

a) Deviation from normal tongue mobility in attempting to lateralize when protruded (Hixon and Hardy, 1964? Hardy, 1983).

b) Restricted tongue movements may range from movement as an inflexible mass to mildly impaired gesture appearing as being slow and imprecise. This may create an anterior hump with lingua alveolar contacts being made with tongue blade against the alveolar ridge,likewise there occurs a posterior humping for lingua - velar contacts (Stark,1985). In both instances, a major contribution to lingual elevation is the associated mandibular movement (Yost and McMillan, 1983; Stark, 1985).

The oral dysphagics exhibit the following deviancies -

(i) Inability to lateralize the food material with tongue and place it onto the grinding surface of the dentition.

(ii) Inability to crush the food item instead exhibiting a compensatory activity such as mashing the food between tongue and palate implicating reduced tongue elevation (Logemann, 1986).

(iii) Retention of food towards one site of the oral cavity resulting due to weakness of the lingual musculature together with facial musculature (Steefel, 1981). The food may fallinto the anterior or lateral sulcus indicating reduced labio-facial tension (Logemann. 1986). Swallowing behaviour from the opposite side is seen in clients with unilateral lingual weakness (Lund, 1987).

(iv) Reduced lingual movements prohibits collection of chewed material into cohesive bolus.

(v) This may lead to aspiration, due to premature lots of bolus into the pharynx.

(vi) Clients may initiate swallow with food spread out through out the oral cavity (Logemann,1986)

(vii) Abnormal position of bolus which maybe either held against the incisors or on the floor of the oral cavity with lingual retraction. This may be accompanied by tongue thrust swallow with bolus being pushed forward. A strong tongue thrust may result in spillage (Logemann, 1986).

(iii) Inadequate mandibular movement includes:-

a) Persistence of primitive bite reflex (Palmer, 1947); Crickmay, 1981; Scherzer, and Tscharnuter, 1982) with a thythmical bite and release pattern with vertical movements of the jaw.

b) Absence of chewing reflex (Crickmay, 1981; Stark, 1985).

c) Absence of voluntary biting and chewing (stark, 1985).

d) Restricted mandibular opening with jaw deviation to the weaker side or to the side with greater spasticity.

e) Slow and sluggish jaw movements (Stark, 1985).

f) Mandibular movements may be adequate enough to attain compensatory movement to assist labial and lingual gestures (Stark, 1985).

g) Extensor thrust with spastic jaw is a frequent finding (Stark, 1985).

h) There appears to be a relationship between the mouth opening pattern and the mandibular facet slip (MFS) often seen in CPs.

Hyper extension of the mandibular (Sheppard, 1962) is the nature of mouth opening pattern. The tonic mouth opening may be maintained by secondary subluxation rather than continued muscle spasm (Stark, 1985).

A.3: Oral Swallow in CP: The following occur as a result of neurological disturbance -

(i) Moderate motor disability and loss of precision in oral function (Strang and Thompson, 1958; Shelton, Haskins and Bosma, 1959; Bloomer, 1963).

(ii) Gross neuromuscular deficiency which includes a tongue thrusting movement as part of generalized extensor thrust (Ingram, cited byHopkin and McEven, 1955; Palmer, 1948)and seen in CP

(iii) Hyposensitive palate which presipitates crude patterns of food manipulation and swallowing (Ray and Santos, 1954).

(iv) Disruption in the tactile sensory control and coordination of swallowing because of inadequate underlying skeletodental configeration (Cleall, 1965).

Following will be the signs/symptoms owing to involvement of this phase.

a) Tongue thrust swallow - Neurologic maturation, genetic factors, mechanical restriction learned behaviour psychogenic causation etc. have been proved to be the causative factors of tongue thrust (Fletcher, 1970). In the syndrome of CP, tongue thrust may be a part of the generalized extensor thrust (Palmer, 1948; Hardy, 1983).

Symptomatology accompanying tongue thrust are -

i) Characteristic vigorous pressing of the tongue against or between the teeth either anteriorly or posteriorly (Palmer, 1962).

ii) Insufficient elevation of tongue during any part of deglutition with resultant sucking movement.

iii) This sucking is made possible by the increased circum-oral tension (Whitman, 1951; Barrett, 1961; Fletcher, Casteel and Bradley, 1961) with the upper lip exerting double the pressure in tongue thrusters than in non-tongue thrusters (Akamine 1962; and Mendel, 1962).

iv) Minimal laryngeal excursion (Palmer, 1962) usually anterior movements only. Few direct superior or posterior movements may be present.

v) Presence of Anesthetic throats (Palmer, 1962). In such cases there is an apparent decrease in gag reflex but not significant enough to hamper the client.

vi) Deviancies in orofacial structures include -high palatal arch,- narrow maxillary dental arch,- Prominent palatal rugae (Plicae),- Flaccid upper lip,- Flaccid masseter and temporalis muscle, - Firm mentalis muscle (Harrington, Barrett, Cited in Palmer, 1962). Malocclusion including - anterior overbite; -posterior or molar malocclusion: Angle's classification II (Palmer, 1962).

b) Stasis of food in the anterior sulcus - resulting due to reduced bucco-labial tension and poor lingual control (Logemann, 1986) seen in oral dysphagic.

c) Stasis of food in the lateral sulcus - also known as parking bolus (Jones, 1979) large residue in this vestibuli is implicative of reduced tension in the buccal musculature.

d) Stasis on the floor of the mouth - During attempts at oral transit, falling of ood onto the anterio-lateral floor of the mouth is an indicator of reduced lingual manipulation of the bolus in its posterior movement (Logemann, 1986).

e) Stasis of food on the tongue - is an indication of reduced lingual movement despite attempts to initiate a swallow; usually seen for food of thicker consistency (Logemann, 1986).

f) Stasis in mid tongue depression - this is usually seen in the presence of scar tissue on the lingual surface (Logemann, 1986).

g) Inadequate linquo-palatal contact - is implicative of restricted lingual elevation. This may also result in disturbance in lingual peristalis (Logemann, 1986).

h) Adherence of ood to the hard palate - This is implicative of reduced tongue elevation.

i) Uncontrolled bolus or premature loss of food into the pharynx - This occurs prior to triggering of the reflexive swallow by the main portion of the bolus with resultant aspiration owing to the open airway (Logemann, 1986).

j) Slow transit time- A slow transit time with delayed swallowing reflex is common in cerebellar disorders (Vitali, 1986).

k) Peace meal deglutition - Due to fear of aspiration which follows the swallowing act, small quantity of bolus is swallowed (Logemann, 1986).

i) Assistive head tilt - Acts as a compensatory mechanism during bolus manipulation and swallowing to avoid spillage (Mavenakere and Sivanathan, 1986). This is also referred to as bird-like head and neck movement (Palmer, 1962).

m) Drooling a common problem which is rarely due to excessive production of saliva from the excitation of the salivary nucleus, but usually due to failure of the tongue to direct saliva backward (as in normal swallowing mechanism) to trigger the swallowing reflex (Stark, 1935).

Apart from deviancies exhibited due to neurological disturbances some of the faulty feeding techniques as employed by parents of CP infants have led to the persistence

of the primitive/abnormal feeding behaviours as listed above. Some of the faulty habits, as quoted by Hoberman and Hoberman, (1960) are as follows:

1) Tilting the head backwards to gain assistance by gravity during swallow thus avoiding spillage.
2) For those children who exhibit minimal tongue manipulation assisting with soft food items placed at the back of the tongue. This prohibits the attempts to maneuver the tongue to propel food from front to back of the mouth for swallow. Hence a poor labial closure in combination with deviant tongue movement results, in drooling and lack of stimulation of the swallow reflex.

A.4: Sucking behaviour in CP - Palmer (1947) stated that sucking activity through straw is a difficult task for the CP. This can be attributed to

i) lack of sustained lip closure (Hoberman and Hoberman, 1960} Westlake and Rutherford, 1961; and McDonald, and Chance, 1964).
ii) Passive state of lips and cheeks (Ward; Malone, Jann and Jann, 1964).
iii) Lack of prolonged velopharyngeal closure (Netsell, 1969).
iv) Absence of sucking reflex (Crickmay, 1981).

v) Delayed development of sucking along with lack of muscular tonicity making the sucking action weak.

A.5: Spoon feeding in CP - Crickmay,(1981); Scherzer and Tscharnuter, (1982); Stark (1985) reported the following abnormal oral pattern in CP individual during spoon feeding

(i) using primitive sucking pattern in imbibing food from spoon

(ii) using tongue thrust pattern with lip retraction for spoon clearance instead of lip usage.

(iii) Scraping of food along the teeth or gingivum, further reinforcing lip retraction.

(iv) Biting the spoon due to bite reflex in a hyper sensitive infant.

(v) Hyper extension of jaw in response to the approaching spoon.

(vi) Bird feeding pattern.

(vii) Delay in emergence of lip retraction on spoon feeding among many other features may be suggestive of weakness and delay in maturation of oromotor system and may be predictive of dysarthria (Stark, 1985).

B. Pharyngeal phase involvement: Dysfunction at this stage includes the dysfunction of swallowing reflex or the

programming mechanism in the brain stem. This structure controls the neuromuscular components that characterizes the pharyngeal response (Logemann, 1986). The deviancies are listed under -

(i) Undeveloped swallow reflex (Gratke, 1957; Crickmay, 1981).

(ii) Weakened pharyngeal reflex

(iii) Inadequate velar elevation - with nasal reflex during eating, absence of gag reflex, hyper - rhinolalia and inadequate intra oral pressure (Sittig, 1951; Mysak, 1965; Steefel, 1981; Logemann, 1986; Stark, 1985).

(iv) Diffuse spillage of material over the base of the tongue (Logemann, 1986).

(v) Vellecular stasis or spillage of bolus onto the pyriform sinuses (Logemann, 1986).

(vi) Coating of the pharyngeal wall with food material after swallow (normals employ a dry/empty swallow to clear this)

(vii) Reduced laryngeal closure which either occurs at the level of aryepiglottic folds or epiglottis or false vocal cords and true vocal cords (Logemann, 1986).

(viii) Reduced laryngeal elevation with a resultant aspiration during the act of swallowing.

(ix) Incoordination between respiration and deglution - infants with CNS lesion often rely on mouth breathing instead of nasal respiration which increases the danger of swallowing

air and aspiration (Scherzer and Tscharnuten, 1982). Also, since nasal respiration requires approximation between tongue and soft palate, a motor disturbance in these areas may contribute to patterns of abnormal breathing (Scherzer and Tscharnuten, 1983).

C. Esophageal involvement: Esophageal phase is the finai stage of deglutition that involves relaxation and subsequent contraction of cricopharyngeus musculature and simultaneous elevation of larynx and glottic closure. A neurological disturbance results in cricopharyngeus malfunction with dysphagia and aspiration. The symptoms in dysphagics (not reported in CP literature) owing to cricopharyngeal dysfunction (Steefel, 1981; Stark, 1985) are - normal oromotor function for swallowing and articulation,- pain and regurgitation during or following a swallow, - aspiration, - drooling, -weak or absent laugh (voluntary reflexive), - intake of thin liquids better than thicker consistency.

2.2: Developmental trends in the abilities of speech, non-speech and feeding skills in cerebral palsied as against normals:

From the previous section it has been made clear that the speech, non-speech and feeding acts are indeed motor skills just

like any other motor skill of other parts of the body as walking. The same fact has been highlighted by several researchers namely:

Eguchi and Hirsh (1969) who accounted for 2 types of developmental motor processes for individual speech skills in normals.

a) By 4 years of age, the consistent opening movement duration, open posture duration and inter articulatory timing is attained.
b) By 4-7 years of age, process that organizes movements which help in decreasing lip movement is attained.

