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AIISH Tests & Therapy Resources Series

ASSESSMENT PROTOCOL FOR ORAL MOTOR, ORAL PRAXIS AND VERBAL PRAXIS SKILLS IN MALAYALAM SPEAKING CHILDREN WITH CHILDHOOD APRAXIA OF SPEECH AND SUSPECTED APRAXIA OF SPEECH (APOOV-M)

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All India Institute of Speech and Hearing

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Rhea Mariam Korah, R. Manjula

All India Institute of Speech and Hearing

Manasagangothri, Mysuru, India-570 006

E-mail: director@aiishmysore.in

Website: www.aiishmysore.in

Printed in India by the All India Institute of Speech and Hearing, Mysuru, Karnataka

Cataloging-in-publication data
Rhea Mariam Korah,
APOOV-M/by Rhea Mariam Korah, & R. Manjula
46 p.; 24x17cm.
I. R. Manjula. II Title.
[Subject Headings]
Class no. – dc23

ISBN: 978-93-94809-03-1
Product Code:TT-46-En-P-P-1
Price: Rs. 500/-

This work is compiled as a part of an AIISH Funded Research Project on **Product Development of Useful Products of Research carried out at AIISH** by a research team comprising:

1. Dr. Prashanth Prabhu P., Assistant Professor in Audiology as Principal Investigator,
2. Dr. Priya M.B., Lecturer in Speech Sciences as Principal Investigator,
3. Dr. Shijith Kumar C., Library and Information Officer as Co-Investigator

&

4. Ms. Merin Susan Mathew and Ms. Rekha D., as Research Officers

PREFACE

The All India Institute of Speech and Hearing (AIISH) is a premier organization in the country mandated for human resource development, research, clinical care and public education in the field of communication disorders. The institute promotes research by giving particular emphasis to clinically relevant applied research on causes, control and prevention of communication disorders, assessment and treatment issues as well as the testing and refinement of new technologies for the speech, language and hearing disorders. A considerable number of tests, word lists and therapy materials are being created as by-products of such research works carried out as postgraduate and funded research. However, these valuable resources are mostly unused as they are not readily accessible for use in the clinical settings. Hence, a project has been initiated to identify, reorganise into suitable formats and publish clinically useful research works carried out at AIISH as independent books, and make them useful for the practicing audiologists and speech-language pathologists working across the country in different setups for the evaluation and management of communication disorders.

All the tests/ therapy materials that are prepared under this project are published under a series titled "***AIISH Tests & Therapy Resources***". The project team comprises: Dr. Prashanth Prabhu P., Assistant Professor in Audiology (Principal Investigator), Dr. Priya M.B., Lecturer in Speech Sciences (Principal Investigator), Dr. Shijith Kumar C., Library and Information Officer (Co- Investigator) and Ms. Merin Susan Mathew and Ms. Rekha D (Research Officers).

This book titled **Assessment Protocol for Oral Motor, Oral Praxis and Verbal Praxis Skills in Malayalam Speaking Children with Childhood Apraxia of Speech and Suspected Apraxia of Speech (APOOV-M)** is an outcome of the effort in the above direction. It was originally developed by **Ms. Rhea Mariam Korah**, in partial fulfillment of her Master's dissertation under the guidance of **Dr. R. Manjula**.

Dr. M. Pushpavathi
Director, AIISH

AIISH: GENESIS AND GROWTH

The All India Institute of Speech and Hearing is a primer Institute in the country imparting training in the field of Speech & Hearing. Established on 9th of August 1965 as an autonomous organization, AIISH caters to manpower generation in the field, promoting research and providing rehabilitation services in the area. The Institute is located on a sprawling area of 39 acres (two campuses) in Mysore. The Institute registered as a Society under the Societies Registration Act XXI of 1860 (Punjab Amendment Act, 1957) and its functioning as an autonomous body under the aegis of the Union Ministry of Health & Family Welfare. Established primarily as training institute, it started training programs at postgraduate level in 1967 followed by B.Sc (Speech and Hearing) in 1968. The institute now offers three Diploma programs: Diploma in Hearing Aids and Ear mould technology, Diploma in training the Young Hearing Impaired, Diploma in Hearing, Language and Speech through distance mode; two graduate programs: Bachelors in Audiology, Speech and Language Pathology (B. ASLP) and B. S. Ed (Hearing Impairment); three Master Programs (M.Sc. in Audiology, M.Sc. in Speech- Language Pathology and M.S.Ed. in Hearing Impairment); two PG Diploma courses (PG Diploma in Forensic Sciences and Technology, Clinical Linguistics for SLPS); two doctoral programs (Ph.D. in Audiology and Speech-Language Pathology); and Post-Doctoral Fellowships. The institute also conducts short- term training and orientation programs for professionals in allied specialties.

The institute has been recognized as a Centre of Excellence in the area of deafness (WHO), as a centre for advanced research (UGC) and as a Science and Technology Institute (DST). The institute is affiliated to the University of Mysore for the award of degrees. The academic programs of the institute have the recognition of the Rehabilitation Council of India. The institute has also been recognized as a Nodal Center for the implementation of the National Program for Prevention and Control of Deafness, Ministry of Health and Family Welfare, Government of India as well as for generating manpower for the same. Owing to its academic and research excellence, the institute has been assessed and accredited by NAAC with 'A' grade . Also, it is an ISO 9001:2015 certified organization for its brilliance of quality. Furthermore, it has been recognized as College with Potential for Excellence by the UGC, and as a Collaborative Organization for the Rashtriya Bal Swasthya Karyakram (RBSK), a Govt. of India scheme under the Ministry of Health & Family Welfare. Also, the Institute is a Centre of Excellence in Communication Disorders and a Govt. of India recognized Disability Certification Centre.

The functioning of the institute is under the direction of the Executive Council with Hon'ble Union Minister for Health and Family Welfare as the Chairman and the Hon'ble Minister of Health and Family Welfare, Government of Karnataka as Vice- Chairman. The other statutory bodies of the Institute are the Finance Committee and the Academic Sub Committee.

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Introduction

Speech production is the process of converting one's thoughts and ideas into meaningful speech. It is governed by many factors, of which motor control of speech forms an important aspect. A developmental trend in speech motor control is supported by the concept of "speech motor age" proposed by some investigators. Speech motor age defines the early expressive speech of children as a sequentially acquired motor event consequent to neuronal maturation. 'Praxis' is a Greek word, which is used to describe the learned ability to plan, and carryout sequences of coordinated movements in order to achieve an objective, which could be a speech or a non-speech act. Praxis control is very important for speech production in terms of generation of articulatory postures and seriation of speech gestures.

In children with childhood apraxia of speech (CAS), the deficits in verbal praxis are primarily due to the inability to sequence or seriate muscle contractions, thereby leading to inaccurate control of skilled speech action sequences. The disruption of speech in apraxia is attributed to the disintegration of temporal schemata that aid in control of movement sequences, and spatial targets defined by a space coordination system of vocal tract. Because of these deficits/ disruptions, children with CAS exhibit various speech sound errors like metathetic, perseverative and anticipatory errors that may be related to the sequencing of sound elements and to reductions in the complexity of word shapes. A particular difficulty in the sequencing of phoneme elements is also present.

There is a paucity of tools available to identify and assess children with/at risk for non-verbal and verbal praxis breakdown, particularly in the Indian context. Banumathy (2008) developed a protocol for assessing oral motor, oral praxis and verbal praxis skills in Kannada speaking children with CAS and suspected apraxia of speech (sAOS) in the age group of ≥4 to ≤14 years. Based on this tool, Radhika (2008) developed a protocol for appraisal of verbal praxis in typically developing Kannada speaking children in the age range of ≥2.6 to ≤4.0 years. In this study, the protocol by Banumathy (2008) was adapted for assessment of oral motor, oral praxis and verbal praxis skills in children with CAS and sAOS in Malayalam language.

Description of the Protocol

The study was carried out in 7 phases with sub stages under each phase, which was as follows:

Phase I: Compilation and development of the protocol

Phase II: Checking for item validity of the protocol developed

Phase III: Modification based on the feedback from phase II

Phase IV: Administration of the protocol on 60 typically developing Malayalam speaking children in the age group of ≥ 2.6 to ≤ 4.6 years

Phase V: Modification based on the feedback from Phase IV

Phase VI: Testing the sensitivity of the protocol by administering it on children with CAS and sAOS (ELD, Autism & DCD).

Phase VII: Modification based on the feedback from Phase VI and finalizing the protocol.

The **Assessment Protocol for Oral Motor, Oral Praxis and Verbal Praxis Skills in Malayalam Speaking Children with Childhood Apraxia of Speech and Suspected Apraxia of Speech (APOOV-M)** is developed in Malayalam language for children with CAS and sAOS in the age group of ≥2.6 to ≤4.6 years. The sensitivity of the test was tested on the following clinical groups with CAS and sAOS:

a) Clinical group I: 4 Malayalam speaking participants with CAS
b) Clinical group II: 14 Malayalam speaking participants with sAOS associated with disorders as follows:
    (i) Clinical Group II-A: Expressive Language Delay (ELD) (N =4)
    (ii) Clinical Group II-B: Autism (N =6)
    (iii) Clinical Group II-C: Developmental Coordination Disorder (DCD) (N =4)

Participants in the clinical group II were further screened for sAOS using the Screening checklist for apraxia (given in Appendix A). All the participants in this group received scores greater than the cutoff score of 60% in the checklist and thus were selected as participants with sAOS.

