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Dysphagia

Development of a Multidisciplinary Feeding Profile for Children Who Are Dependent Feeders

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Abstract. The multidisciplinary feeding profile (MFP) is the first statistically based protocol for the quantitative assessment of feeding disorders in severely disabled children. This assessment can be completed in 30–45 min with foods and facilities that are available in homes, hospitals, and chronic care units. This paper describes the state of current testing methods, the parameters of successful feeding activity, the development of the test protocol, and the results of statistical analyses.

Key words: Feeding disorders, assessment – Feeding profile multidisciplinary

The oral preparatory phase of swallowing involves a complex range of activities that include food-getting, bolus management and transport, and mastication. Feeding disorders, which include malfunctions of the oral preparatory phase, present a major and complex problem for disabled persons. Clinicians and investigators who assess or treat such patients require an understanding of the normal anatomy and physiology of feeding and the pathophysiology of feeding disorders. The anatomical components of the oral preparatory phase involve the oral cavity, the pharynx, the muscles of mastication, and the mimetic musculature of the face. The functional components of oral feeding include food-getting, masticatory efficiency, the formation of a swallow-safe bolus, and the initiation of swallow.

A disruption in the anatomical structures or physiologic function of the feeding system can severely inhibit the individual's ability to feed safely and to deliver a sufficient quantity of food to the gastrointestinal tract to be nutritionally supportive. Feeding disorders can be congenital or acquired and anatomical or functional in nature. Patients with cleft lip and palate [1, 2], excised oral and neck carcinomas [3], dental abscesses [4], and those who are neurologically impaired [3] are included.

Furthermore, children who do not ingest solid foods at a "critical period" in their development when chewing solids normally begins may miss that milestone of development. This may lead to the rejection of solids introduced into the mouth at a later date [5]. It is thought that a child who is tube-fed or who is developmentally delayed is at risk of not having the stimulus of solid foods applied at the "critical period" to produce normal chewing and swallowing actions. Older patients fed by a nasogastric feeding tube with prolonged abstinence from oral intake may also lose their ability to initiate a swallow [6].

Dysphagia is often a sequela of head injuries [7] or occurs in patients who have suffered brainstem or anterior cortical strokes [8–10]. Damage to the cranial nerves or to the brainstem will cause weakness or paralysis to muscles of the face or oropharyngeal region. Protective reflexes of the palatopharyngeal region may be diminished or absent [11]. Logemann [3] has reported that the delay or absence of stimulation of swallowing and cricopharyngeal dysfunction are the two most frequent problems of patients in this group. Cortical injury may remove higher brain center inhibitory influences on primitive vegetative functions (e.g., suckle reflex) and interfere with the mature feeding process in such patients. Mastication may be limited to the basic jaw opening and closing movements with no apparent lateralization of the jaw.

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Primitive reflexes of the normal infant such as suckle-swallow, rooting, gagging, and biting are essential for infant survival or are part of normal development [12]. However, the persistence of these and other primitive reflexes such as the asymmetrical tonic neck reflex (ATNR) often observed in patients with developmental delay, cerebral palsy, or head injury can interfere with the patient's feeding skills [13, 14]. Abnormal responses such as bite reflex, suckle-swallow reflex, lack of tongue lateralization, instability of lower jaw, and phasic biting can severely limit the individual's ability to masticate, position, and swallow a food bolus safely.

A proper body position for feeding is essential to promote normal swallowing [15]. Ideal feeding requires that a person be placed in a seated position with the buttocks well back in the chair, knees bent, and trunk and head in the midline. The neck should be in slight ventroflexion. This position facilitates normal head and oral motor activity during feeding and maintains proper breathing patterns [14]. It also provides good alignment of the upper alimentary tract [15] and minimizes occurrence of the gag reflex [6]. By 18 months of age a normal child can usually sit in a chair unsupported [16]. However, the neurologically disabled individual may require trunk, neck, and head supports.

Head and trunk control are crucial for the normal self-feeding individual [16]. A person must be able to control head and mouth movement independently from the rest of body to be successful as a self-feeder [14]. The ATNR is a reflex rotation of the head away from the arm as the arm flexes toward the body. This reflex can be observed in normal infants from birth to 6 months of age [17]. Patients with cerebral palsy and head injured persons may display strong ATNRs that interfere with their ability to bring food to the mouth as the head reflexly moves away from the approaching hand [13, 17, 18].

The degree of neck flexion/extension can influence neurologically impaired patients as they feed. Neck extension can inhibit muscular movements of swallowing [6] and can align the airway to facilitate aspiration [15]. A patient who has an extensor thrust "reflex" can go into full body extension as a result of the hyperextension of the neck. This full-body extension interferes with positioning and subsequent feeding attempts [14]. It often requires that the patient be restrained in a seat for feeding.

Control of body posture is a fundamental component of feeding. The clinician must evaluate the patient's posture and make the necessary changes and provisions to facilitate safe feeding. An inability to control motor responses that interfere with feeding must be minimized in an effort to allow the patient to become a self-feeder.