They also stated that speech motor control begins at around 3 years and stabilizes by 8 years of age.

Dissimoni (1974) attributed the durational timing difference with age to the following factors:

a) Operating efficiency of the system assumes adult level of maturity by 9 years.
b) The orofacial structures of a child are smaller than that of adults and thus there are spacial differences between vowels of the two groups.

Thompson and Hixon (1979); Kent and Forner (1980) and Kent (1981) attribute the immaturity seen in children during

speech to inefficiency in planning and sequencing speech gestures as compared to adults.

Stark (1981) states that foundations for skill acquisition is laid down in the first 3 months of life. The next 3-12 months is a crucial period where morphologic and functional plasticityof maturing nervous system are being challenged. By 6 months the dinstinction between voiced and voiceless features are seen. Between 3-9 months jaw independence with respect to lower lips and tongue movements arise. At this stage the velopharyngeal mechanism becomes active thus intonation patterns emerge and nasal, non-nasal distinction attained.

Netsell (1984) stated that the first 24 months, movements are dominated by spacial goals ie child practices placement, shaping or movement of component parts of yield acoustic patterns to match his or her model.

Huffman (1985) attributes the increased variability in child to the physiological limitations seen in their articulators.

Sharkey and Folkins (1985) found that lip and jaw movements and open postures and timing between the onset of lower lip and jaw opening all decreased in variability from 4-10 years of age.

Robbin and Klee (1987) state that speechmotor control takes place gradually between birth and puberty which is dependent on the maturation of the individuals nervous system. The first 24 months of life is critical for the child when child begins to get familiarized with the movement pattern or parameters of the peripheral.

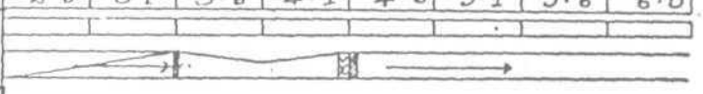
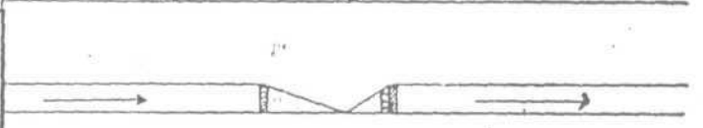
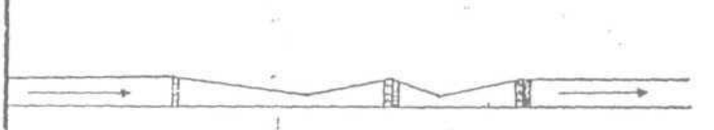
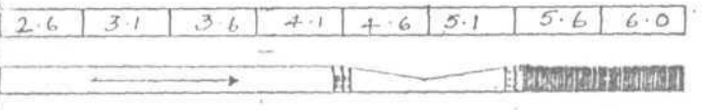
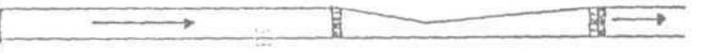
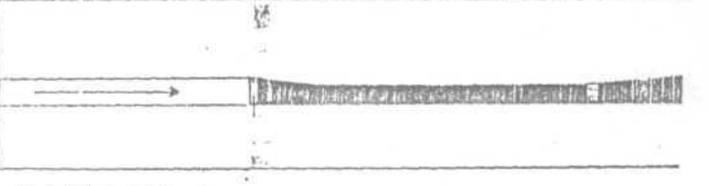
In general, most of the motor skills of speech seems to achieve adult form with increase in age from 2-6 years of age (Bobbin and Klee, 1987).

In a study conducted by Kavitha (1985) following were the developmental trend observed in normals for speech and non-speech which is depicted in Table-1. Similarly, the development trend for feeding was studied by Jyothi,(1990) and the results are depicted in Table-2.

Table-1

DEVELOPMENTAL TREND FOR SPEECH AND NONSPEECH ACTIVITIES IN NORMALS :

SUMMARY OF DEVELOPMENTAL PATTERNS

NO.	Structure	Letter Code	Activities Speech	Activities Non-speech	Performance through age range 2·6 | 3·1 | 3·6 | 4·1 | 4·6 | 5·1 | 5·6 | 6·0
1	Lip	A	A: /a/, /i/, /u/-/i/, /m/, /b/, /ap^{y}/, /p$_{h}$/, /m$_{h}$/, /b$_{h}$/, /w$_{h}$/.		
		G		Rounding, Retraction; Alternate prostrusion & retraction; Closing lip from open position; Pursing lips; Side to side movement of lips; Protrusion; Opening & closing lips with teeth clenched; Upper teeth on lower lips; Lower teeth on upper lips; Tongue out of mouth test	
2	Jaw	B	B: /u/, /pa/, /ta/, /ma/, /a-i/:		
		H		Opening mouth as in yawning, Opening and closing jaw, Chewing	
3	Velo-pharynx	C	C: /m^{y}/, /h$_{h}$/:		
		I		Blowing through nose with mouth closed; Sighing through mouth	
4	Tongue	D	D: /g$_{h}$/, /r$_{h}$/, side to side /l/, /n$_{h}$/, /j$_{h}$/, /ʃ$_{h}$/, /g$_{h}$/, /g$_{h}$/, /ʧ$_{h}$/, /K$_{h}$/, /dʒ$_{h}$/, /l$_{h}$/, /n$_{h}$/, /k$_{h}$/, /s$_{h}$/, /ʃ/.		
		J		Elongation outside mouth, Flattening, Alternate retracting & protrusion; Side to side movement of tongue touching corner of mouth, Elevation of tip to alveolus, Curling, tip touching mid palate, Curling lateral edge of tongue upward to touch inter-dental position, Touching blade to alveolus, Touching body to mid palate, Lift back touch soft palate, Flapping of tongue against lower teeth, Trill production /r r r/, Raise & lower tongue against upper lip to lower lip, Curl lip towards floor of mouth.	
5	-/, Jaw, Tongue, Velo-pharynx		Compiled scores		
				Compiled scores	
6	Respiration & Laryngeal system	E	E: Breath group, Pitch range, Loudness range, S/Z.		
7	All the above (coordination & sequencing)	F	F: /P$_{h}$/, /l$_{h}$/, /K$_{h}$/, /h$_{h}$/, /P$_{h}$/, /K$_{h}$/, /l$_{h}$/, /P$_{h}$/, /K$_{h}$/, /l$_{h}$/, /n$_{h}$/, /P$_{h}$/, /l$_{h}$/, /n$_{h}$/, /l$_{h}$/, /P$_{h}$/		

Key :- Colour codes

- : Improvement in performance
- : Age at which reduction in performance noticed
- : Negligible reduction of performance represented by a small notch.
- : Marked reduction of performance through the age range, represented by a large notch
- : Age at which there is a readiness to improve after a detriment.
- : True improvement begins after a detrimental performance.
- : Asymptotic levelling of performance through the age range seen.

Table - 2

DEVELOPMENTAL TREND FOR FEEDING ACTIVITIES (SOLIDS & LIQUIDS) IN NORMALS:

Deglutition in solids

Item	Feeding act	Age range in years	Performance of normals	Minimally involved	Mild involvement.	Moderate	Moderate - severe
1.	2.	3.	4.	5.	6.	7.	8.
A.	Imbibition						
	-Clearance	5-6	Dentition against labial pursing for clearance	Similar to normals	Solids:Similar to normals. Liquids: Falls below lower limits of age range.	Drop in performance for both solids & liquids.	Marked drop for both solids and liquids (inability)
	-	6	Stability is attained.				
	-Efficiency	5-6	Steady pattern	Similar to normals (Good-Fair)	May or may not be similar(fair-poor)	Poor	Poor
B.	Mastication						
	-Labial movements.	6-7	Open mouth chewing	Slight performance difference of 3-4 years.	Greater performance difference	Marked difference.	Mere marked difference.
		7	Plateau obtained				
	-Detection of food	2-4	Open mouth detection + buccolabial tention + cheek bulging	Similar to normal	Same as normals per formance	Buccolabial tension + lip purse + cheek 1bulging + open mouth.	
		4-5	Lesser ease to food location.	Similar to normal	Same as normals. performance	Buccolabial tension + lip purse +check bulging + open mouth.	
		>5	Minimal cheek pulge + labial pursing + open mouth	Same but with performance difference of 3-4 years.	Greater difference	Buccolabial tension + lip purse + cheek bulging + open mouth.	
	-Spillage	2-4	minimal spillage	minimal	comparatively more	maximum	Marked
		>4	Plateau (no spillage				

1.	2.	3.	4.	5.	6.	7.	8.
	-Mode of labial clearance during chewing.	2-6	Hand/finger + lips vs dentition + tongue protrusion.	Similar to normals	Similar to normals	Similar to normals	Similar to normals.
		6-7	Lip vs teeth + lingual protrusion	Similar to normals	May or may not be similar with performance difference.	Performance as 2-6 year olds.	
		> 7	Plateau obtained with labial pursing + minimal lingual protrusion ± hand usage.	<------	not obtained	>	
	-Mandibular arc traversed	2	No variation	normal or minimal deviation from rotatory or lateral types with increased range of movements.		minimal to marked deviation.	Marked deviation + Jaw thrusting + bite
	Range of movements	6	Exaggerated movements in chewing solids with increase in the force of masseter contraction.	Same as normals (of 6 years)	Persist at a later age. Weak contraction	Weak to absent contraction	Mostly absent
		> 6	Plateau obtained	Performance difference	Weak contraction	Weak to absent contraction.	Mostly absent
	-Lingual movements food placement.	2-3	Marked lingual protrusion + dissociated jāw movement + bolus anteriorly placed(close to incisors).	Same as in normals with similar performance persisting for higher age range.			
		> 5	Plateau attained + no lingual movement during chew-	not attained	not attained	not attained	not attained

1.	2.	3.	4.	5.	6.	7.	8.
	Masseter contraction	2-3	Minimal variation + difficulty in detecting masseter contration	May/may not be	Weak	Weak absent	Absent
	Chewing efficiency		Efficient (not predictable)				
C.	Swallowing						
	Cohesive bolus formed	2-4 4 >8	Spread out in oral cavity. Majority of the time centrally placed on the tongue and on palate minimal spreading. well defined margin.	Performance difference (This performance may persists at a later age)	No lingual dissociation from mandibular movement + marked tongue protrusion + variation in tongue movement with no maneuvering to shift food to grinding surface of the dentition (less marked) (More) (more) <------minimal variation with age ---->		
	Laryngeal elevation		No developmental pattern observed.				
	Masseter contraction		No developmental pattern observed.				
	Circumoral tension	2-4	Greater tension	Similar to normal	may/may not be	Minimal marked	Marked
		4-8	Stabilized	No may/may not	No	No	No
	Lingual positioning		No developmental pattern		Tongue thrust may be present	May be	Present in most CPs.
	Spillage during swallow.	2-3	Minimal spillage	Minimal	Minimal or marked(may/may not be)	Marked usually	Marked
		4-5	Due to individual variation a drop is observed.				
		>5	Stable with no spillage.				
	Mandibular Stability	2-4	Exaggerated mandibular displacement	<---------	same as normal	--------->	
		4-6	Minimal displacement	Same	Same	Marked	Marked
		>6	Greater stability	-	-	-	-

1.	2.	3.	4.	5.	6.	7.	8.
	Post swallow intra oral examination	2-3	Minimal amount of resi- due after one minutes post swallow.	minimal	Minimal to marked	Marked	Marked
		3	Plateauing with no residual bolus	minimal			
	DEGLUTITION IN LIQUIDS						
A.	Imbibition						
	-Position of the glass.	2-6	Place over lip & teeth	same as in normals.	Same or open mouth imbi- bition	open mouth	open mouth or severe bite
		> 6	Placement between lips alone	May/may not			
	Degree of lip protru- sion.	2-6	Marked labial protru- sion	Minimal	Minimal	Marked protrusion/no protrusion due to restricted mobility.	
		> 7-8	Minimal/no protrusion				
	Degree of cheek in drawing	2-4	Marked in drawing during sucking.	<---	____marked	---- --- --->	
		4-6	Minimal Plateau.	Minimal	Minimal marked	Marked/no indrawing due to restricted buccolabial mobility.	
	Position of straw	2-6	Place between lips & teeth	same	<--------	bites the straw	------->
		> 6	Labial placement				
	Degree of lip closure	2-4	Greater closure	minimal tension		Marked	Marked/no ten- tion in pre- sence of flabby lips.
		4-7	Plateau obtained.				
B.	SWALLOWING						
	Anterior seal	2-3	Adequate antr. seal	minimal fluid leakage		Same/absent/ inadequate	Absent with fluid loss.
	Posterior seal	2-3	adequate postr. seal	Adequate minimal leakage		minimal leakage	marked leakage.