The protocol included three major domains namely, Oral motor assessment tool, Oral praxis assessment tool and Verbal praxis assessment tool with several sub domains under each. The test stimuli in the first two domains were adapted from the protocol by Banumathy (2008) as these domains were not language specific. However, the instructions and description of the scoring procedure were translated to Malayalam language. The third domain on 'Verbal praxis assessment tool' was language sensitive and has been compiled and developed based on the linguistic structure of Malayalam language, taking into account the phonemic, semantic and phonetic constraints of the language. The hierarchy of sub domains in Malayalam was indentified in line with the protocol in Kannada by Banumathy (2008). The sub domains in the verbal praxis assessment tool are given in the table below and described in the following section.

Sl. No.	Sub domains of Verbal Praxis assessment tool	No. of items/tasks	Analysis/Scoring Pattern
A	Isolated verbal movements	25	Rating scale
B	Sequential verbal movements	7	Rating scale
C	Diadochokinetic (DDK) tasks	2	Rate, number of attempts, accuracy, & consistency
D	Word level praxis	44	• Phonological process analysis

	assessment		• Sequence maintenance score • Analysis for specific praxis errors
E	Sentence level praxis assessment	8	• Percentage of consonants correct (PCC) & Percentage of Vowels Correct (PVC) • Sequence maintenance score • Sentence length
F	Analysis of spontaneous speech	10-150 utterances	• Phonotactic assessment • PCC & PVC • Analysis for specific praxis errors

A. Isolated verbal movements

25 vowels, consonants and CV syllables with consonants that occur in the initial position in Malayalam (Kumari, 1972) constituted the stimuli in this sub domain. They were selected based on the use of jaw, lip and tongue movements as praxis deficits, if present, are evident in the movements of these structures.

B. Sequential verbal movements

The stimuli in this section included seven double and triple speech movements comprising vowels and continuant /m/.

C. Diadochokinetc (DDK) tasks

This task required the participants to repeat syllables /pa/, /ta/, /ka/ independently (AMR-Alternating Motion Rate) and /pa/-/ta/-/ka/ sequentially (SMR-Sequential Motion Rate) after the examiner. If the participants had difficulty in understanding the instructions, they were given cues by tapping a finger with every syllable. Ten continuous iterations were considered as the best response.

D. Word level praxis assessment

The stimuli comprised of 44 words arranged in a hierarchy of increasing length and presence of clusters as follows:

- Disyllabic words with no clusters (DNC - 5 words)
- Disyllabic words with geminate clusters (DGC - 5 words)
- Disyllabic words with non-geminate clusters (DNGC- 3 words)
- Trisyllabic words with no clusters (TNC - 5 words)
- Trisyllabic words with geminate clusters (TGC - 5 words)
- Trisyllabic words with non-geminate clusters (TNGC - 3 words)
- Multisyllabic words with no clusters (MNC - 5 words)
- Multisyllabic words with geminate clusters (MGC - 5 words)
- Multisyllabic words with non-geminate clusters (MNGC - 3 words)
- Complex words (CW - 5 words)

E. Sentence level praxis assessment

The stimuli included eight sentences with length varying from 3 syllables to 10 syllables presented for a repetition task**.**

F. Spontaneous speech

Spontaneous speech samples should include a minimum of 10 utterances to a maximum of 150 utterances recorded from the participants by engaging them in general conversation about home, routine activities and school using age appropriate toys and pictures. Utterances can involve request for toys, names or description of toys, etc.

Refer to Appendix B for the assessment protocol including stimuli, details of analysis and scoring patterns. A sample protocol for a participant with CAS is given in Appendix C.

Summary

The findings indicated deficits related to praxis failure in both children with CAS and sAOS in all the three domains including oral motor, oral praxis and verbal praxis skills. Even though each participant exhibited a unique profile, all of them exhibited deficits in all the domains and sub domains of the protocol proving the usefulness and sensitivity of the protocol in identifying the praxis breakdown at different levels in different domains. The demographic details and scores obtained by the participants of the study on the assessment protocol are presented in Appendix D.

Clinical implications of the Study

- The protocol developed is one of the first attempts in Malayalam language for the assessment of children with CAS and sAOS.
- It will facilitate the identification of the breakdown in different domains or distribution of the symptoms in CAS and sAOS.
- The protocol can facilitate the selection of speech therapy goals for children with CAS and sAOS.
- The protocol can be used for periodic re-evaluation of children with CAS and sAOS.

APPENDIX A

SCREENING CHECKLIST (Banumathy, 2008)

Note: Information with respect to items 1 to 10 to be obtained from parent of the child. The rest of the items are to be scored by the Speech-Language Pathologist. The items are to be recorded as 'Yes' or 'No'(Score 1 is offered for 'Yes' and '0' for 'No').

Sl.No.	Information from Parents	Yes/No
1.	Is there any family history of speech, language, hearing or learning deficits?	
2.	Psycho social history: Does your child show high frustration levels, behavioral problems, and excessive shyness especially in unfamiliar social settings?	
3.	History of feeding: a) Does your child show poor co-ordination of suck-swallow-breathe process resulting in mild but frequent coughing/choking or spillage? b) Does your child exhibit excessive drooling, especially when talking or engaged in other motor activities?	
4.	Was your child a quiet baby, that is, he/she did not show much of vocalization/verbalizations especially between 4-12 months of age?	
5.	Prebabble vocalizations: Did your child present the following: a) There was no or little babbling except vowel like vocalizations? b) The babble consisted of few or no consonants?	
6.	*Intelligibility:* Did the intelligibility of your speech of your child vary from situation to situation? E.g.: Speech was more intelligible with closest family members when compared to that with strangers.	
7.	*Rate of Speech:* Does your child use a slow rate of speech?	
8.	*Development of Speech:* Did the child show delayed development of speech (i.e., the development of speech occurred at a slower rate when compared with his/her counterparts?)	
9.	*Use of non – verbal modes:* Did your child show increased use of gestures to communicate his needs (E.g., leading parents to desired objects)? Or use mime, conventional or idiosyncratic signs (natural gesture system invented by child) or both?	
10.	*Play:* Did your child exhibit age-appropriate, single action pretend play, but showed delay in developing sequences of pretend play?	

Observations by the Speech-Language Pathologist		
11.	Are there any indications of soft neurological signs (immature reflexes, mild low muscle tone, sensory hypersensitivity, or hyposensitivity)?	
12.	Does the child show difficulty in voluntary use of oral structures?	
13.	Does the child have difficulty in moving the tongue independently of jaw?	
14.	Does the child show any evident silent posturing/ Groping (searching of the articulators) or effort at initiation of speech?	
15.	Does the child show difficulty in learning sequenced movements (E.g., learning sequenced speech movements to utter a particular word)?	
16.	Does the child show incoordination while shifting from one motor activity to another?	
17.	Does the child experience difficulty with initial consonants in words?	
18.	Does the child omit or distort vowel sounds?	
19.	Does the child show word or morpheme sequencing errors (E.g., “he’s go” for “he goes”)?	
20.	Does the child tend to produce a word once and never utter the same word again in a same or different context? In other words, are the responses of the child inconsistent?	
21.	Does the child demonstrate multiple consistent misarticulations?	
22.	Does the child producesome words involuntarily and is unable to reproduce or imitate the same on request?	
23.	Does the child demonstrate prolongations and syllable additions in speech frequently?	
24.	Does the child repeat sounds and syllables in multi syllabic words?	
25.	Does the child transpose sounds within words (E.g., naba:na/banana)?	
26.	Does the child use more of signs/gestures, vocal noises, and/or idiosyncratic words than meaningful intelligible words?	
27.	Does the child use more of signs/gestures along with a few words while attempting to speak in sentences?	
28.	Does the child omit, mis-select or mis-place pronouns (E.g., /adu/-meaning ‘that/it’, /aval/-meaning ‘she’, /nja:n/-meaning ‘I’) and PNG markers (structures referring to person, number and gender)?	
29.	Does the child exhibit difficulty in organizing and sequencing segments (speech sounds) while speaking or when indulged in conversations?	