The feeding therapist uses techniques designed to reduce abnormal reflexes, improve muscle tone, and increase or decrease sensorimotor input to improve feeding skills. The range of anatomical variations, primitive reflexes, and even postural factors described above all appear to be relevant to the oral preparatory phase of swallowing. Nevertheless, most if not all of the techniques used in feeding therapy are empirically based with little scientific validation [14]. Techniques are often applied without complete diagnoses or any quantitative means of measuring their outcome. Before diagnosis-based therapy can even be designed, a quantitative means of assessment and diagnosis of oral feeding skills is required. A number of clinicians have developed feeding assessments, but they vary widely in content, quantification techniques, and statistical analysis.

Feeding Assessments

Morris [19] produced her pre-speech assessment scale (PSAS) for children with feeding disorders. The normal values of the PSAS were established by analysis of video films made of six normal infants. The infants were filmed monthly from birth to 12 months, at 3 month intervals between 12 and 24 months, and again at 36 months. The PSAS is used to assess a child's developmental feeding milestones by quantifying an observed motor function based on Morris's previously established norms. The clinician can then display graphically how the tested child compares to the PSAS norm. The PSAS requires a significant time commitment both to learn how to administer it and then to assess the individual. Furthermore, PSAS assessment reliability is based upon percentage-of-agreement of therapists (different categories ranged from 65% to 87% agreement) who were asked to score filmed samples of behavior. Percentage-of-agreement is a statistical measure that ignores the extent of agreement expected by chance [20]. It is inadequate for estimating reliability [21]. Finally, the PSAS was developed mainly for speech pathologists rather than for a multidisciplinary group of clinicians.

Stratton's [22] behavioral assessment scale of oral functions in feeding is a clinically practical assessment that documents oral preparatory function. This scale was designed to identify areas of the patient's strengths and deficits for feeding.

However, the scale measures only a limited number of oral motor functions and does not deal with nonoral motor function such as the postural factors shown to be important for normal feeding. Although this scale was not designed for statistical analysis, Ottenbacher and colleagues [23] applied statistical measures to it. Individual interrater reliability coefficients for two separate samples were 0.72 and 0.76, which Ottenbacher viewed to be only marginally acceptable based upon other studies that recommend reliabilities of 0.80 and greater [24, 25]. Ottenbacher suggested that expansion and refinement of the Stratton assessment might produce more traditionally accepted statistical reliabilities.

The Rehabilitation Institute of Chicago evaluation of dysphagia (CED) [26] provides the therapist with an assessment package for feeding disorders. However, although mastication and swallowing are included in the assessment, it fails to include limb/trunk control and ventilation. The CED facilitates organization of a therapist's clinical observations into a concise package but it is a qualitative evaluation of feeding skills. It provides no accurate means of measuring changes in performance other than traditional written clinical impressions.

Rationale for this Study

The Morris PSAS, Stratton's behavioral assessment scale of oral functions in feeding, and other assessment protocols all have significant limitations. These limitations provided the incentive to develop a new protocol for the assessment of patients with feeding disorders. The protocol was designed to be easy to learn, clinically efficient of both time and equipment, and provide a comprehensive quantitative assessment of the patient. Finally, the protocol was to be statistically analyzed for rater agreement and consistency. It was the goal of the pilot group to make the assessment protocol multidisciplinary in nature to enable clinicians of different health disciplines to make reliable evaluations of neurologically disabled children. Populations of patients with feeding disorders are naturally classified into those who can feed themselves and those who cannot (dependent feeders). Dependent feeding was chosen for the inclusion criterion since dependent feeders are the most functionally disabled and often the subject of decisions about oral bypass feeding methods.

This paper describes the pilot study, the main study, and presents the multidisciplinary feeding profile (MFP) in its final form. A companion paper [27] described the statistical analyses of both studies and the significance of the MFP to clinicians.

Methods and Patients

The pilot MFP was developed by the authors (except P.L.J.) and other consultants. It consisted of 198 items organized into 6 sections: physical/neurologic, oral-facial structure, oral-facial sensory inputs; oral-facial motor function, ventilation/phonation, and functional feeding assessment.

Each test item had a variable number of response option cells in an array that represented the range of a subject's ability to perform a feeding task or the presence/absence of normal and abnormal behaviors or reflexes. Each test item had a numerical scale for each option cell to allow quantification of the subject's disability and statistical analysis of the data. Numerical values from 1 to 5 were chosen to allow for differentiation of the various responses. A value of 5 represented normal ability, while a 1 represented either the inability to perform a task or the rater's inability to determine if the subject could perform the task.

A pilot study of 8 children and adolescents who were dependent feeders due to neurologic deficits was completed by three of the authors: a speech pathologist, an occupational therapist, and a pediatric dentist (J.G., D.R., D.J.K.). Each child was tested once by each rater. Each test item and the pilot MFP as a whole was analyzed for interrater reliability. Statistical details are given in the companion paper [27]. Some items were discarded while others were reworded and clarified. A total of 146 items were included in the protocol used for the main study. Videotape records were made during the pilot study to provide a training aid for raters chosen for the main study. A draft training manual was also developed to assist in the administration and interpretation of patients responses.