1.	2.	3.	4.	5.	6.	7.	8.
	Laryngeal elevation		Nodevelopmental tread	Detectable elevation	Minimal elevation	May/may not be detectable.	
	Masseter contraction		Present	Present	Present/weak		Weak/absent
	Circum oral tension	2-4	Marked	Similar to normals	Similar on minimal tension.	Minimal marked	Marked
		> 4-8	Stabilized				
	Lingual positioning	2-6	Tongue thrust between teeth	Tongue thrust between teeth		Placed between dentition + spillage	+ Spillage.
		7-9	Not visually evident.				
	Mandibular stability	2-3	Marked lowering and elevation	May/may not be similar to normals.	Slight displacement may be present.	Slight displacement or marked displacement	
		3-6	Minimal jaw movement				
		6-7	Minimal jaw movement + muscular movement in sub-mandibular region				
		7-8	Either jaw movement or muscle movement.				
		8-9	Only muscle movement.				
	Spillage during swallow	2-4	Minimal spillage	Same	Same may/ may not be	Minimal to marked.	Marked(if tongue thrust-present)
		> 5	No spillage.				

2.3: Need to study the three activities in CP population:

The above section implicates the necessity of developing a test format which enalbes the assessment of deglutition speech and non-speech functions together.

The studies reviewed so far throws some light on the developmental trend for the deglutition, speech and non-speech activities in normals.

Historically, the therapeutic program in the management of cerebral palsy included a universal prescription of oro-neuromotor training. Training was directed towards the reduction of swallowing problems by incorporating feeding programs tackling the oral and pharyngeal stages and thereby improving dysarthria.

Some of the feeding facilitation programs were recommended by Shohara (1932); Palmer (1947) Mysak (1960); Gallender (1979), Scherzer and Tscharnuter (1982) but the precise criteria for developing such programs are limited. Speech pathologist employing the neurodevelopmental therapy question the efficacy of such a program that is, extent to which the abnormal cranio oropharyngeal reflexes influence the speech production in cerebral palsied.

Ingram (1962) asserts that abnormalities of spontaneous feeding ace of greatest diagnostic and prognostic significance

in neurological disorders of infants. They state that, the artificial elicitation of individual feeding behaviours are less informative; since they vary even in healthy infants. It is seen that feeding behaviour can be easily elicited when the infant is hungry or drowsy or in a feeding posture than supine posture.

Sheppard (1964) in a study on 51 CP including 25 athetoids, 24 spastics, 2 rigidities, age ranging between 2.1 to 2.6 years stated the relationship between infantile cranio-oro-pharyngeal motor patterns in relation to age, feeding competence, speech intelligibility and progress after speech therapy. Results indicated, as the age increased the patterns were generally less numerous and of longer latency. As the number of patterns increased and latency of patterns decreased, the adequacy of speech, and feeding were found to decrease. This study gave a basis for administering 2 therapeutic methods.
(1) Selective facilitation of infantile feeding reflexes to enhance feeding behaviour and
(2) once the infantile feeding reflexes are facilitated they should be suppressed and replaced by higher forms of oro-neuromotor activity like speech. This follows the "stimulation development principle emergent reflexes (Mysak, 1960).

Hagerman and Taimi (1980) conducted a study, investigating the relationship between speech performance, dysphagia and oral

reflexes in 60 severely handicapped CP ranging in age from 3-26 years. Five feeding skills namely - sucking, biting, swallowing, chewing (of soft and firm food) was assessed for their adequacy.

Hardy (1983) gave his opinion that severity of dysphagia is not reflective of severity of dysarthria. Although such observations of feeding problem which confirms a neuromotor problem involving oral structures, may be helpful in selecting instances in the clinical process.

Recently Jyothi (1990) conducted a study on the activities of deglutition in five spastic CP children. However, there is no data on the performance of these functions in different subtypes of CP.

In order to provide directions in the management of deglutition as well as speech and non-speech act, a thorough evaluation covering all the 3 acts in CP population is necessary.

The rationale behind the inclusion of all the 3 acts is to give an account of the individual articulatory movements in speech, non-speech and deglutition acts. This again has a therapeutic implication wherein an evaluation of tongue

movement say retraction would give us a baseline whether this movement is adequate to bring about swallowing as well as in production of velar sound production. Based on this the child could be given exercises for tongue movements. Thus management program can be directed by listing out the parameters that ought to be tackled for a given client in relation to his peer group.

2.4: Role of speech-language pathologist:

The sustained interest in the abnormal reflex behaviours and postural reactions that are a component of developmental neuromotor disorders has led to the identification of oral and pharyngeal behaviours in CP speakers that are believed by some to interfere specifically with the development of motor speech skills. There also has been a renewed interest in the chewing and swallowing difficulties experienced by many persons with CP. Programs for the management of these difficulties have been designed with the belief that they either diminish or exaggerate the oral reflex like behaviours (Love, Hagermann, Taimi, 1980).

Frequently the rationale of these programs is that the development of more normal patterns of mastication and deglutition will reduce the severity of the dysarthria that is likely to emerge as the child matures. However alleviation of one set

of manifestations need not always automatically lead to changes in others. This is evident from the observations of Love et al (1980) who found no correlation between the abnormal oropharyngeal behaviour, mastication and deglutition problem and speech status of their CP subjects.

Thus an over view of literature (Hardy, 1983) evidences 2 major schools - (a) who believe that the systems underlying chewing, swallowing and speech are parallel (b) the systems are interconnected. Thus with this in view the role of the speech language pathologists should be directed towards :

1. Channelizing muscular activity towards speech production.
2. Systematic exhaustive observations of the speech apparatus in order to formulate impressions regarding neuromotor involvement.
3. A thorough evaluation of the acoustic output of these CP children (such as abnormal vocal tone, restricted, variations of pitch and loudness, imprecise articulations) which ate the best indicators of future dysarthria.

Section-III:

Available testing procedures for assessing the speech, non-speech and feeding activities:

Vitali (1986) compiled a "test of oral structure and function (TOSF)". This test can be used for screening,

diagnostic, pre and post treatment assessment, assistance with case load management decisions and prosthesis evaluation. TOSF consists of 5 parts.

Part-I includes speech survey which considers speech parameters such as articulation rate/prosody,fluency and voice. Part-II includes verbal oral functioning such as (a) resonance balance, (b) sequenced syllable utterances, (c) mixed syllable sequence utterance, (d) sequenced vowel utterancex, (e) sequenced syllable rates. Part-III includes non-oral functions which inturn taps the following (a) Isolated functioning such as puckering of lips, smiling, elevation of the tongue and so on. (b) Sequenced functioning such as orofacial, labial, lingual, and intra oral vegetative functions. Part-IV includes survey of orofacial structures. Part-V includes history-behavioural survey.

Scoring of the verbal oral functioning and non-oral subtests are objective,depending upon the subjects performance on standardized tasks.

Kavitha (1989) conducted a study to test the motor behaviour of speech mechanisms in 35 normal children, their age ranging from 2.5 - 6.0 years.

Most of the items in this test was adapted from the study by Bobbins and Klee (1987) and the vitalis test (1986). The test focuses on 2 activities -

a) the speech test items

b) the non-speech test items.

The result of the developmental trends in this study imply that speech and non-speech motor functioning matures with age just like any other fine motor skills of other Parts of the body. The results supported Netsells view (1980) that maturation occurs only when the neural hard wiring to the respective structure are complete. The study also revealed a positive correlation between speech and non-speech counterparts implicating that the two are partially dependent en each other and they improve with age.

Jyothi (1990) conducted a study to assess thefeeding and related speech behaviour on 12 normal adult females ranging from 17-25 years; 35 normal children from 2-9 years: The group of children were divided into 7 subgroups. A group of verbal spastic CP children were also included. Results indicated a clear developmental trend in normal children that may be accounted for maturational influence. This study implied that (a) the test format could be used to enlist the

primitive and the pathological features in the dysarthric

(b) It suggested that vegetative therapy may be of use to tackle the pathological and normal but primitive features, the latter following the developmental sequence. The developmental profile would help to provide the direction for the vegetative therapy. It suggested the possibility of averaging the baseline deglutition age which could be compared with the post therapy deglutition age.

(c) This study suggested that owing to the close relationship between articulation and deglutition it may be possible to alleviate symptoms of dysarthria by attempting to remedy dysphagia. Eg. spillage and aspiration, tackled via vegetative therapy may bring about a normalization of the wet gurgling voice quality seen in some spastics owing to stasis of saliva close to the laryngeal inlet.

(d) The profile can be applied to other clinical population such as cleft palate and other neurogenic speech disorders.

A test profile used in Winfield State Hospital and training centre evaluates chewing, sucking and swallowing. It also encloses a detail examination of oral structures. It also considers oral hygiene and takes into account the severity of drooling. There is a rating scale provided to grade the above listed activities as no response for a 0 score; poor = 1; fair = 2 and good =3.

Section-IV:

Need for the assessment scale in the present set-up:

We are all aware of the fact that before evaluating an abnormal child, one must have the norms. The neurological and speech development of the normal child gives us the necessary background for the treatment of the CP child. In treating these children, it is essential at all stages to evaluate their performance against that of their normal counterpart's developmental pattern as closely as possible.

As is made evident in the review there has been controversies regarding the relationship between speech, non-speech and feeding functions. These functions were studied by Kavitha (1989) and Jyothi (1990). Here the speech, non-speech, and feeding functions in normals were studied. These two studies revealed a clear cut developmental pattern for all the 3 functions.

This has boosted the present idea of developing an assessment scale for CP population, as in our present set-up we do not have a standardized test profile to tap in detail the speech , non-speech and feeding functions as exhibited by CP's. It would be interesting to see if any developmental trend exists within the group of cerebral

palsy patients and if it exists, the qualitative differences that exists between this and the normals. It would also be interesting to note if there are any similarities or differences within the subgroups of cerebral palsied. The scale may enable the clinician to establish and grade the CP children in terms of severity. This in turn will provide the clinician with a baseline on which the appropriate therapeutic strategies can be decided.

METHODOLOGY

The present study was aimed at assessing the functions of speech, non-speech and feeding acts in CP population by -

a) Comparing the performance of CP population against normals for developmental trends in feeding, speech and non-speech.
b) By assessing the status of the 3 skills in the different types of CP children namely spastic, athetoid and mixed types and rate them in the heirarchy of severity.

Subjects:

Sample size: The test protocol formulated was administered to 3 groups of 32 CP children under following categories.