30.	Does the child show poor accuracy for words as and when the length or phonetic complexity of the utterance increases?	
31.	Does the child show poor accuracy for words as and when the length or phonetic complexity of the utterance increases?	
32.	Does the quality and quantity of speech reduce in unfamiliar contexts (situations, location, interlocutors, topic, etc)? or when a task is altered or when a new task is introduced (E.g., child seems to have mastered /s/ sound but begins mispronouncing it when /ʃ/ is introduced)?	
33.	Does the child exhibit jargon speech ("speaking gibberish"; varied consonant and vowel patterns with appropriate intonation patterns, but no apparent meaning) in his/her speech?	
34.	Does the child demonstrate difficulty with rate, rhythm, stress or intonation? Or Is the child monotonous in his/her speech?	
35.	Does the child show significantly higher receptive language skills than expressive language skills?	
36.	Did the child show unusually slow progress in spite of intensive speech-language treatment in the past?	
37.	Does the child show mildly low muscle tone? (Exclude extreme tone differences which are typical of CP)?	
38.	Does the child exhibit limb apraxia: Fine and gross motor-planning difficulties, especially for action sequences (hands, whole body)?	
39.	Does the child show mild to moderate sensory hypersensitivity, hyposensitivity, or both in different areas of the face and/or body?	

Total score: _____

Clinical Impression:

APPENDIX B

ASSESSMENT PROTOCOL FOR ORAL MOTOR, ORAL PRAXIS AND VERBAL PRAXIS SKILLS IN MALAYALAM SPEAKING CHILDREN WITH CHILDHOOD APRAXIA OF SPEECH AND SUSPECTED APRAXIA OF SPEECH (APOOV-M)

NAME: DATE:

REGISTRATION NUMBER:

AGE/GENDER:

EDUCATION:

CRECHE/NURSERY:

OTHER RELEVENT INFORMATION:

I. ORAL MOTOR ASSESSMENT

A. Oral structures at rest

The clinician should score for the following based on his/her observation. Score 2 for 'a', 1 for 'b' and 0 for 'c'

Sl. No.	***At Rest***	***Score***
1	The child's jaw is: a) In normal alignment b) Slightly protracted or retracted c) Noticeably protracted or retracted	
2	The child's jaw at rest is: a) Closed b) Slightly open c) Noticeably open	
3	The child's lips are: a) In a normal position b) Slightly protracted or retracted c) Obviously protracted or retracted	
4	The child: a) Does not drool b) Drools, but tries to swallow it c) Drools and does not use any strategy to clear it	
5	The child's tongue is: a) Placed appropriately inside the mouth b) On the bottom of the lower lip c) Outside the mouth	
6	Based on the interpretation from the five items above, the oral structures seems to show: a) Normal tone b) Mildly abnormal tone c) Moderately abnormal tone	
7	Involuntary movements are: a) Absent b) Present but barely noticeable c) Apparently present	
8	When the child moves his/her oral structures: a) Other parts of the body do not move b) Other parts of the body move minimally c) Other parts of the body move noticeably (and hinder in speech production)	
Total score =		

B. Functions of the oral mechanism for speech

The clinician should score for the following based on his/her observation. Score 1 for 'adequate' and 0 for 'inadequate'.

Sl.No.	***Functions***	***Score***
1	The intra-oral air build-up for stops	
2	Air build up and precision of fricatives	
3	Oral-nasal distinction	
4	The range of movement of lips when the child spreads his lips	
5	The range of movement of jaw when the child opens and closes his/her mouth	
6	The range of movement of the tongue when the child moves the tongue from side to side	
Total score =		

II. ORAL PRAXIS ASSESSMENT

A. Isolated oral movements

The clinician should ask the child to imitate the following movements. A maximum of three repetitions should be given if needed. The clinician should comment regarding the accuracy & rate of movement, the number of repetitions required and then provide a score accordingly.

Sl. No.	***Action***	***Accuracy***	***Rate***	***Repetitions***	***Score***	***Sub scores***
Jaw movement						
1	Click teeth together once					
2	Open your mouth					
3	Close your mouth					
4	Hold your mouth open at mid range					
Lip movement						
5	Smile					
6	Pucker lips					
7	Bite lower lip					
8	Blow					
9	Pretend to kiss					
Tongue movement						
10	Stick out your tongue					
11	Lick your lips with tongue					
12	Touch the nose with tip of tongue					
13	Move your tongue in and out					
14	Move your tongue to the right					
15	Move your tongue to the left					
16	Click your tongue					
17	Wiggle your tongue from side to side					
Others						
18	Clear your throat					
19	Puff up your cheeks					
Total score =						

Scoring:

The accuracy and rate are evaluated based on the number of repetitions provided. All responses are scored based on rate, accuracy and repetitions used as follows:

4 - Movement/action is accurate and rate is appropriate.
3 - Movement/action is accurate and rate is appropriate with one or more repetitions.
2 - Either movement/action or rate is inappropriate with more than one repetition.
1 - Both are inappropriate with more than one repetition.
0 - Child is unable to perform even with repetitions.

B. Sequential oral movements

The clinician should ask the child to imitate the sequential oral movements given in the table. A maximum of three repetitions should be given if needed. The clinician should comment regarding the response and provide appropriate scoring as given below.

Sl. No.	***Stimulus***	***Response***	***MCS***	***SMS***
1	Bite and blow			
2	Smile and kiss			
3	Blow and smile			
4	Kiss and stick out your tongue			
5	Bite and open your mouth			
Total score				

Scoring:

Motor Control Score (MCS):

2 - Both movements are precise
1 - One of the movements is imprecise
0 - Both movements are imprecise

Sequence Maintenance Score (SMS):

2 - Completes both movements in the order stated (correct sequence)
1 - Completes both movements in the reverse order (incorrect sequence) or an extra movement
0 - Completes only one movement or completes the same movement twice.

III. VERBAL PRAXIS ASSESSMENT

A. Isolated verbal movements

The clinician should ask the child to imitate the following syllables, consonants and vowels. A maximum of three repetitions should be given if needed.

Sl.No.	***Action***	***Response***	***Accuracy***	***Repetitions***	***Score***
Jaw movement					
1	Open your mouth & say /a/ (അ)				
2	Close your mouth & say /m…/(മ്…)				
3	Say /ja/ (യ)				
4	Say /ai/ (ഐ)				
5	Say /au/ (ഔ)				
Lip movement					
6	Say /pa/ (പ)				
7	Say /o/ (ഒ)				
8	Say /u/ (ഉ)				
9	Say /i/ (ഇ)				
10	Say /e/ (എ)				
Tongue movement					
11	Say /ṭa/ (ട)				
12	Say /ḍa/ (ഡ)				
13	Say /n̲…/ (ന്…) alveolar				
14	Say /n.../ (ന്…) dental				
15	Say /l.../ (ല്…)				
16	Say /ka/ (ക)				
17	Say /ga/ (ഗ)				
18	Say /ta/ (ത)				
19	Say /da/ (ദ)				
20	Say /ʧa/ (ച)				
21	Say /ʤa/ (ജ)				
22	Say /r̲a/ (റ)				
23	Say /ra/ (ര)				
24	Say /s…/ (സ്....)				
25	Say /ʃ…/ (ശ്....)				
Total score =					

Scoring:

The speech movements are scored based on the accuracy and repetition used as follows:

3 - Movement/action is accurate.
2 - Movement/action is accurate with one or more repetition.
1 - Movement/action is inappropriate with more than one repetition.
0 - Child is unable to perform even with repetitions.

B. Sequential verbal movements

The clinician should ask the child to imitate the following sequential verbal utterances. A maximum of three repetitions should be given if needed.

Sl. No.	***Stimulus***	***Transcribed response***	***MCS***	***SMS***
1	a-u (അ-ഉ)			
2	o-i (ഒ-ഇ)			
3	m-u (മ്-ഉ)			
4	a-m-u (അ-മ്-ഉ)			
5	u-i-a (ഉ-ഇ-അ)			
6	i-u-a (ഇ-ഉ-അ)			
7	m-o-i (മ്-ഒ-ഇ)			
Total score=				

Scoring:

Two types of scores are given as follows:

Motor Control Score (MCS):

For two phoneme sequences:

2 - All movements are precise
1 - One of the movements is imprecise
0 - All movements are imprecise or child does not say all phonemes

For three phoneme sequences:

2 - All movements are precise
1 - One or two of the movements are imprecise
0 - All movements are imprecise or child does not say all phonemes

Sequence Maintenance Score (SMS):

For two phoneme sequences:

2 - Repeats both phonemes in the correct order
1 - Repeats both phonemes in reverse order or repeat a phoneme or add a phoneme
0 - Repeats only one phoneme or does not repeat any phoneme

For three phoneme sequences:

2 - Repeats all phonemes correctly
1 - Repeats 2 out of 3 phoneme sequences correctly or repeats the phonemes 5 or 6 times
0 - Repeats one out of 3 phoneme sequences correctly or repeats the phoneme sequence more than 6 times

If the child does not respond, mark NR and score 0.

C. Diadochokinetic rate (DDK)

The clinician should demonstrate SMR (/pa/-/ṭa/-/ka/) and AMR (/pa/,/ṭa/,/ka/ independently) and ask the child to imitate as fast and as clearly as possible. A maximum of three trials should be given for the child to produce a minimum of ten iterations per trial. Analysis is in terms of the attempts, accuracy and consistency of production.