Spastics	Athetoids	Mixed
18	7	7

Diagnosis was made by the neurologist to whom they were referred to. The subjects were chosen from the 'spastic society'. Bangalore and those attending therapy at AIISH, Mysore.

Age range: Subjects selected fell withinthe age range of 4 years to 17 years.

Social economic status: The subjects were from middle to upper socio-economic status both sexes.

Subject selection criteria: The subjects were required to fulfil the following criteria (i) Being otologically normal. (ii) Being at least of average intelligence or Borderline to mild Mental retardation (as diagnosed by clinical psychologist). (iii) They were also screened using DST (Developmental Schedule test) by Bharath Raj. (iv) Having no other associated problems like hearing loss or visual inacuity or anyother associated problem, at the time of testing.

Materials: The materials for speech and non-speech activity was adapted from Kavitha (1989) study. Speech items in this format consisted of the sounds that required the active participation of the articulators namely lips, jaws, tongue, velum and also tapped the efficiency of respiratory and laryngeal system. Non-speech activities again demand the active participation of the above mentioned articulators. The details are provided in Appendix.

The feeding protocol was adapted from Jyothi (1990) study.

Utensils used: Standard ice-cream spoon, tea-spoon, tongue depressor, measuring glass pouted and unpouted glass, standard cellophane straw, 1.3 cm diameter and 1.8 am diamter. Feeding activity included the items that were easily accessible with a range of consistency from liquids to solids to highlight the

different oral strategies employed in its manipulation.

Items included -

Solids - (1) Cooked rice - a common item which is the staple food.

(2) Biscuit - easily softened by saliva.

(3) Chocolate - requiring exaggerated mandibular motion for chewing.

(4) Rusk - which gets easily fragmented with increased mastication.

Liquids: - Lime juice was selected owing to easy accessibility and taste which will be readily (consumed by the subject.

Test protocol for evaluation of speech, non-speech and feeding skills include -

The general format includes the

-General history and examination of oral structures.

-Speech skills include the production of the various sounds eg. lip sounds (/p/ /b/ etc.). Tongue tip sounds (/t/ /d/ etc) etc.

-Non-speech skills include movements such as: lip protrusion, retraction, tongue elevation etc.

-Feeding skills included the performance during eating which inturn included imbibition, mastication and the swallowing acts. Similarly drinking act included imbibition and swallowing

The details of the whole format in detail is presented in Appendix-A.

Test administration:

A. Test environment: The subjects were tested in an isolated room with minimum distractions. He was seated in a comfortable sitting posture during testing.

B. Procedure: The test format as presented in Appendix-A was administered as follows. History pertinent to feeding was taken including details of presence and duration of intraoral habits of thumb/finger sucking and tongue thrusting. Details were obtained from parents of the C.P. children regarding the types of problems as encountered during the act of feeding, history of choking, aspiration. History of alternate feeding methods if employed in infancy. Information regarding the posture as adopted as a compensatory act during feeding also to be noted. In addition, the mother/was required to demonstrate the posture adopted for feeding and the method of feeding including, the size of bolus, type of food used, mode of presentation into the oral cavity and utensils used.

The test was administered in a randomized manner. The steps involved during testing were as follows:

i) Place the child in a comfortable sitting posture.

ii) Instruction: The stages of instruction is as follows - For speech functions, the subjects were instructed to listen to the speech sounds as produced by the examiner and imitate the model presented as well as they could. The subjects were givenas many trials as needed to elicit the response before scorring, keeping the mode of cueing constant. The external cues were presented in a heirarchical order. The order being (a) auditory (b) audio-visual (c) audio-visual tactile.

To tap the respiratory and laryngeal systems efficiency, the subjects were instructed to take a deep breath and produce /p /, /t /, /k / in a sequence. Similarly, they were instructed to produce - a whole length of utterance in one expiration; - imitate rising and falling tone in terms of pitch and loudness; - produce /s/ and /z/.

For tapping the non-speech activities the above instruction was used. The external cues provided were in the order of (a) visual (b) visuo auditory (c) visuo audio tactile.

For feeding act, the subjects were presented the various food items (both solid and liquid) one by one and asked to eat or drink as they do under natural circumstances.

iii) During this testing a napkin was tied round the child neck and one was placed on his lap.

iv) Cooked rice biscuit, chocolate and rusk were introduced in the same order and deglutition act such as imbibition, biting, chewing and swallowing were observed in detail and noted down.

v) Similar assessment for deglutition of liquids (juice) were made and observation were noted down.

C. Recording of responses - The observed responses were scored immediately depending on the performance of the subject. A scoring of 3, 2, 1 were assigned to the speech, non-speech and feeding activities of the subjects under the following conditions of scoring.

Scoring:

Score	Speech acts	Non-speech acts	Feeding acts
1.	Totally deviant response even when all three cues are provided.	Totally deviant response with all 3 cues presented.	Totally deviant from normals such as clearance with teeth with lips apart or inability to clear the food material with excessive spillage; marked labial opening + clumsy labial movement with marked accompanying sound.
2.	(just emerging) Adult like response elicited with auditory, visual and tactile cues.	Just emerging adult like responses elicited with visual, auditory and tactile cues.	Performance which approximates adult like pattern but not attained completely eg. clearance with lips and teeth both labial opening and closing during chewing with minimal accompanying sound.
3.	Adult like response elicited with only auditory, visual cues.	Adult like response elicited with only visual cue.	Adult like performance eg. clearance of food items with lips alone; predominantly closed lip during chewing, no accompanying sounds etc.

(Appendix- A for details)

Repeated testing of all the above subtests of speech, non-speech and feeding were done a minimum of 2-3 times. Testing session lasted for 40-50 minutes per individual depending on the sample group. The oral behaviour thus obtained were recorded in the response sheet and transcribed into the appropriate rating scale. The raw scores obtained from the rating scale were quantified and subjected to suitable statistical analysis.

Reliability check: The entire test battery was administered by the same tester to four randomly chosen subjects after a gap of one month to check for test retest reliability. The scores were found to be reliable as they were identical for ail the subjects in all the parameters of speech, non-speech and feeding activities.

Problems encountered during testing:

i) For the elicitation of non speech activities more promptings were required.

ii) Instruction had to be modified to suit the different age groups especially for the younger age group subjects to produce a whole length of utterance in one expiration and rising and falling tone both in pitch and loudness.

iii) Feeding the subjects were a laborious act.

iv) Difficulty in feeding increased for severely affected subjects and hence special utensils were to be used.

v) Some of the subskills like presence and absence of gulp; amount of water intake in one sucking etc. could not be rated. However, features of these functions are discussed in the next chapter.

vi) Some subjects were uncooperative and hence the examiner had to readminister the test after a gap of few hours or days.

vii) Some subjects (Athetoids) who had severe involuntary movement of head or tongue had to be assisted during food intake.

ANALYSIS, RESULTS AND DISCUSSION

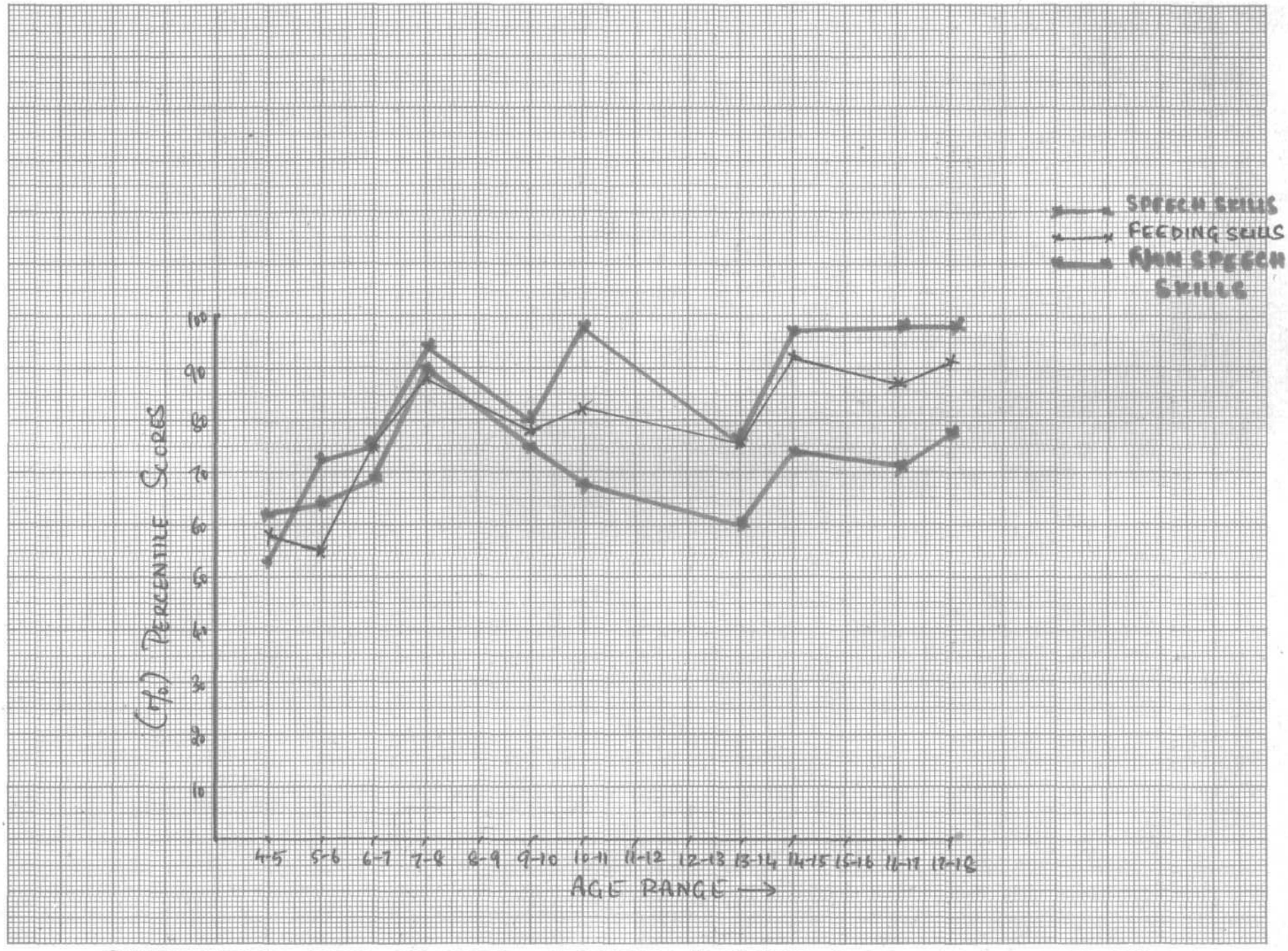
The data obtained for speech, non-speech and feeding activities were tabulated and subjected to suitable statistical analysis wherever appliaable and the other sub-skills which could not be scored, have been discussed qualitatively.

I) Developmental trend:in speech, non-speech and feeding activity:

Developmental trend as observed in the C.P. population have been depicted through line graphs. This graph indicates that (a)the performance on each of the 3 skills - speech, non-speech and feeding improves with age in normals (Kavitha, 1989; Jyothi, 1990).

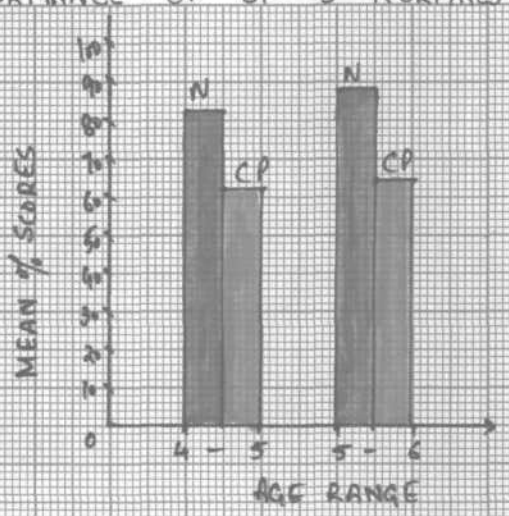
(b) In all the 10 age groups (ranging from 4 to 17) the speech, non-speech and feeding skills seems to develop in parallel to each other. Also the 3 motor skills become less variable with age.