DDK	***Stimuli***	***Attempt***	***Accuracy***	***Consistency***	***DDK rate***
AMR	/pa-pa-pa…/ പ..പ..പ				
	/ṭa-ṭa-ṭa.../ ട..ട..ട				
	/ka-ka-ka.../ ക..ക..ക				
SMR	/paṭaka.../ പടക..				

Scoring:

a) Attempts:

A maximum of three attempts should be given to each child and the best attempt with atleast ten iterations should be considered for calculation of DDK.

b) Accuracy:

Responses of the child should be rated for accuracy with respect to articulation. If the first four repetitions are accurately produced, a score of 1 should be given and 0 if the repetitions are inaccurate.

c) Consistency:

The initial four repetitions should be considered for scoring.

3 - Consistent repetitions; no change from one repetition to the next.
2 - Three of the four repetitions are consistently repeated.
1 - Two of the four repetitions are consistently repeated.
0 - All repetitions are different from one another.

d) DDK rate:

DDK rate is calculated using the following formula:

$$\text{DDK rate} = \frac{\text{Total number if iterations}}{\text{Duration of trial (in sec)}}$$

D. Word level praxis assessment

The clinician should ask the child to repeat the following words after him/her. Three trials should be provided if the child is unable to repeat with one. Words 1-36 are appropriate for ≥ 2.6 to < 3.6 *years and words 1-44 for* ≥ 3.6 to ≤ 4.6 *years.*

Sl. No.	***Target***	***Transcribed response***	***PE***			***G***	***D***	***WP***	***SMS***
			SE	***TE***	***WWE***				
DNC: Disyllabic words with no clusters									
1	/a:na/ ആന								
2	/ila/ ഇല								
3	/pu:vʌ/ പൂവ്								
4	/kat^{h}a/ കഥ								
5	/vaḍi/ വടി								
DGC: Disyllabic words with geminate clusters									
6	/toppi/ തൊപ്പി								
7	/laittʌ/ ലൈറ്റ്								
8	/kaṇṇʌ/ കണ്ണ്								
9	/veḷḷam/ വെള്ളം								
10	/u:ɲa:l/ ഊഞ്ഞാൽ								
DNGC: Disyllabic words with non-geminate clusters									
11	/su:rjan/ സൂര്യൻ								

12	/raɳɖʌ/ രണ്ട്								
13	/vaɳɖi/ വണ്ടി								
TNC: Trisyllabic words with no clusters									
14	/kutira/ കുതിര								
15	/mo:tiram/ മോതിരം								
16	/vajaṛʌ/ വയറ്								
17	/miʈʰa:ji/ മിഠായി								
18	/vima:nam/ വിമാനം								
TGC: Trisyllabic words with geminate clusters									
19	/marunʌ/ മരുന്ന്								
20	/kaɳɳa:ɖi/ കണ്ണാടി								
21	/ʧeruppʌ/ ചെരുപ്പ്								
22	/takka:ḷi/ തക്കാളി								
23	/uɖuppʌ/ ഉടുപ്പ്								
TNGC: Trisyllabic words with non-geminate clusters									
24	/uṛumbʌ/ DIi\§								
25	/ti:vaɳɖi/ തീവണ്ടി								
26	/paruntʌ/ പരുന്ത്								
MNC: Multisyllabic words with no clusters									
27	/talamuɖi/ തലമുടി								
28	/alama:ri/ അലമാരി								
29	/birijani/ ബിരിയാണി								
30	/talajaɳa/ തലയണ								
31	/kuḷimuṛi/ കുളിമുറി								
MGC: Multisyllabic words with geminate clusters									
32	/ʧu:ɖuveḷḷam/ ചൂടുവെള്ളം								
33	/aɖukaḷa/								

	അടുക്കള								
34	/so:ppupoḍi/ സോപ്പുപൊടി								
35	/kuɲɲuva:va/ കുഞ്ഞുവാവ								
36	/kuppivaḷa/ കുപ്പിവള								
MNGC: Multisyllabic words with non-geminate clusters									
37	/paɲʤasa:ra/ പഞ്ചസാര								
38	/ambiḷima:man/ Aìynyixi©								
39	/ʧilantivala/ ചിലന്തിവല								
CW: Complex words									
40	/paʧʧakkaṛi/ പച്ചക്കറി								
41	/moṯṯattala/ മൊട്ടത്തല								
42	/uɳɲijappam/ ഉണ്ണിയപ്പം								
43	/kaḷippa:ṯṯam/ കളിപ്പാട്ടം								
44	/pu:mba:tta/ e¢ìxl÷								
Total Scores									

Note: *PE- Phonological errors, G- Groping errors, D- Disfluencies, WP- Weak precision, Di – Distortion, SMS- Sequence maintenance score.*

The errors should be transcribed and the total number of errors counted.

Key for scoring errors:

1) Phonological errors

Space errors (SE): fronting, backing, palatalization, depalatalization, deretroflexion, and vowel deviations including vowel prolongation, vowel shortening, vowel centralization, vowel decentralization, monothongization, diphthongization, vowel raising, vowel lowering, vowel fronting, vowel backing.

Timing errors (TE): voicing errors, affrication, deaffrication, denasalization, nasalisation, deaspiration, gemination and degemination of consonants.

Whole word errors (WWE): cluster reduction, cluster deletion, reduplication, consonant harmony, migration, metathesis, epenthesis, initial consonant deletion, medial consonant deletion, vowel deletion, substitution of geminates for non-geminates and vice versa, initial, medial and final syllable deletions.

A score of ‘1’ is given for each error.

2) ***Groping errors:*** Self corrections that are silent or audible should be considered as groping errors. A score of '1' should be given if it is observed in a word.
3) ***Disfluencies****:* Repetitive production of speech sounds, hesitations and pauses should be considered as disfluencies. A score of '1' should be given if one or more of it is observed in a word.

4) ***Weak precision:*** Every occurrence of weak precision with respect to the consonants produced should be given a score of '1'.

5) Sequence maintenance score (SMS):

For Disyllabic words:

2 - Repeats both syllables in the correct order.
1 - Repeats both syllables in reverse order or repeats a syllable or adds/substitutes a syllable.
0 - Repeats only one syllable or does not repeat any syllable.

For Trisyllabic and multisyllabic words:

2 - Repeats all syllables in the correct sequence.
1 - Repeats all syllables except one in the correct sequence or any one syllable in reverse order or addition/deletion of a syllable.
0 - Repeats one syllable correctly or does not repeat any syllable in the correct order.

If the child does not respond, mark NR (No response) and score 0.

E. Sentence level assessment

The clinician should ask the child to repeat the following sentences after him/her. Three trials should be provided if the child is unable to repeat with one. Sentences 1-6 are appropriate for ≥2.6 to ≤3.6 *years and sentences 1-8 for* ≥3.6 to ≤4.6 *years.*

Sl. No.	***Target***	***Transcribed response***	***SMS***
1	/pa:lʌ ta:/ പാല് താ		
2	/ka:r̲ʌ po:ji/ കാറ് പോയി		
3	/miʈʰa:ji ve:ɳam/ മിഠായി വേണം		
4	/ʧe:ʧi vel̪lam tannu/ ചേച്ചി വെള്ളം തന്നു		
5	/pu:ʧʧa pa:lʌ kuɖiʧʧu/		

	പൂച്ച പാല് കുടിച്ചു		
6	/kiļi marattil irunnu/ കിളി മരത്തിൽ ഇരുന്നു		
7	/kuṭṭi puṛattΛ uɲɲaalaaḍi/ കുട്ടി പുറത്ത് ഊഞ്ഞാലാടി		
8	/aɳɳa:n ʃa:ḍi marattil kajaṛi/ അണ്ണാൻ ചാടി മരത്തിൽ കയറി		
SMS =			

Scoring:

The following calculations should be done:

a) Sequence maintenance score (SMS):

2 - All words are in the exact order or position

1 - Sentences with ≤3 words- at least 1 word is in order
Sentences with > 3 words- at least 3 of the key words are in order

0 - Sentences with ≤ 3 words-no words in order
Sentences with > 3 words-2, 1 or no key words are in order

If the child does not respond, mark NR (No response) and score 0.

b) Percentages of consonants correct (PCC) & Percentages of vowels correct (PVC):

For the calculation of these measures, the following data should be excluded from the analysis:

- All unintelligible and partially intelligible utterances.
- All consonants in the third or greater repetition of the same word if the pronunciation does not change.

The errors in the remaining data should be identified using the following criteria:

- Dialectal changes, casual speech pronunciations and allophonic variations were not scored as incorrect.
- Any doubt about the correctness of the consonant was scored as incorrect.
- Consonant deletions were scored as incorrect.
- Consonant substitutions were scored as incorrect.
- Partial voicing was scored as incorrect.
- Additions of consonants were scored as incorrect.

Percentage of consonants correct (PCC):

$$PCC = \frac{\text{Total number of consonants produced correctly}}{\text{Total number of consonants attempted}} \times 100$$

Percentage of vowels correct (PVC):

$$PVC = \frac{\text{Total number of vowels produced correctly}}{\text{Total number of vowels attempted}} \times 100$$

PCC :
PVC :

c) Sentence length:

Calculate the number of syllables imitated appropriately by the participants in the sentences with increasing lengths. The clinician should write in the columns regarding the presence or absence of errors in the respective sentences.

Sl.No.	***Sentence length***	***Errors***
1	3	
2	4	
3	5	
4	6	
5	7	
6	8	
7	9	
8	10	

F. Analysis of spontaneous speech sample

Record a spontaneous speech sample of the child by eliciting speech using age appropriate toys and pictures and conversations with family members. Write the transcription in the space given below.

Transcribed sample:

Scoring:

The following calculations should be done:

a) PCC & PVC:

Percentage of consonants correct (PCC):

$$\text{PCC}= \frac{\text{Total number of consonants produced correctly}}{\text{Total number of consonants attempted}} x\ 100$$

Percentage of vowels correct (PVC):

$$\text{PVC}= \frac{\text{Total number of vowels produced correctly}}{\text{Total number of vowels attempted}} x\ 100$$

Percent intelligible words:
PCC:
PVC:

b) Phonotactic analysis (Vellemen, 1998):

- *Percentage occurrences of different types of syllables:*

$$\%\ \text{V syllables} = \frac{\text{Number of V syllables}}{\text{Total number of different types of syllables}} x\ 100$$

$$\%\ \text{VC syllables} = \frac{\text{Number of VC syllables}}{\text{Total number of different types of syllables}} x\ 100$$

$$\%\ \text{CV syllables} = \frac{\text{Number of CV syllables}}{\text{Total number of different types of syllables}} x\ 100$$

$$\%\ \text{CVC syllables} = \frac{\text{Number of CVC syllables}}{\text{Total number of different types of syllables}} x\ 100$$

Fill in the types of syllables shapes occurring in the sample with the respective percentage of occurrences of each in the table given below.

Types of syllables	***Percentage occurrences***	***Types of syllables***	***Percentage occurrences***	***Types of syllables***	***Percentage occurrences***

- *Percentage occurrences of different types of words:*

$$\% \text{ monosyllabic words} = \frac{\text{Number of monosyllabic words}}{\text{Total number of words}} x\ 100$$

$$\% \text{ disyllabic words} = \frac{\text{Number of disyllabic words}}{\text{Total number of words}} x\ 100$$

$$\% \text{ trisyllabic words} = \frac{\text{Number of trisyllabic words}}{\text{Total number of words}} x\ 100$$

$$\% \text{ multisyllabic words} = \frac{\text{Number of multisyllabic words}}{\text{Total number of words}} x\ 100$$

Fill in the word shapes occurring in the sample with the respective percentage of occurrences of each in the table given below.

Types of words	***Percentage occurrences***
monosyllabic words	
disyllabic words	
trisyllabic words	
multisyllabic words	

- *Percentage occurrences of different types of clusters:*

% initial geminate clusters $= \frac{\text{Number of initial geminate clusters}}{\text{Total number of words with clusters}} x\ 100$

% initial non-geminate clusters $= \frac{\text{Number of initial non}-\text{ geminate clusters}}{\text{Total number of words with clusters}} x\ 100$

% medial geminate clusters $= \frac{\text{Number of medial geminate clusters}}{\text{Total number of words with clusters}} x\ 100$

% medial non-geminate clusters $= \frac{\text{Number of medial non}-\text{ geminate clusters}}{\text{Total number of words with clusters}} x\ 100$

% final geminate clusters $= \frac{\text{Number of final geminate clusters}}{\text{Total number of words with clusters}} x\ 100$

% final non-geminate clusters $= \frac{\text{Number of final non}-\text{ geminate clusters}}{\text{Total number of words with clusters}} x\ 100$

Fill in the types of clusters occurring in the sample with the respective percentage of occurrences of each in the table given below.

Types of clusters	***Percentage occurrences***
Initial geminate clusters	
Initial non-geminate clusters	

Medial geminate clusters	
Medial non-geminate clusters	
Final geminate clusters	
Final non-geminate clusters	

c) Specific praxis errors

Praxis errors	***Frequency***
Groping	
Disfluencies	
Weak precision	

FINDINGS:

DIAGNOSTIC FORMULATION:

APPENDIX C

ASSESSMENT PROTOCOL FOR ORAL MOTOR, ORAL PRAXIS AND VERBAL PRAXIS SKILLS IN MALAYALAM SPEAKING CHILDREN WITH CHILDHOOD APRAXIA OF SPEECH AND SUSPECTED APRAXIA OF SPEECH (APOOV-M)

NAME: XXX DATE: YYY

REGISTRATION NUMBER: ZZZ

AGE/GENDER: 4 years/Male

EDUCATION:

CRECHE/NURSERY:

OTHER RELEVENT INFORMATION: The child's expressive vocabulary consists of simple disyllabic and monosyllabic utterances.

I. ORAL MOTOR ASSESSMENT

C. Oral structures at rest

Sl. No.	***At Rest***	***Score***
1	The child's jaw is: d) In normal alignment e) Slightly protracted or retracted f) Noticeably protracted or retracted	2
2	The child's jaw at rest is: d) Closed e) Slightly open f) Noticeably open	1
3	The child's lips are: d) In a normal position e) Slightly protracted or retracted f) Obviously protracted or retracted	1
4	The child: d) Does not drool e) Drools, but tries to swallow it f) Drools and does not use any strategy to clear it	0
5	The child's tongue is: d) Placed appropriately inside the mouth e) On the bottom of the lower lip f) Outside the mouth	2
6	Based on the interpretation from the five items above, the oral structures seems to show: d) Normal tone e) Mildly abnormal tone f) Moderately abnormal tone	1
7	Involuntary movements are: d) Absent e) Present but barely noticeable f) Apparently present	2
8	When the child moves his/her oral structures: d) Other parts of the body do not move e) Other parts of the body move minimally f) Other parts of the body move noticeably (and hinder in speech production)	2
Total score = 11/16		

D. Functions of the oral mechanism for speech

Sl. No.	***Functions***	***Score***
1	The intra-oral air build-up for stops	0
2	Air build up and precision of fricatives	0
3	Oral-nasal distinction	0
4	The range of movement of lips when the child spreads his lips	0
5	The range of movement of jaw when the child opens and closes his/her mouth	0
6	The range of movement of the tongue when the child moves the tongue from side to side	0
Total score = 0/6		

II. ORAL PRAXIS ASSESSMENT

C. Isolated oral movements

Sl. No.	***Action***	***Accuracy***	***Rate***	***Repetitions***	***Score***	***Sub scores***
Jaw movement						
1	Click teeth together once	NR	-	3	0	4
2	Open your mouth	inaccurate	adequate	3	2	
3	Close your mouth	inaccurate	adequate	3	2	
4	Hold your mouth open at mid range	NR	-	3	0	
Lip movement						
5	Smile	inaccurate	inadequate	3	1	3
6	Pucker lips	inaccurate	inadequate	3	1	
7	Bite lower lip	NR	-	3	0	
8	Blow	inaccurate	inadequate	3	1	
9	Pretend to kiss	NR	-	3	0	
Tongue movement						
10	Stick out your tongue	inaccurate	inadequate	3	1	1
11	Lick your lips with tongue	NR	-	3	0	
12	Touch the nose with tip of tongue	NR	-	3	0	
13	Move your tongue in and out	NR	-	3	0	
14	Move your tongue to the right	NR	-	3	0	
15	Move your tongue to the left	NR	-	3	0	
16	Click your tongue	NR	-	3	0	
17	Wiggle your tongue from side to side	NR	-	3	0	
Others						
18	Clear your throat	NR	-	3	0	1
19	Puff up your cheeks	inaccurate	inadequate	3	1	
Total score = 9/76						

D. Sequential oral movements

Sl. No.	*Stimulus*	*Response*	*MCS*	*SMS*
1	Bite and blow	NR	0	0
2	Smile and kiss	NR	0	0
3	Blow and smile	NR	0	0
4	Kiss and stick out your tongue	NR	0	0
5	Bite and open your mouth	NR	0	0
Total score			0	0

III. VERBAL PRAXIS ASSESSMENT

G. Isolated verbal movements

Sl.No.	*Action*	*Response*	*Accuracy*	*Repetitions*	*Score*
Jaw movement					
1	Open your mouth & say /a/ (അ)	/a/	accurate	0	3
2	Close your mouth & say /m…/ (മ്…)	M…	accurate	1	2
3	Say /ja/ (യ)	NR	-	3	0
4	Say /ai/ (ഐ)	/ai/	accurate	1	2
5	Say /au/ (ഔ)	/av/	inaccurate	3	1
Lip movement					
6	Say /pə/ (പ)	/pə/	inaccurate	3	1
7	Say /o/ (ഒ)	/ə/	inaccurate	3	1
8	Say /u/ (ഉ)	/u/	accurate	2	2
9	Say /i/ (ഇ)	/i/	accurate	1	2
10	Say /e/ (എ)	/ai/	inaccurate	3	1
Tongue movement					
11	Say /ʈa/ (ട)	/ʈa/	inaccurate	3	1
12	Say /ɖa/ (ഡ)	NR	-	3	0
13	Say /n̲…/ (ൻ…) alveolar	NR	-	3	0
14	Say /n.../ (ൻ…) dental	NR	-	3	0
15	Say /l.../ (ല് …)	/ʈa/	inaccurate	3	1
16	Say /ka/ (ക)	/ka/	accurate	2	2
217	Say /ga/ (ഗ)	NR	-	3	0
18	Say /ta/ (ത)	/ta/	accurate	1	2
19	Say /da/ (ദ)	/ta/	inaccurate	3	1
20	Say /ʧa/ (ച)	/a/	inaccurate	3	1
21	Say /ʤa/ (ജ)	/ə/	inaccurate	3	1
22	Say /r̲a/ (റ)	NR	-	3	0