(c) It is also evident from the graph that the curve assumes a rugged course in all the 3 skills and is not always smooth. A typical trait observed is that after every dip in efficiency there is an apparent improvement in performance indicated by a steep slope upwards especially around 7-8 years age range. A similar finding was reported in normals by Kavitha (1989). This fact was earlier highlighted by Netsell (1986) and was



DEVELOPMENTAL TREND FOR SPEECH, NONSPEECH & FEEDING SKILLS IN CEREBRAL PALSIED :

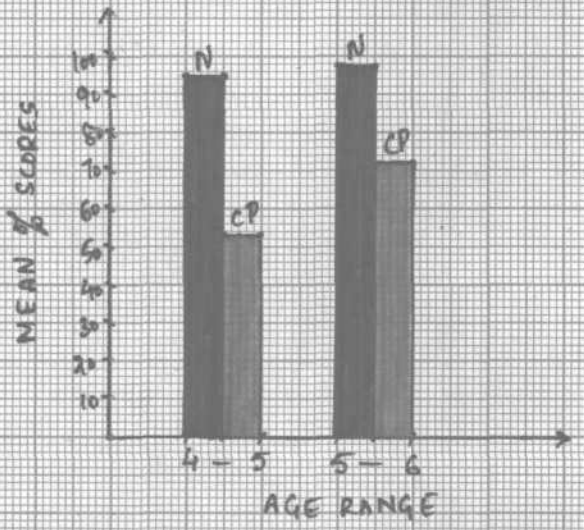
PERFORMANCE OF CP Vs NORMALS FOR NONSPEECH, SPEECH & FEEDING SKILLS



NON-SPEECH SKILLS

NORMAL

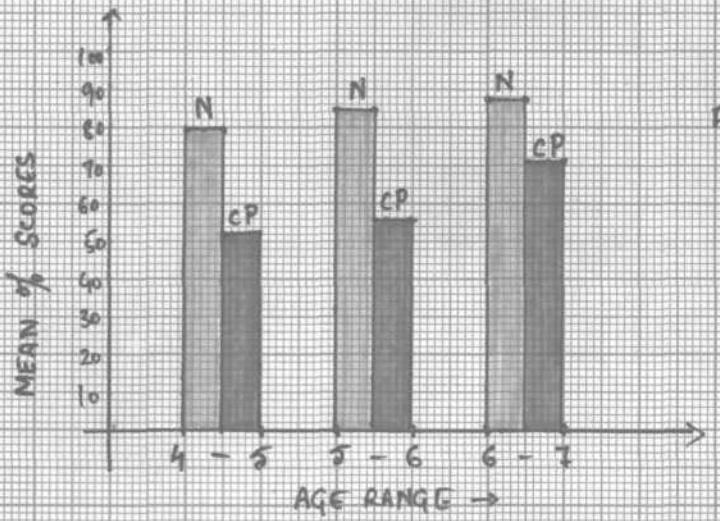
CP



SPEECH SKILLS

NORMAL

CP



FEEDING SKILLS

NORMAL

CP

attributed to the fact that for every motor act there were sensitive periods. These were explained as periods of non-linearity where in certain neural musculo skeletal, environmental and cognitive changes occured and which attributed to these spurts in performance. The jumps can be attributed to the degree of neuromuscular involvement of the CP subjects in these age groups.

ii) Performance of CP children vs normals for speech, non-speech, and feeding: activities in the age range of 4 to 7 years:

A comparison of age ranges 4-5; 5-6; and 6-7 for normals and CP children was done as the subjects could not be obtained for all the age groups. The comparison is depicted in Graph-2, through bar diagrams. This gives a clear-cut indication that in general CP children perform poorly when compared to normals for each of the 3 skills. This can be attributed to neuromuscular system impairment in cerebral palsy population.

II.A(i) Comparison between the performance of CP children and normals for feeding activities:

Since the raw data for speech and non-speech activities for normals (Kavitha, 1989) could not be made available the performance of the two groups ie normals and CP for these

skills could not be compared. The feeding skills of normals and cerebral palsy group however could be subjected to statistical analysis. The 'S' and 't' values for these two groups were computed by comparing the feeding skills of normals and cerebral palsy group for age groups 4-5; 5-6; and 6-7. The results are tabulated below:

Age group - 4-5 years

	Solids		Liquids	
	Normals	C.p.	Normals	C.p.
Mean	50.2	37.5	28.6	14.5
'S'	5.50		2.43	
't'	2.74		6.91	

found significant at .05 level for df=5 from Table-D.

Age group - 5-6 years

	Solids		Liquids	
	Normals	C.p.	Normals	C.p.
Mean	54.3	35.6	28.2	17.6
'S'	5.28		4.17	
't'	4.59		3.48	
	significant at .01 level for 6 df		Significant at .05 Level and not at .01 for 6 dB	

Age group - 6-7 years

	Solids		Liquids	
	Normals	C.P.	Normals	C.p.
Mean	56	45.79	31.2	24.77
'S'	2.15		2.51	
't'	6.38		3.19	
	Significant at.01 level		Significant at .05 level	

The above statistical data gives a clear picture of a significant difference between in terms of performance of the two major groups viz. normals and C.P. children. This implies that the performance of CP population is poorer to that of normals which could be due to poor scores as obtained on the following sub-skills.

1) Oral phase involvement such as (a) faulty imbibition and buccal closure due to deviant labial movement such as lip protrusion and retraction which was also reported in Hixon and Hardy(1964) study. Inadequate lip closure has also been found by Hoberman and Hoberman (1960); Ruther ford (1961); McDonald and Chance (1964). Excessing mouth opening was also reported by Crickmay (1981). (b) Mastication difficulty which could be attributed to

- Malocclusion also found by Crickmay (1981).
- Problems with lingual movements such as restricted tongue movements (stark, 1985); Inability to lateralize and crush the food item also found (Logeman (1986); Retention of food towards one side of the cavity due to weakness of lingual musculature which arealso reported by Steefel (1981); Swallowing being initiated with food spread out throughout the oral cavity (Logeman, 1986).

c) Inadequate mandibular movement including

- bite reflex (Palmer, 1947; Crickmay, 1981; Scherzer and Tscharnanter, 1982).

- absence of chewing reflex (Crickmay, 1981; Stark, 1985).
- slow and sluggish sawmovement (Stark, 1985).

2) Deviant oral swallow pattern may be attributed to

a) Loss of precision in oral function (Strang and Thompson, 1958; Shelton, Haskins and Bosma, 1959; Bloomer, 1963).

b) Tongue thrust swallow (Palmer, 1948; Hardy, 1983; Fletcher, 1970).

c) Accumulation of food in buccal cavity also known as parking bolus as described by Jones (1979).

d) Accumulation of food on the tongue due to reduced lingual movement also stated by Logeman (1986).

e) Peace meal swallow due to fear of choking was also found which conforms to Logemann (1986) study.

f) Assistive head tilts which was used as a compensatory mechanism during bolus manipulation, and swallowing to avoid spillage which again conforms to Mavinkere and Sivanathan (1980) study.

g) Drooling - a commonly observed problem faced by the CP population also conforming to Stark (1990) study.

h) Sucking behaviour which is affected due to lack of Up closure (Hoberman and Hoberman, 1960} Westlake and Rutherford, 1961; Mc Donald and Chance, 1964) lack of velopharyn-

geal closure (Netsell, 1969); absence of sucking reflex as in Crickmay (1981) study.

3) Pharyngeal/laryngeal involvement:

- Reduced laryngeal elevation during swallowing (Logemann, (1986).
- Weakened swallow reflex, absence of ga reflex which was also found by sittig(1951); Mysak (1963); Steefel (1981) and others.

II.A(ii): Performance of speech activities by CP children:

Speech performance in general is also found to be lowered in CP group compared to normals. This could be attributed to

- faulty articulatory maneouvering especially of tongue, jaw and lips.
- malocclusion such as over bite which was a common feature in the CP group.
- other deviancies of dentition such as missing teeth which led to lisping of sounds; and distorted production of /s/ sound.

Out of the 32 Cp children tested, following were the persentile scores as sub-skills under speech activity who scored poorly.

Subskills	Percentage of subjects (%)	
	Correct pro-duction	Incorrect pro-duction
Lip sounds	77	23
Jaw sounds	76	24
Velopharyngeal sounds		
- /m/ /n/	74	26
- /k/ /g/	70	30
/t/ /d/	69	31
/s/	46	54
/r/	44	56

From the above data one can infer that more simpler the speech motor act, the better the performance of the cerebral palsy population. As the speech motor act becomes more and more complex requiring a complex neuromuscular control over their speech musculature, more the poorer the performance of CP population. This finding is in accordance with Wolff(1979) findings.

II.A(iii) Performance of non-speech activities by CP children:

The non-speechactivities being a voluntarymotor act, in general, it was found to be performed poorly compared to normals. Among the 34 non-speech items, the following were

the percentage of CP population who scored poorly for the non-speech activities.

Subskills	Percentage of subjects	
	Correct production	Incorrect production
Lip function	57	43
Jaw function	91	9
Velopharyngeal function	66	34
Tongue function	44	56

This can be attributed to the complexity of the movement which requires finer control over the articulators and also the familiarity of the task which was lacking in this group. Poor performance of lip function may be due to -circum oral tension? -deviation of lips towards one side at rest; -flabby lips.

Poor jaw performance can be attributed to -

- Jerky movements of jaw
- Jaw deviation to greater side of involvement
- Slow and sluggish movements and poor velopharyngeal skills attributed to inadequate velopharyngeal closure resulting in poor inter-oral pressure.

Again the poor tongue function may be due to -

- restricted tongue movements.
- sluggish or involuntary movements of the tongue.

In general a five control over oral musculature is lacking in this population which have led to poor performance in the 3 motor skills. Thus deviating from norms.

II.B(i) Correlation between the 3 motor skills within each subgroup of cerebral palsy.

Product moment correlation by Carl Pearson was used to find the correlation coefficient. The results are tabulated as follows:

Spastics		
Skills		r
Speech	Feeding	.89
Speech	Non-speech	.78
Non-speech	Feeding	.60

Athetoids		
Skills		r
Speech	Feeding	.90
Speech	Non-speech	.94
Non-speech	Feeding	.84

Mixed		
Skills		f
Speech	Feeding	.84
Speech	Non-speech	.40
Non-speech	Feeding	.62

A high correlation between the speech and feeding skills within each subgroup indicates that with a fall in performance of speech skill, the feeding act is also affected and vice-versa. This was evident through findings such as poor articulation exhibited by subjects for /p / and/ap/, also exhibited poor performance on the act of clearance with lips alone; lip closure during chewing; labial pursing to prevent spillage; imbibition of liquids by placing glass between lips and degree of lip closure to hold straw between lips. This observation was found to be universal in all the 3 sub-groups.

This observation supports the findings of Mysak (1959); 1963; 1968) Sheppard (1964) study which stated that if infantile oral feeding reflexes persist in a CP individual it may lead to speech defects too.

A high correlation coefficient between speech and non-speech except in mixed subgroup is again in support of Netsells (1986) hypothesis that the 2 functional components of the same anatomic substrate may not be totally independent of each other. From the present study there are evidences indicating that a speech skill which requires pursing of lips is affected if the non speech pursing is not developed or vice-versa. Similarly, in subjects where a speech skill of

production of /r/ is affected, a simultaneous defect in the production of non-speech skill such as trill production is seen.

	Non-speech	Speech
1.	Trill production	/r/
	88%	52%
2.	Pursing lips	/ap/
	24%	24%

Such strong support for a positive relationship between the two skills were found to be in line with Foerester (1951); Stark (1985)study.

Correlation between feeding and non-speech skills as compared to other two cognate was comparatively low. Though there are no evidences in literature regarding the relationship between these 2 skills, the present study evidenced that 48% of the population exhibited chewing problem, cut of which 16% exhibited poor non-speech chewing movements.

IIB.(ii): Comparison between the speech, non-speech and feeding skills across each of the sub-group using 't' test formula revealed the following results.

Spastics vs athetoids

	Speech	Non-speech	Feeding
'S'	25.64	17.46	16.25
't'	1.20	0.32	0.02

No significant differences between the two sub-groups (spastics and athetoids) across the 3 skills at either .05 or .01 level for 23 df.

Spastics vs mixed

	Speech	Non-speech	Feeding
'S'	4.79	15.97	15.96
't'	.51	.58	.81

No significant difference between the 2 sub-groups(spastlcs and mixed) across the 3 skills at either .051 or .01 level for 23 df.

Athetoids vs mixed

	Speech	Non-speech	Feeding
'S'	25.1	16.36	12.03
't'	1.1	0.76	0.86

No significant difference at either .05 or .01 level for 12 df across the 2 sub-groups (athetoids and mixed) for either of the 3 skills. The above statistics reveals that in terms of performance of the 3 motor skills, the 3 sub-groups performed almost similarly. Hence ASCP can be used for assessment of CP cases in general irrespective of the sub-groups.

C. Correlation between the solids and liquids in the 3 sub-groups

Spastics

	Solids		Liquids
Mean	45.61		25.83
's'.D.		3.09	
't'		6.40	

This data gives no significant difference at either .05 or .01 levels for df 34.

Athetoids

	Solids	Liquids
Mean	46.16	25.70
'S'.D.	5.83	
't'	6.57	

Not significant at either of the leveles for df 13.

Mixed

	Solids	Liquids
Mean	50	27.28
's'.D.	7.27	
't'	5.90	

Not significant at either of the 2 levels for 13 df.

The above data reveals no significant differences at either .05 or .01 level among the performance of feeding act for solids and liquids in either of the 3 groups.

This implicates that a subject who scores poorly on feeding of solids will also perform poorly on feeding of liquids and vice versa.

III. Reliability check:

Test retest reliability method was adapted to determine the agreement between two sets of scores of the examiner after

administering the scale to assess C.P. subjects with a gap of one month.

The significant difference between the two means, s was found tobe 1.96 which is not significant at either .05 or .01 level at 8 df. which implies ASCP is a reliable test.

IV. Establishing cut off scores:

In any assessment scale the cut off scores to demarcate the pathological group from the normals is required. In attempt was made by converting the scores for the 3 skills into percentile ranks for each age agroup ranging from 4 years to 17 years with one year interval is 4-5? 5-6,....17-18.

4-5 years

Speech		Non-speech		Feeding	
Scores	PR	Scores	PR	scores	PR
73	83.3	86	8333	74	83.3
51	50	53	50	63	50
33	16.67	51	16.67	41	16.67

5-6 years

Speech		Non-speech		Feeding	
Scores	PR	Scores	PR	Scores	PR
99	83.3	80	83.3	69	83.3
79	50	62	50	49	50
33	16.67	53	16.67	40	16.67

6-7 Years

Speech		Non-speech		Feeding	
Scores	PR	Scores	PR	Scores	PR
97	93.75	87	68.25	77	81.25
96	81.26	89	81.25	73	56.25
91	68.75	62	37.5	72	37.50
90	56.25	84	6.25	74	68.75
88	43.75	91	93.75	78	93.75
71	31.25	62	37.50	72	37.50
33	12.50	56	18.75	58	6.25
33	12.50	34	6.25	65	18.75

9-10 Years

Speech		Non-speech		Feeding	
Scores	PR	Scores	PR	Scores	PR
99	100	100	83.3	92	83.3
99	100	73	50	88	50
33	16.66	56	16.66	45	16.66

10-11 years

Speech		Non-speech		Feeding	
Scores	PR	Scores	PR	Scores	PR
99	83.3	81	83.3	87	83.3
97	50	53	16.6	83	50
95	16.6	71	50	66	16.6

13-14 years

Speech		Non-speech		Feeding	
Scores	PR	Scores	PR	scores	PR
97	87.5	54	37.5	79	62.5
96	62.5	76	87.5	86	87.5
67	37.5	74	62.5	65	37.5
35	12.5	40	12.5	51	12.5

14-15 years

Speech		Non-speech		Feeding	
Scores	PR	scores	PR	Scores	PR
99	83.3	97	83.3	96	83.3
97	50	54	16.6	81	16.6
95	16.6	78	50	88	50

16 - 17 years

Speech		Non-speech		Feeding	
Scores	PR	Scores	PR	Scores	PR
97	66.66	87	83.3	79	16.6
97	66.66	53	16.67	84	66.6
96	16.66	77	50	84	66.6

Based on the above persentile rank (PR) conversion of the scores one can establish norms for each age group. A PR of 50 would indicate an average performance and a PR above 50

is above average and APR below 50 would indicate a below average performance. The performance of a subject falling within the age group of 4-5 years with a PR of 16.67 across all the 3 skills, can be classified as below average performance. A PR of 50 in 4-5 years age group can be considered average or borderline CP and a PR of 83.3 as near normal performance.

It is also evident that with advancing age the scores have also increased ie for PR of 83.3 the scores expected are 73 at 4-5 years age range and 99 at 5-6 years age range. This again exhibits a developmental trend across the age range.

Qualitative analysis:

1. Speech activities - A qualitative analysis of the respiratory and laryngeal system reveals that there is a definite improvement in performance of both functions with age, though in the CP population there is a developmental lag. The study by Eguchi and Hirsh (1969) is relevant here because they state that by 8 years of age the VOT, which is a part of laryngeal function is stabilized in normals while in CP Children stabilization is not achieved. Also the oromotor activities for sequencing and coordination is impaired which ean be attributed to the neuromuscular in coordination. The incoordinated movements uniformly stow down and the subjects fail to voluntarily speed up. In general, as viewed by Netsell and Kent (1975) and (1976), their movement are ½ to 2 times as slow as those of normals.

2. Feeding - During the imbibition of liquids using straw the following observations were made:

i) Introduction of liquids at the centre of the tongue - Deviancy in terms of performance could be attributed to weak lip closure to hold the straw.

ii) Tongue thrust during continuous sucking if present, was indicative of persistence of primitive pattern or pathological features, a sequelae of nerouv system involvement

iii) Angle of introduction of liquid using straw - the CP population positioned the straw more vertically at 25^{o} angle which was deviant from the normal angle which is 45^{o} as stated by Jyothi (1990). This deviant behaviour could be attributed to weak sucking ability.

Also it was noted that scores as obtained using 1.8 cm diameter straw was lower than 1.3 cm diameter straw which goes with the laws of liquid motion mechanics in that the resistance is greater with greater diameter, requiring greater application of pressure to suck.

iv) Gulp: Variability in the amount of fluid in ml at which gulp was auditorily detectable was noticed. In general, the amount of liquid in ml was found to increase with age as in normals. The amount approximately varied from 4 to 12 ml

which can be accounted for on the basis of the swallow reflex being very weak in CP population. This also can be attributed to anatomical variation in size of the oral cavity, permitting retention of greater volume of fluid in the larger cavity as stated by Jyothi (1990).

Limitations:

1. For each group subjects could not be made available.
2. Equal number of subjects under each age group could not be selected.
3. Since the raw scores for normals for speech and non-speech performance could not be made available a quantitative comparision between normals and CP performance for the two skills speech and non-speech could not be completed.
4. The percentile ranks from age range 4-17 years for CP population were limited because of availability of limited number of subjects.

SUMMARY AND CONCLUSIONS

The present study was aimed at developing an assessment scale for cerebral palsied (ASCP). The test consisted of 3 major motor skills the speech, non-speech and feeding skills.

The test protocol is a compilation of 2 studies as conducted on normals by Kavitha (1989) and Jyothi (1990) on speech, non-speech and feeding skills respectively. It was administered on 32 CP children in the age range 4-17years. Out of 32,18 were diagnosed as spastics, 7 as athetoids and 7 as mixed types of cerebral palsy.

The speech, non-speech and feeding skills consisted of subskills. Each subskills were rated subjectively by a single test with scores 3, 2 or 1. Scoring was based on the performance of the children. A score of 3 was fixed for in adult like performance and 2 for just emerging adult like response and l for totally deviant response. Those sub-skills which described based on the quality of performance.

The children were examined in their respective classrooms relatively quite environment. Appropriate statistical Measures were applied to analyze the raw scores obtained by the cerebral palsy individuals. The results obtained are as follows:

1. Like their normal counterparts cerebral palsied population too exhibit a developmental trend for speech, non-speech and feeding skills.
2. Performance of CP children when compared to normals for speech, non-speech and feeding skills is poor.
3. A high correlation between the 3 motor skills within each subgroup of cerebral palsy was found.
4. A comparision between the speech, non-speech and feeding skills across each of the sub-groups revealed no difference in performance.
5. Comparision between performance on deglutition for solids and liquids in the 3 sub-groups revealed no significant difference in performance.
6. Percentile ranks were computed to establish norms for different age groups (Table depicted in IV)
7. A test-retest-reliability check was carried out which revealed a high intra judge reliability.
8. Qualitative analysis gave a variable picture about performance of the CP population.

The ASCP thus can be used as a diagnostic and therapeutic tool to assess the abilities of the cerebral palsied individuals in speech, non-speech and feeding motor skills.

Future suggestions:

1. Larger CP population to achieve standardization.
2. Subgroups could be increased in numbers like spastics, athetoids, ataxics, flaccids etc. and could be matched.
3. To use the scales to compare the pre and the post treatment session thereby cross checking the efficacy of the scale.
4. Provide a kit with standardized and improvised materials to test the major skills of the scale.

BIBLIOGRAPHY

Zbbs, J.H., Netsell, R. (1973): "An interpretation of jaw acceleration during speech as a muscle forcing function", JSHR, 16, 175-200, 1975.

Abbs, J.H. (1981): "Neuromotor mechanism of speech production" in"Speech evaluation in medicine" (ed.) by J.K Darby, Grune and Stratton Inc, New York, 1981.

Abbs, J.H., and Kennedy, J. (1982): "Neurophysiological processes of speech movement control" in "Speech, language and hearing", N.J. Lass, et al Saunders, Philadelphia, 1982.

Akamine, J. (1962): Cited in "Tongue thrusting:A clinical hypothesis", by J.M.Palmer, JSHD, 27, 323-333, 1962.

Ardran, G.M., and Kemp,F.H. (1955): Cited in "Deglutition and related speech performance in normals and spastic cerebral palsied", by Jyothi(1990. An unpublished Dissertation submitted as part fulfilment of Masters Degree in Speech and Hearing, University of Mysore.

Atkinson, M., Kramer, P,Wyman,S.M., and Ingelfinger, F.J. (1957): Cited in "Deglutition and spastic cerebral palsied" by Jyothi (1990), An unpublished Dissertation submitted as part fulfilment of Masters Degree in Speech and Hearing, University of Mysore.