23	Say /ra/ (ര)	NR	-	3	0
24	Say /s…/ (സ്....)	/tə/	inaccurate	3	1
25	Say /ʃ…/ (ശ്....)	NR	-	3	0
Total score = 26/76					

H. Sequential verbal movements

Sl. No.	***Stimulus***	***Transcribed response***	***MCS***	***SMS***
1	a-u (അ-ഉ)	NR	0	0
2	o-i (ഒ-ഇ)	NR	0	0
3	m-u (മ്-ഉ)	NR	0	0
4	a-m-u (അ-മ്-ഉ)	NR	0	0
5	u-i-a (ഉ-ഇ-അ)	NR	0	0
6	i-u-a (ഇ-ഉ-അ)	NR	0	0
7	m-o-i (മ്-ഒ-ഇ)	NR	0	0
Total score			0	0

I. Diadochokinetic rate (DDK)

DDK	***Stimuli***	***Attempt***	***Accuracy***	***Consistency***	***DDK rate***
AMR	/pa-pa-pa…/ പ..പ..പ				
	/ʈa-ʈa-ʈa.../ ട..ട..ട				
	/ka-ka-ka.../ ക..ക..ക				
SMR	/paʈaka.../ പടക..				

Note: The child couldn't produce 10 iterations and therefore scoring was not done.

J. Word level praxis assessment

Sl. No.	***Target***	***Transcribed response***	***PE***			***G***	***D***	***WP***	***SMS***
			SE	***TE***	***WWE***				
DNC: Disyllabic words with no clusters									
1	/a:na/ ആന	/a:na/	0	0	0	0	0	0	2
2	/ila/ ഇല	/ilʌ/	3	0	0	0	0	0	2
3	/pu:vʌ/ പൂവ്	/u:vʌ/	0	0	1	0	0	2	1
4	/kat^{h}a/ കഥ	/kʌkʌ/	7	1	2	1	0	2	1

5	/vaɖi/ വടി	/əkə/	6	1	2	0	0	1	0
DGC: Disyllabic words with geminate clusters									
6	/toppi/ തൊപ്പി	/oppi/ /appaa/	4	0	2	0	0	0	1
7	/laittʌ/ ലൈറ്റ്	/airrʌ/	1	0	1	0	0	2	1
8	/kaɳɳʌ/ കണ്ണ്	/i..inga/ /i..iɲa/	11	1	3	0	2	4	0
9	/veɭɭam/ വെള്ളം	/mba/	4	1	3	0	0	4	0
10	/u:ɲa:l/ ഊഞ്ഞാൽ	/ɲa:/	0	1	2	1	0	1	0
DNGC: Disyllabic words with non-geminate clusters									
11	/su:rjan/ സൂര്യൻ	NR	-	-	-	-	-	-	0
12	/raɳɖʌ/ രണ്ട്	NR	-	-	-	-	-	-	0
13	/vaɳɖi/ വണ്ടി	/aappa/	5	0	2	1	0	2	0
TNC: Trisyllabic words with no clusters									
14	/kutira/ കുതിര	/kaka/ /aa/ /aaga/	8	1	7	1	0	2	0
15	/mo:tiram/ മോതിരം	NR	-	-	-	-	-	-	0
16	/vajaṟʌ/ വയറ്	/aaʈaa/	4	1	2	0	0	1	0
17	/miʈʰa:ji/ മിഠായി	/aʈaaʈa/	6	2	1	0	0	2	0
18	/vima:nam/ വിമാനം	/ai/	1	0	3	0	0	1	0
TGC: Trisyllabic words with geminate clusters									
19	/marunʌ/ മരുന്ന്	NR	-	-	-	-	-	-	0
20	/kaɳɳa:ɖi/ കണ്ണാടി	/ka:/	0	0	2	1	0	0	0
21	/ʧeruppʌ/ ചെരുപ്പ്	/taappaa/	9	1	1	0	0	1	0
22	/takka:ɭi/ തക്കാളി	NR	-	-	-	-	-	-	0
23	/uɖuppʌ/ ഉടുപ്പ്	/uuʈʌ/	4	0	1	0	0	0	0
TNGC: Trisyllabic words with non-geminate clusters									
24	/uṛumbʌ/ Dlj‌ì§	/uuvaa/ /aka/	7	2	2	1	1	2	0
25	/ti:vaɳɖi/ തീവണ്ടി	/taata/	2	0	3	0	0	1	0

26	/paruntʌ/ പരുന്ത്	NR	-	-	-	-	-	-	0
MNC: Multisyllabic words with no clusters									
27	/talamuḍi/ തലമുടി	/aa/	1	0	4	0	0	0	0
28	/alama:ri/ അലമാരി	NR	-	-	-	-	-	-	0
29	/birijani/ ബിരിയാണി	NR	-	-	-	-	-	-	0
30	/talajaɳa/ തലയണ	NR	-	-	-	-	-	-	0
31	/kuḷimuṛi/ കുളിമുറി	NR	-	-	-	-	-	-	0
MGC: Multisyllabic words with geminate clusters									
32	/ʧu:ḍuveḷḷam/ ചൂടുവെള്ളം	/aa/ /uua/	2	0	8	0	0	0	0
33	/aḍukaḷa/ അടുക്കള	NR	-	-	-	-	-	-	0
34	/so:ppupoḍi/ സോപ്പുപൊടി	NR	-	-	-	-	-	-	0
35	/kuɲɲuva:va/ കുഞ്ഞുവാവ	/aadaa/ /uɲʌ-aappa/	5	3	5	0	0	0	0
36	/kuppivaḷa/ കുപ്പിവള	NR	-	-	-	-	-	-	0
MNGC: Multisyllabic words with non-geminate clusters									
37	/paɲʤasa:ra/ പഞ്ചസാര	/əngə-ada/	7	1	2	0	0	0	0
38	/ambiḷima:man/ AÌynyixi©	NR	-	-	-	-	-	-	0
39	/ʧìlantivala/ ചിലന്തിവല	NR	-	-	-	-	-	-	0
CW: Complex words									
40	/paʧʧakkaṛi/ പച്ചക്കറി	NR	-	-	-	-	-	-	0
41	/moṯṯattala/ മൊട്ടത്തല	/aṭaaṭaaa/	4	3	2	0	0	0	0
42	/unɲijappam/ ഉണ്ണിയപ്പം	NR	-	-	-	-	-	-	0
43	/kaḷippa:ṯṯam/ കളിപ്പാട്ടം	/aṭaaṭa/	5	2	2	0	0	0	0
44	/pu:mba:tta/ e¢ÌxÌ÷	/aa-aa-aa/	1	0	3	0	0	0	0
Total Scores			101	21	65	6	3	28	8/88

Note: *PE- Phonological errors, G- Groping errors, D- Disfluencies, WP- Weak precision, Di – Distortion, SMS- Sequence maintenance score.*

K. Sentence level assessment

Sl. No.	*Target*	*Transcribed response*	*SMS*
1	/pa:lʌ ta:/ പാല് താ	/aataa taa/	1
2	/ka:r̲ʌ po:ji/ കാറ് പോയി	/u-u-aa/	0
3	/miʈʰa:ji ve:ɳam/ മിഠായി വേണം	/aa/	0
4	/ʧe:ʧi ve|am tannu/ ചേച്ചി വെള്ളം തന്നു	NR	0
5	/pu:ʧʧa pa:lʌ kuɖiʧʧu/ പൂച്ച പാല് കുടിച്ചു	NR	0
6	/ki|i marattil irunnu/ കിളി മരത്തിൽ ഇരുന്നു	NR	0
7	/kuʈʈi puṛattʌ uɳɳaalaaɖi/ കുട്ടി പുറത്ത് ഊഞ്ഞാലാടി	NR	0
8	/aɳɳa:n ʧa:ɖi marattil kajaṛi/ അണ്ണാൻ ചാടി മരത്തിൽ കയറി	NR	0
SMS =1/16			

Scoring:

d) Sequence maintenance score (SMS):1/16

e) PCC & PVC

Note: Sentences produced were unintelligible and therefore scoring was not done

PCC	**-**
PVC	**-**

f) Sentence length:

Sl.No.	*Sentence length*	*Errors*
1	3	Present
2	4	Present
3	5	Present
4	6	NR
5	7	NR
6	8	NR
7	9	NR