Barrett, R.H. (1961): Cited in "Deglutition and spastic cerebral palsied", by Jyothi (1990), An unpublished Dissertation submitted as part fulfilment of Masters Degree in Speech and Hearing, University of Mysore.

Bloomer, H.H. (1953): "Observations of palatopharyngeal movements in speech and deglutition" JSHD, 230-246, 1953.

Byrne, Margaret(1959): "Speech and language development of athetoid and spastic children", JSHD, 24, 231-240, 1959.

Cleall, J.F.,(1965): Cited in "Deglution and related speech performance in normals and spastic cerebral palsied" by Jyothi (1990), An unpublished Dissertation submitted as part fulfilment of Masters Degree in Speech and Hearing, University of Mysore.

Crickmay, M.C. (1981): "Speech therapy and the bobath approach to CP". Charles C Thomas, Springfield, Illinois, USA, 1981.

Dissimoni, F.G. (1974): " Influence of vowel environment on the duration of consonants in the speech of 3, 6, and 9 year old children", JASA, 46, 362, 1974.

Egnchi,S, and Hirsh, I.J. (1969): "Development of speech sounds in children", ACTA Otol. Suppl. 257-261, 1969.

Fletcher, S.G., Casteel,R.L., and Bradley,D.P. (1961): "Tongue thrust swallow, speech articulation and age", JSHD, 26, 201-208, 1961.

Fletcher, S.G.(1970): "Processes and maturation of mastication and deglutition", ASHA Report, 5, 92-99, 1970.

Foerester(1951): Cited by D.Weiss, and H.H.Beebe (1951): "The chewing approach in speech and voice therapy" S.Karger Publishers, Basel, New York, 1951.

Folkins,J.W., and Abbs, J.H., (1975): "Lip and jaw motor control during speech responses to resistive loading of the jaw", JSHR, 28, 207, 1975.

Folkins,J.W., and Abbs,J.H. (1982): "Lip and jaw motor control during speech responses to resistive loading of the jaw", JSHR, 18, 207, 1982.

Froeschels, E.,(1943)LA"Contribution to the pathology and theraps of dysarthria due to certain cerebral lesions". JSP, 8, 301-321, 1943.

Gallender, D. (1979): "Eating handicaps -illustrated technique for feeding disorders", Charles C Thomas, Springfield, Illinois, USA, 1979.

Granit, R. (1977)L Cited in "Speech motor control" by Netsell R. Werner-Gren Symposium series, 36, Ed. by S.Grillner, B.Lindblom, J.Lubker, A.Person, Pergamon Press, Stockholm, 1981

Guyton, C. (1986): Cited in "Deglutition and related speech performance in normals and spastic cerebral palsied" by Jyothi (1990): An published Dissertation submitted as part fulfilment of Masters Degree in Speech and Hearing, University of Mysore.

Hardy, J.C., Raymond, R.R., Spriestersbach, D.C. Jayapathy, B. (1961): "Surgical management of palatal paresis and speech problem in C.P.: A preliminary report" JSHD, 24, 320-325, 1961.

Hixon, T., and Hardy, J. (1964): "Restricted mobility of the speech articulators in cerebral palsy", JSHD, 29, 293-306, 1964.

Humphrey and Reed (1983): Cited in "Speech Sciences Recent Advances" Ed.by Daniloff, R.G., London, Taylor and Francis,1983.

Ingram, T.T.S. (1962): Cited in "Deglutition and related speech performance in normals and spastic cerebral palsied" by Jyothi (1990), An unpublished dissertation submitted as part fulfilment of Masters Degree in Speech and Hearing, University of Mysore.

Jones, R.M.(1989): "Physiology of the mouth, pharynx and oesophagus" in "Scott Brown's diseases of ENT 1, Basic sciences (Ed.5) ed.) by J.Ballantyne and Graves, J. Butterworth and Co. London, 1989.

Kent, R.D., and Netsell, R., and Baver, L.L. (1979): "Cinema-diographic assessment of articulatory mobility in the dysarthrias", JSHD, 40,467-480, 1979.

Logemann, J.A. (1986): "Cited in "Deglutiion and related speech performance in normals and spastic cerebral pal-sied" by Jyothi,(1990)" An unpublished Disserta-tion submitted as part fulfilment of Masters Degree in Speech and Hearing, University of Mysore.

Love, R.J., Hagerman,E.L., and Taimi, E.G. (1980); "Speech performance, dysphagia and oral reflexes in C.P.", JSHD, 41, 59-75, 1980.

Lund, W.S.(1987): "Deglutition" in D.Wright (Ed.) Scott Brown's otolaryngology. Basic Sciences, Edn.5, Butterworth International, 284-295, 1987.

Magendie, (1816): Cited in "Deglutition" by S.S.Lund, in D.Wright (Ed.), 'Scott-Brown's otolaryngology: Basic sciences, Edn.5, Butterworth International, 284-295, 1989.

Mavinakere, A.(1984): Cited in Mavinakere, A. , Sivanathan, M. (1986), "Feeding problems in CP seen as modified skills"in papers presented at the second symposium on Cerebral palsy, Singapore, 1986.

Mavinakere, A., Sivanathan, M. (1986): "Feeding problems in cerebral palsy seen as modified skills" in Paper presented at the second symposium on Cerebral Palsy, Singapore, 1986.

McDonald, E., Chance, B.(1964): "Cerebral palsy", Englewood Cliffs, Prentice Hall, Inc, New Jersey, 1964.

Mendel, (1962): Cited in "Tongue thrusting A clinical hypothesis" by Palmer, J.M., JSHD, 27, 323-333. 1962.

Milner, E. (1976): "CNS maturation and language acquisition" in H.Whitaker, and H.A. Whitaker (Eds.), Studies in Neurolinguistics, 1, Academic Press, New York, 31-102, 1976.

Moll, K.F. (1969): "A cinefluorographic study of velopharyngeal function in normals during various activities". Cleft palate, J. 2, 112-122, 1969.

Mysak, E.D. (1960): "Cited in "Dysarthria and Oropharyngeal reflexology: A review", by Mysak, E.D.(1963), JSHD, 28(3), 252-260, 1963.

Mysak, E., "CP speech syndromes", in Handbook of speech pathology and audiology". Ed. by Travis, L.E., New York, Appleton Century-Crofts, 1971.

Netsell, R.,and Ronald (1969): "Changes in Oropharyngeal cavity size of dysarthric children", JSHR, 12, 646-649, 1969.

Netsell, R., (1969): "Evaluation of velopharyngeal dysfunction in dysarthria", JSHD, 34, 113-122, 1969.

Netsell, R., Abbs, J.H. (1977): "Some possible use of neuro-motor speech disturbance in understanding the normal mechanism" in 'Dynamic aspects of speech production', Eds. by Sawashima, M., Coope F.S.,Japan, University of Tokyo Press, 1979.

Netsell, R, (1986): "Neurobiological views of speech production and dysarthria", San diego, California, College Hill Press, 1986.

Palliard, J. (l960):"Restricted mobility of speech articulators in C.P" in Hixon, T.s., and Hardy, J.C., JSHD, 29, 293-306, 1964.

Palmer, J.M., Martin, F., and Osborn (1940): "Study of tongue pressures of speech defective and normal speaking individual", JSD, 5, 133, 1940.

Palmer, J.M. (1962): "Tongue thresting: A clinical hypothesis" JSHD, 2, 323-333, 1962.

Ray, H.G., Santos (1954): Cited in "Deglutition and related speech problems in normals and spastic cerebral palsied" by Jyothi, N. An unpublished dissertation submitted as a part fulfilment of Master Degree (Speech and Hearing), University of Mysore, 1990.

Robbins, J.A., Klee, T.(l987): "Clinical assessment of oro-pharyngeal motor development in young children", JSHD, 52, 271, 1987.

Rusell, (1984): Cited in"Feeding problems in Cerebral Palsy seen as modified skills" by Mavinakere A., and Sivanathan, M., papers presented at the Second symposium on Cerebral palsy, Singapore, 1986.

Saunders, J.B., Davis, C, Miller, F.E.(1951): "Deglutition and related speech performance in normals and spastic cerebral palsied" by Jyothi, N. An unpublished Dissertation submitted as a part fulfilment of M.Sc., (Speech and Hearing), University of Mysore, 1990.

Scheibel, A. (1979): Cited in "Speech motor control and selected neurologic disorders", by Netsell, R in "Speech motor control", Wenner-Gren Symposium series, Vol.36, Eds. S.Grillner, B.Lindblom, J.Lubker, A.Persson, Pergamon Press,(1981.

Scherzer, A.L., and Tscharnuter, I. (1982): "Early diagnosis and therapy in cerbral palsy: A primer on infant developmental problems". Marcel Dekker Inc. Basel, New York, 152-159, 186-201, 1982.

Sharkey, and Folkins (1985): "Variability of lip and jaw movement in children and adults: Implication for development of speech motor control", JSHR, 28, 15, 1985.

Shelton, R.R., Brooks, A., and Youngstrom, K.A., "Articulation and Patterns of palatopharyngeal closure", JSHD, 29, 39, 1964.

Shelton, R., Brooks, A., and Youngstrom, K.A., (1965): Clinical assessment of palatopharyngeal closure". JSHD, 30, 37-43, 1965.

Sheppard, J.J., "Cranio-oropharyngeal motor patterns associated with Cerebral Palsy ,JSHR, 7, 373-380, 1964.

Sittig, E. (1951): "The chewing approach in speech and voice therapy"; Eds. D.A. Weiss, H.H. Beebe, S.Karger publisher, Basel, New York, 39-51, 1951.

Sokol, E.M. (1966): Cited in "Deglutition and related speech performance in normals and spastic cerebral palsied" by Jyothi, N.,An unpublished dissertation submitted as part fulfilment of M.Sc.Degree (Speech and Hearing) University of Mysore, 1990.

Stark, R.E., (1985): "Dysarthria in children" chap.6 in J.K. Darby, Speech and Language evaluation in neurology Childhood disorders, Grune and Stratton Inc, Orlando, San Diego, 185-217, 1985.

Steefel, J. (1981): Cited in "Deglutiton and related speech performance in normals and spastic Cerebral Palsied" by Jyothi, N., An unpublished dissertation submitted as part fulfilment of M.Sc., Degree (Speech and Hearing) University of Mysore, 1990.

Stevens, K.N. (1973): "Phonetic features and physiology of speech production" cited in Language production, B.Butterworth (Ed.) New York, Academic Press, 1980.

Strang, R.H.W., and Thompson, W.A.(1958): Cited in "Deglutition and related speech performance in normals and spastic cerebral palsied" by Jyothi, N. An unpublished dissertation submitted as part fulfilment of M.Sc,degree (Speech and Hearing), University of Mysore, 1990.

Studdert-Kennedy, M. (1980): Cited in "Speech motor control", Wenner-Gren Symposium series,Vol.36, Eds. S.Grillner, B.Lindbloom, J.Lubker, A.Persson, Pergamon Press, Stockholm, 1981

Subtelny, J. Mestre, J. and Subtelny, J (1964):"Comparative study of normal of defective articulation of /s/ as related to malocclusion and deglutition" JSHD, 29, 269-285, 1964.

Vitali, G.J. (1986): "The test of oral structures and functions (TOSF)" New York, Slosson, Education Publication Inc, 1986.

Ward, M.M.,Malone, S.H.D., Jann, G.R., and Jann,H.W. (l961): Articulation variations associated with visceral swallowing and malocclusion",JSHD, 26, 334-341, 1961.

Weinberge, B.,(l970): "Deglutition - Areview of related topics" in Speech and Dento facial complex, ASHA Report 5, 116-131, 1970.