8	10	NR

L. Analysis of spontaneous speech sample

Transcribed sample:

/ila a-ə-a a intə a taa taa I ə ija aappa ppaa aappa taa taa aaŋŋa aaja a aappa ta aataappa ambaa ambaa amba amba ila ammaa i-i-I ila m… a əkəkən ə-ə-kkə ammə ammə engə ta a m… inda inda a in-ta-inta amme intaa indaa inta iium taa inda inda ija ammaa m… k-ikka va va po pa inga inga i…ŋa imam əmba əmba vaa ppa aaja a ala ila ila ila ila sssi…ka la a in ve ə ha a… ija ija ija aka ila pa po pa po po po popo inga appə u-a-u-akkə iɲe inga ʈa ila ija ila/

Percent intelligible words	*60.19*
PCC	*47.37*
PVC	*41.49*

d) Phonotactic analysis (Vellemen, 1998):

- *Percentage occurrences of different types of syllables:*

Types of syllables	***Percentage occurrences***	***Types of syllables***	***Percentage occurrences***	***Types of syllables***	***Percentage occurrences***
V	10.68	VVCVVCCV	0.97		
VCV	19.42	VCCVV	5.83		
VVV	1.94	CCV	1.94		
VCCV	22.33	VC	0.97		
CVV	8.74	CVCV	0.97		
VCVV	0.97				
VCVCVC	0.97				
VVCCV	3.88				
CCVV	0.97				
VVCV	1.94				
CV	14.56				
C	2.91				

- *Percentage occurrences of different types of words:*

Types of words	***Percentage occurrences***
monosyllabic words	37.62
disyllabic words	59.41
trisyllabic words	2.97
multisyllabic words	0.00

- *Percentage occurrences of different types of clusters:*

Types of clusters	***Percentage occurrences***
Initial geminate clusters	5.41
Initial non-geminate clusters	-
Medial geminate clusters	43.24
Medial non-geminate clusters	51.35
Final geminate clusters	-
Final non-geminate clusters	-

e) Specific praxis errors

Praxis errors	***Frequency***
Groping	12
Disfluencies	08
Weak precision	55

FINDINGS:

DIAGNOSTIC FORMULATION: Childhood Apraxia of Speech

APPENDIX D

Demographic details and scores obtained by the participants on the assessment protocol

Demographic details:

Participant code	Age (years)/ Gender	Baseline
Participants with CAS		
A	3.6/Male	Client's expression was restricted to monosyllabic utterances which is inconsistent.
B	3.6/Male	Client's expression was restricted to disyllabic to trisyllabic utterances, which were inconsistent.
C	4/Male	Client's expressive vocabulary consists of simple disyllabic and monosyllabic common utterances.
D	4/Female	Client's expression was restricted to simple monosyllabic and disyllabic words.
Participants with sAOS associated with ELD		
E	2.6/Male	*Significant features of suspected AOS (according to the therapist):* Volitional speech affected Difficulty increases with complexity and length of utterances Inconsistency and Variability Limited improvement noted even after therapy. *Screening checklist results:*25/39 (Interpretation: sAOS)
F	3/ Male	*Significant features of suspected AOS (according to the therapist):* Volitional speech affected Difficulty increases with complexity and length of utterances Inconsistency and Variability Unintelligibility varies across situations *Screening checklist results:*27/39 (Interpretation: sAOS)
G	3.6/ Male	*Significant features of suspected AOS (according to the therapist):* Volitional speech affected Difficulty increases with complexity and length of utterances Inconsistent errors *Screening checklist results:*24/39 (Interpretation: sAOS)
H	3.6/ Male	*Significant features of suspected AOS (according to the therapist):* Volitional speech affected Difficulty increases with complexity and length of utterances Inconsistency and Variability Difficulty in correct production even on immediate production after a model *Screening checklist results:*28/39 (Interpretation: sAOS)
Participants with sAOS associated with Autism		
I	4.5/ Male	*Significant features of suspected AOS (according to the therapist):* Limited verbal output Lack of significant progress even after therapy Volitional speech affected Groping on attempting to speak *Screening checklist results:*33/39 (Interpretation: sAOS)

J	4.5/ Male	*Significant features of suspected AOS (according to the therapist):* Limited verbal output Correct production of words occasionally Groping on attempting to speak Easier initiation of words when given a tactile cue *Screening checklist results:* 30/39 (Interpretation: sAOS)
K	3/ Male	*Significant features of suspected AOS (according to the therapist):* Limited verbal output Unable to produce although attempts to produce (struggle) Inconsistent production of certain monosyllabic utterances *Screening checklist results:35/39* (Interpretation: sAOS)
L	4.5/ Male	*Significant features of suspected AOS (according to the therapist):* Limited verbal output Unable to produce although attempts to produce Sequencing difficulty Inconsistent errors *Screening checklist results:30/39* (Interpretation: sAOS)
M	4.5/ Male	*Significant features of suspected AOS (according to the therapist):* Slow progress rate even after intensive stimulation Groping behaviour on voluntary production Sequencing difficulty *Screening checklist results:28/39* (Interpretation: sAOS)
N	4.5/ Male	*Significant features of suspected AOS (according to the therapist):* Limited verbal output Lack of significant progress even after therapy Volitional speech affected Groping on attempting to speak Speech repertoire restricted to more of monosyllablic, reduplicated disyllabic and trisyllabic utterances Difficulty in imitating longer utterances *Screening checklist results:29/39* (Interpretation: sAOS)
Participants with sAOS associated with DCD		
O	4/ Male	*Significant features of suspected AOS (according to the therapist):* Volitional speech affected. Difficulty increases with complexity and length of utterances. Inconsistency and variability. Groping on attempting to speak. Whispered speech occasionally. *Screening checklist results:*32/39 (Interpretation: sAOS)
P	2.6/ Female	*Significant features of suspected AOS (according to the therapist):* Noticeable groping behavior. Volitional speech and sequencing skills affected. Sound repertoire restricted to vowels and bilabials. *Screening checklist results:34/39* (Interpretation: sAOS)
Q	3.6/ Male	*Significant features of suspected AOS (according to the therapist):* Groping on speaking on request Volitional speech affected Difficulty increases with complexity and length of utterances Productions include more of repetitive sound sequences *Screening checklist results:29/30* (Interpretation: sAOS)

R	4/ Male	*Significant features of suspected AOS (according to the therapist):* Volitional speech affected Limited sound repertoire Productions include more of repetitive sound sequences for everything Groping on attempting to speak Difficulty increases with complexity and length of utterances *Screening checklist results:*31/39 (Interpretation: sAOS)

Scores obtained by the participants with CAS:

Domains & sub domains	*Participant code*			
	A	*B*	*C*	*D*
I. Oral motor skills				
A. Oral structures at rest (Max: 16)	13.00	16.00	11.00	12.00
B. Function of the oral mechanism for speech (Max: 6)	1.00	3.00	0.00	1.00
II. Oral praxis skills				
A. Isolated oral movements (Max: 76)	30.00	11.00	9.00	5.00
B. Sequential oral movements				
MCS (Max: 10)	4.00	0.00	0.00	0.00
SMS (Max: 10)	0.00	0.00	0.00	0.00
III.Verbal praxis skills				
A. Isolated verbal movements	42.00	15.00	26.00	9.00
B. Sequential verbal movements				
MCS (Max: 14)	7.00	4.00	0.00	0.00
SMS (Max: 14)	3.00	2.00	0.00	0.00
C. Diadochokinetic (DDK) tasks	-	-	-	-
D. Word Level praxis assessment				
Number of words attempted	19.00	24.00	27.00	5.00
Phonological process assessment				
Frequency	126.00	160.00	187.00	13.00
Space Errors	82.00	105.00	101.00	5.00
Timing Errors	9.00	10.00	21.00	0.00
Whole Word Errors	35.00	45.00	65.00	8.00
SMS - words (Max: 88)	5.00	6.00	8.00	5.00
Groping	7.00	4.00	6.00	1.00
Disfluencies	2.00	2.00	3.00	0.00
Weak precision	28.00	42.00	28.00	0.00
E. Sentence level praxis assessment				
SMS - sentence (Max: 16)	2.00	0.00	1.00	0.00
PCC	33.30	-	33.33	-
PVC	40.00	-	66.67	-
Sentence length	1.00	NR	1.00	NR
F. Analysis of Spontaneous speech				
Phonotactic assessment				
Number of utterances	88.00	147.00	103.00	25.00
Number of different syllable shapes	17.00	28.00	17.00	11.00
Monosyllables	61.90	67.35	37.62	52.00
Disyllables	36.90	27.89	59.41	44.00
Trisyllables	1.19	4.76	2.97	4.00
Initial geminate	6.25	0	5.41	0.00
Initial non-geminate	0.00	0.00	0.00	0.00
Medial geminate	68.75	81.82	43.24	100.00
Medial non-geminate	25.00	9.09	51.35	0.00
Final geminate	0.00	0.00	0.00	0.00
Final non-geminate	0.00	9.09	0.00	0.00
PCC	75.00	47.13	47.37	-
PVC	55.74	38.71	41.49	-
Groping	4.00	9.00	12.00	4.00
Disfluencies	3.00	4.00	8.00	1.00
Weak precision	39.00	63.00	55.00	8.00

Scores obtained by the participants with sAOS associated with ELD:

Domains & sub domains	Participant code			
	E	F	G	H
I. Oral motor skills				
A. Oral structures at rest (Max: 16)	16.00	16.00	14.00	16.00
B. Function of the oral mechanism for speech (Max:6)	4.00	2.00	2.00	4.00
II. Oral praxis skills				
A. Isolated oral movements	40.00	42.00	42.00	49.00
B. Sequential oral movements				
MCS (Max: 10)	0.00	1.00	0.00	6.00
SMS (Max: 10)	0.00	0.00	0.00	2.00
III. Verbal praxis skills				
A. Isolated verbal movements	36.00	42.00	36.00	44.00
B. Sequential verbal movements				
MCS (Max: 14)	0.00	7.00	7.00	4.00
SMS (Max: 14)	0.00	2.00	3.00	3.00
C. Diadochokinetic (DDK) tasks	-	-	-	-
D. Word Level praxis assessment				
Number of words attempted	20.00	44.00	38.00	41.00
Phonological process assessment				
Frequency	94.00	205.00	168.00	308.00
Space Errors	47.00	100.00	87.00	161.00
Timing Errors	9.00	15.00	9.00	38.00
Whole Word Errors	38.00	90.00	72.00	109.00
SMS - words (Max: 88)	8.00	6.00	9.00	3.00
Groping	3.00	6.00	3.00	9.00
Disfluencies	0.00	3.00	2.00	2.00
Weak precision	25.00	37.00	29.00	57.00
E. Sentence level praxis assessment				
SMS - sentence (Max: 16)	0.00	0.00	2.00	2.00
PCC	-	-	39.13	53.85
PVC	-	-	50	41.67
Sentence length	1-2	1-6	1-4	1-6
F. Analysis of Spontaneous speech				
Phonotactic assessment				
Number of utterances	82.00	52.00	51.00	79.00
Number of different syllable shapes	21.00	12.00	22.00	23.00
Monosyllables	39.02	34.62	41.18	58.97
Disyllables	57.32	59.62	50.98	37.18
Trisyllables	3.66	5.77	7.84	3.85
Initial geminate	20.00	0.00	0.00	15.00
Initial non-geminate	0.00	0.00	0.00	0.00
Medial geminate	80.00	100.00	77.78	65.00
Medial non-geminate	0.00	0.00	22.22	5.00
Final geminate	0.00	0.00	0.00	15.00
Final non-geminate	0.00	0.00	0.00	0.00
PCC	52.17	20.00	55.81	52.00
PVC	63.21	49.18	46.48	68.6
Groping	0.00	2.00	1.00	0.00
Disfluencies	2.00	0.00	0.00	1.00
Weak precision	24.00	35.00	26.00	42.00

Scores obtained by the participants with sAOS associated with Autism:

Domains & sub domains	Participant code					
	I	J	K	L	M	N
I. Oral motor skills						
A. Oral structures at rest (Max: 16)	9.00	13.00	12.00	16.00	15.00	13.00
B. Function of the oral mechanism (Max: 6)	1.00	0.00	1.00	1.00	1.00	0.00
II. Oral praxis skills						
A. Isolated oral movements	3.00	6.00	7.00	8.00	14.00	12.00
B. Sequential oral movements						
MCS (Max: 10)	0.00	0.00	0.00	0.00	0.00	0.00
SMS (Max: 10)	0.00	0.00	0.00	0.00	0.00	0.00
III. Verbal praxis skills						
A. Isolated verbal movements	26.00	28.00	19.00	25.00	33.00	30.00
B. Sequential verbal movements						
MCS (Max:14)	1.00	2.00	0.00	0.00	5.00	8.00
SMS (Max:14)	0.00	0.00	0.00	0.00	0.00	2.00
C. Diadochokinetic (DDK) tasks	-	-	-	-	-	-
D. Word Level praxis assessment						
Number of words attempted	9.00	44.00	11.00	15.00	44.00	12.00
Phonological process assessment						
Frequency	23.00	286.00	56.00	46.00	239.00	42.00
Space Errors	6.00	194.00	39.00	17.00	124.00	22.00
Timing Errors	0.00	33.00	5.00	2.00	12.00	2.00
Whole Word Errors	17.00	59.00	12.00	27.00	103.00	18.00
SMS - words (Max: 88)	0.00	6.00	7.00	3.00	9.00	2.00
Groping	2.00	19.00	4.00	7.00	7.00	6.00
Disfluencies	0.00	5.00	0.00	2.00	0.00	1.00
Weak precision	0.00	66.00	7.00	2.00	16.00	5.00
E. Sentence level praxis assessment						
SMS - sentence (Max: 16)	0.00	0.00	0.00	0.00	1.00	3.00
PCC	-	30.00	-	-	66.67	-
PVC	-	0.00	-	-	66.67	-
Sentence length	NR	1-3	NR	NR	1-6	1-3
F. Analysis of Spontaneous speech						
Phonotactic assessment						
Number of utterances	17.00	28.00	25.00	20.00	37.00	20.00
Number of different syllable shapes	7.00	10.00	8.00	9.00	15.00	10.00
Monosyllables	52.94	60.71	44.00	65.00	27.03	25.00
Disyllables	35.29	35.71	56.00	35.00	67.57	55.00
Trisyllables	11.76	3.57	0.00	0.00	5.41	15.00
Initial geminate	0.00	0.00	0.00	0.00	0.00	0.00
Initial non-geminate	0.00	0.00	0.00	0.00	0.00	0.00
Medial geminate	0.00	100.00	0.00	0.00	100.00	100.00
Medial non-geminate	0.00	0.00	0.00	0.00	0.00	0.00
Final geminate	0.00	0.00	0.00	0.00	0.00	0.00
Final non-geminate	0.00	0.00	0.00	0.00	0.00	0.00
PCC	-	-	-	-	-	-
PVC	-	-	-	-	-	-
Groping	0.00	2.00	4.00	2.00	2.00	2.00
Disfluencies	0.00	2.00	0.00	0.00	0.00	0.00
Weak precision	12.00	18.00	5.00	3.00	19.00	15.00

Scores obtained by the participants with sAOS associated with DCD:

Domains & sub domains	Participant code			
	O	P	Q	R
I. Oral motor skills				
A. Oral structures at rest (Max: 16)	9.00	1.00	13.00	11.00
B. Function of the oral mechanism for speech (Max: 6)	1.00	0.00	1.00	0.00
II. Oral praxis skills				
A. Isolated oral movements	26.00	10.00	9.00	9.00
B. Sequential oral movements				
MCS (Max: 10)	2.00	0.00	0.00	0.00
SMS (Max: 10)	0.00	0.00	0.00	2.00
III. Verbal praxis skills				
A. Isolated verbal movements	57.00	27.00	9.00	10.00
B. Sequential verbal movements				
MCS (Max: 14)	7.00	2.00	0.00	0.00
SMS (Max: 14)	5.00	0.00	0.00	0.00
C. Diadochokinetic (DDK) tasks	-	-	-	-
D. Word Level praxis assessment				
Number of words attempted	33.00	12.00	12.00	5.00
Phonological process assessment				
Frequency	127.00	57.00	57.00	20.00
Space Errors	73.00	34.00	40.00	13.00
Timing Errors	12.00	2.00	4.00	0.00
Whole Word Errors	42.00	21.00	13.00	7.00
SMS - words (Max: 88)	25.00	1.00	4.00	0.00
Groping	3.00	10.00	4.00	5.00
Disfluencies	1.00	1.00	2.00	0.00
Weak precision	25.00	5.00	12.00	0.00
E. Sentence level praxis assessment				
SMS - sentence (Max: 16)	1.00	0.00	0.00	1.00
PCC	47.06	33.33	-	-
PVC	46.15	0.00	-	-
Sentence length	1-4	1	NR	NR
F. Analysis of Spontaneous speech				
Phonotactic assessment				
Number of utterances	100.00	51.00	45.00	64.00
Number of different syllable shapes	28.00	13.00	16.00	11.00
Monosyllables	48.00	64.71	19.00	62.5
Disyllables	47.00	35.29	21.00	32.81
Trisyllables	5.00	0.00	3.00	4.69
Initial geminate	7.89	14.29	0.00	0.00
Initial non-geminate	0.00	0.00	0.00	0.00
Medial geminate	84.21	71.43	81.25	75.00
Medial non-geminate	5.26	14.29	18.75	25.00
Final geminate	2.63	0.00	0.00	0.00
Final non-geminate	0.00	0.00	0.00	0.00
PCC	67.58	19.35	-	49.09
PVC	75.00	43.75	-	36.36
Groping	10.00	15.00	4.00	7.00
Disfluencies	4.00	3.00	1.00	1.00
Weak precision	35.00	29.00	13.00	35.00