Westlake, H.,(1962); Hixon, T.s., and Hardy, J.C.(1964): Restricted mobility of speech articulators in Cerebral palsied, JSHB, 29, 293-306, 1964.

Whitman, D.F., and Jann,H.W.(1951): Cited in "Deglutition and related speech performance in normals and spastic cerebral palsied" by Jyothi, N. An unpublished dissertation submitted as part fulfilment of M.sc., degree (Speech and Hearing), University of Mysore, 1990.

Whitaker, H. (1976): "Neurobiology of language", in E.Carterette, and M.Friedman (Eds). Handbook of perception, 7, Language and Speech, Academic Press, New York, 121-144, 1976.

Wolff (1979): Cited in "Deglutition and related speech performance in normals and spastic cerebral palsied", Ay Jyothi, N. An unpublished dissertation submitted as part fulfilment of M.sc, degree (Speech and Hearing), Universityof Mysore, 1990.

APPENDIX-A

Name: Sex:

Age:

Diagnosis:

History pertinent to feeding:

Oral structure examination for appearance.

a) Mandibular function Yes/no
- Elevation Yes/No
- Depression Yes/No
- Normal/Micrognathia-Macrognathia Yes/No
- Symmetry/Asymmetry Yes/No
- Any other deviancies

b) Dentition Yes/No
- Correct occlusion Yes/No
- Missing teeth Yes/No
- Normal spacing Yes/No
- Open bite Yes/No

(i) anterior
(ii) lateral

- Any other deviancies

c) Gingiva
- Normal appearances Yes/No
- Hypertropy Yes/No
- Tenderness Yes/No

d) Labium Yes/No
- Normal occlusions Yes/No
- Involuntary movement Yes/No
- symmetry Yes/No
- Spastic grin Yes/No
- Any other deviances eg. open mouth Yes/No

e) Lingual appearances Yes/No
- Macroglossia Yes/No
- Microglossia Yes/No
-Tongue thrust Yes/No
- Pointedness of tongue lip Yes/No
  ie. no tongue tie
- Involuntary movements Yes/No
- Any other deviances.

f) Palate Yes/No
- Normal Yes/No
- High arched Yes/No
- Low arched Yes/No

g) Oral hygeline
- Poor Yes/No
- Fair Yes/No
- Good Yes/No

h) Dooling
- severe Yes/No
- Moderate Yes/No
- Mild Yes/No
- Absent Yes/No

EVALUATION OF FEEDING FUNCTION

DEGLUTITION ACT: EATING

Imbibition	Activities observed	Rating/scoring	Remark)
*Clearance task	Clearance with lips alone	3	
	Clearance with lips+teeth	2	
	Clearance with teeth with lips apart or inability to clear the food material.	1	
*Task efficiency	Good with no reminant food material on spoon clearance	3	
	Fair, with minimal reminant of food material on spoon clearance	2	
	Poor, with residue present on spoon on inability to clear the food material off the spoon	1	
Biting:			
* Dentition between which food is inter-spersed during up & down man-dibular movement against the maxilla.	Biting with incisors or canine when employed voluntarily in the initial phase of mastica - tion.	3	
	Weak bite with either indent formation or minimal pulveri-zation, delayed response post bolus placement.	3	
	Biting at a reflexive level (bite reflex) in the initial masticatory phase, this being continue into the chewing phase.	1	
Transfers food & retains food on molars.	Effectively transfers the food and retains.	3	
	Fairly well with partially diffused/spread of food to other regions other than molars.	2	
	Complete failure to transfer food and retain it on molars.	1	

Chewing:

*Chewing sound + Pulverization of rice.	No accompany sound Minimal sound marked sound	3 2 1
* Labial movement + Circum oral tension	Predominantly closed both labial opening and closure Marked labial opening ± clumsy labial movement.	3 2 1
* Detection of food positioning.	Difficulty in detection to very minimal labial pursing to retraction. Minimal check bulge + minimal labial pursing + detection through open mouth. Bucco labial tension + lip purse + check bulging + through open mouth.	3 2 1
Food goes to roof of mouth		Yes/No
Food held on tongue until it softens		Yes/No
Food collects in the anterior nestibule		Yes/No
Food collects in the check cavity		Yes/No
* Spillage	Absent Minimal Marked	3 2 1

*Mandibular arc traversed	Rotatry/side to side	3
	Minimal deviation from rotatory or lateral types, with increased range of movements.	2
	Marked deviation from the 2 typist deviation to oneside during chewing + jaw thrusting + bite	1
* Lingual move meats disso ciation of lingual from mandi bular move ment and variation in tongue positioning	Normal tongue placement within the oral cavity.	3
	Tongue thrusting/fronting with disso-ciation from mandibular movement + bolus placed anteriorly in the oral cavity with/without minimal spillage.	2
	No lingual dissociation from mandi-bular movement + marked tongue pro-trusion + variation in tongue move-ment with no maneuvering to shift food to grinding surface of the dentition.	1
* Masseter contraction	Normal contraction	3
	Weak contraction	2
	Absent	1
* Chewing efficiency	Good with fine particles	3
	Fair with medium size	2
	Poor with large size	1
* Labial sur-face clea-rence in presence of spillage	Labial pursing + minimal lingual protrusion $\pm$ hand usage.	3
	Lips versus teeth $\pm$ lingual protrusion	2
	Lips versus teeth + hand/finger usage $\pm$ tongue protrusion	1
Swallowing		
* Anterior seal (tongue posture)	Cohesive bolus formed	3
	Contours of bolus not marked, with minimal diffused food from the main bolus.	2

	Bolus present elsewhere (sub-lingually/adhered to palate/ postr. pharyngeal wall)	1
*Laryngeal elevation	Detectable laryngeal elevation	3
	Minimal laryngeal elevation	2
	No detectable laryngeal elevation	1
* Masseten contraction	Present	3
	Weak	2
	Absent	1
* Circum oral tension	Negligible COT + labial partition easily achieved.	3
	Minimal lesion + slight difficulty in lips parting.	2
	Marked tension + difficulty in parting.	1
* Lingual position with respect to - circumoral tession - Messeter contraction - Laryngeal elevation	Not usually evident	3
	Placed behind incisors or between the dentition without spillage	2
	Placed between the dentition with food spillage.	1
* Mandibular stability	No detectable displacement(only) muscular movement in sub-mandibular region).	3
	Slight displacement	2
	Marked displacement	1
Gulp (presence/ absence and amount of solid for which gulp was noted)	Pattern to be noted but no rating	

* Post swallow intra oral examination	Clear, with no residual food in the oral cavity - full meal swallow	3
	Minimal residue (full meal swallow)	2
	Marked residue/piece meal swallow for the limited quantity of food provided.	1
Swallows with back teeth closed.		Yes/No
Swallows with tongue tip at alveolar ridge.		Yes/No
Needs tactile stimulation to trigger swallowing		Yes/No
Swallowing elicited from apex.		Yes/No
Drinking		
Imbibition		
a)Through pouted and unpouted glass.		
* - Position of the glass.	Glass rim placed between the lips	3
	Placed between lips and teeth $\pm$ on tongue	2
	Rim placed between teeth with lips parted or unable to imbibe	1
* - Degree of lip protrusion.	No protrustion	3
	Minimal protrusion	2
	marked protrusion/no protrusion due to restricted labial mobility	1

* Check indrawing	No check indrawing	3
	Minimal indrawing	2
	Marked/no indrawing due to restricted bucco labial mobility	1
Tongue thrust		Yes/no
Amount of water consumed in 3 trials(in ml) (note)		...ml
Through straw		Yes/No
Recognize straw		Yes/No
Liquid introduced at the centre of tongue.		Yes/No
Bites straw		Yes/No
* Degree of lip closure.	No labial tension	3
	Minimal tension	2
	Marked labial closure or no tension in presence of flabby lips	1
Tongue thrust during continuous sucking		Yes/No
Uses straw in glass at 25^{o} angle.		Yes/No
Uses straw in glass at 45^{o} angle		Yes/No
Swallowing		
* a)Anaterior seal whether	Adequate seal	

-labial	Minimal fluid leakage	3
-linguadental	Absent/inadequate lingua dental	2
-lingua alveolar	Alveolar seal with fluid loss	
Amount of water in ml. for which anteri seal could be obtained	Note	1
* Posterior seal	Adequate seal	3
-To maintain lingua velar contact for 1 minute by holding water with head tilted backwards slightly	Minimal fluid leakage	2
	Inadequate seal with fluid loss	1
* Swallow reflex straight head + mouth open + water introduced horizontally.	Present	3
	Weak	2
	Absent	1
* Laryngeal elevation	Detectable laryngeal displacement	3
	Minimal elevation	2
	No detectable elevation	1
* Masseten contraction	Present	3
	Weak	2
	Absent	1
* Circumoral tension	Negligible	3
	Minimal	2
	Marked	1

* Lingual position	Not visually evident	3
	Placed between incisors or b/w dentition without food spillage.	2
	Placed between the dentition + spillage.	1
* Mandibular stability	No detectable mandibular displacement with sub-mandibular muscle movement being present.	3
	Slight mandibular displacement	2
	Marked displacement	1
Gulp minimum amount of water to elicit an audible gulp		Yes/No

Evaluation of non-speech motor activities

Structure	Activities	Scoring (3)(2)(1)	Remark
Lip	- Rounding		
	- Retraction		
	- Alternate protrusion and retraction		
	- Closing lips from open position		
	- Pausing lips		
	- Side to side movement of lips which is closed		
	- Protrusion		
	- Opening and closing lips with clenched teeth		
	- Upper teeth on lower lips		
	- Lower teeth on upper lips		
	- Tongue out of mouth test		
Jaw	- Elevate mandible (open wide)		
	- Depress mandible		
	- Elevate and depress		
	- Chewing		
Velopharynx	- Blowing through nose with mouth closed		
	- Signing through mouth		
	- Blowing (through mouth) the candle		
Tongue	- Volutional extension		
	- Apex to left corner of mouth		
	- Apex to right corner of mouth		
	- Flattening		
	- Retracting		
	- Alternate retracting and protrusion		
	- Elevation of apex to alveolus		
	- Contacts of tip with midpalate		
	- Contacts of tip with velum		
	- Lateral movement		
	- Touching blade to alveolus		
	- Touching body to midpalate		
	- Flapping tongue against lower teeth		
	Trill production (rrr....)		
	- Raise and lower tongue against upper and lower lip.		
	- Curl tip towards floor of the mouth.		

Evaluation of speech motor activities:

Structare	Activities	Scoring (3)(2)(1)	Remarks
1. Lip	/a/		
	/i/		
	/u/		
	/au/		
	/u-i/		
	/ua/		
	/ao/		
	/pa/		
	/b/		
	/m^/		
	/f^/		
	/o/		
2. Jaw	/u/		
	/pa/		
	/ba/		
	/ma/		
	/a-i/		
3. Velopharynx	/m^/		
	/n^/		
4. Tongue	/g ^/		
	/k^/		
	/r/		
	/l/		
	/t/		
	/d/		
	/s/		
	/ /		
	/t / /d7/		
	/ṣ/		
	/ṭ/		
	/ḍ/		
5. Respiration and Laryngeal system			
i) Diadachokinetic rate:	/p//t//k/		
	/t//P//k/		
	/k/ /p/ /t/		
	/p/ /k/ /t/		
	/t/ /k/ /p/		
	/k/ /t/ /p/		

ii) Breath group:

/namma mane jalli, obalu cikka hudugi iddale/

iii) Pitch range Phonate /a/

(i) Ascending
(ii) Descending

iv) Loudness range Phonate /a/

(i) Ascending
(ii) Descending

v) Prolonged /s/ and /z/