Three different naive raters from the same specialities – speech pathology, occupational therapy, and pediatric dentistry (R.G., M.M., P.L.J.) – took part in the main study. They were trained with a clinical videotape and manual. These raters applied the protocol to 18 different neurologically impaired children and adolescents, who were all dependent feeders. Each child was tested by each rater on a one-to-one basis. At no time did the raters confer with each other. Assessments took place at the same time of day in the same room over a 2 week period. The room lacked external stimuli to maximize the subjects' concentration. Thirty to 45 min were required for a rater to complete the assessment of a single subject.

Although it was not practical to select 18 subjects randomly from a larger population sample, the investigators were "blind" to the selection of subjects: subjects were selected by other clinicans who were unaware of the precise details of the study. There were 10 boys and 8 girls in the sample. Their ages ranged from 6 to 18 years, with a mean age of 10.2 years. Half of the subjects were 7 years or younger. The only eligibility criterion for acceptance was the classification of "dependent feeders", that is, patients who were unable to feed themselves without the assistance of a caregiver.

Each test item of the revised MFP was examined statistically for rater agreement and for its clinical value. Weighted kappa coefficients [28] were calculated for each pair of raters for each of the 146 items of the main study as a measure of interrater agreement. The weighted kappa coefficient was used to correct for rater agreement expected by chance. The calculation of the weighted kappa depends, in part, on the use of different penalty weights for different degrees of disagreement, that is, when the response choices of an item are scored on an ordinal scale. The results of this preliminary analysis helped

the investigators to identify which test items gave rise to sufficient disagreement to warrant a closer examination of their content and wording. These items were identified and subsequently reworded for future versions of the MFP or were eliminated.

In the main study a subject's score for each section and his or her total score over all six sections were calculated by the summation of the value of each cell chosen by the rater. The section scores and total scores were subjected to a two-way analysis of variance. The distribution of section scores and total scores for all subjects were examined for normality and homogeneity to see if the two-way analysis of variance was appropriate. Two-way repeated measures analyses of variance were then performed.

Intraclass correlation coefficients to measure rater agreement and rater consistency were calculated. The intraclass correlation coefficient (ICC) is now generally accepted as the best method to quantify reliability [20, 29]. This study used two different versions of the ICC: one to measure rater agreement and the other to measure rater consistency.

Results

The calculation of weighted kappa coefficients for each of the 146 items for each pair of raters led to the selection of 136 test items for further statistical analysis. The revised MFP includes all 136 items chosen as well as 56 items deemed clinically important for the MFP that were retained but were not part of the scores. The complete MFP forms are shown in Figure 1. The numbers shown are the values assigned to each option cell. Not analyzed (NA) refers to option cells included for clinical value. These items will be retested and the results reported in a future study.

Rater agreement and consistency were calculated as intraclass correlations [30]. The reliability of the total score is 0.86 (agreement) and 0.90 (consistency). Detailed statistical information, interpretation, and discussion are included in the companion paper [27].

Discussion

The results of this study show that the MFP is a reliable assessment protocol for children with neurologic deficits that render them unable to feed themselves. The range of clinical data that the MFP encompasses makes it a comprehensive feeding disorder assessment package with a multidisciplinary base. Furthermore, the 30–45 min required to complete a patient assessment fulfill the requirement that it be a clinically practical assessment battery. Each item of the MFP has been judged for both its statistical and clinical value. The high interrater agreement of 0.86 for the total 136 items demonstrates the MFP's reliability among different raters. Furthermore, the strong rater agreement shows that the MFP has been successfully designed for use by different health professionals who treat patients with feeding disorders. The still higher intraclass correlation of 0.90 that reflects rater consistency demonstrates that the MFP allows trained raters from a variety of health disciplines to quantify and rank the degree of disability of dependent feeders.

The assessment of physically and/or mentally handicapped subjects is difficult and the subjects of this study were no exception. Those who have worked with such patients understand the difficulties an investigator must deal with in a clinical study that assesses performance skills. Decreased motor control, sensory-motor deficits, communication difficulties, and altered cognitive function challenge the investigator's ability to assess these individuals accurately. As well as the low functional level of the subjects of this investigation, the physically and/or mentally disabled patient shows variability in his or her performance skills on a day-to-day basis. As a result, the investigators cannot put the rigid control demands on the subjects they would in experimental designs for normal adult subjects.

An assessment protocol for feeding disorders requires statistical verification for its reliability. The developers of such a protocol should justify the use of the test statistic selected to measure rater reliability. They must also address the importance of content validity in the development of such a protocol. The application of statistics to measure an assessment protocol for clinical appropriateness should be done in conjunction with clinical assessment. A combination of statistical tests and clinical input is the best method for developing a clinically valid, statistically reliable assessment protocol for feeding disorders such as the MFP. The need for a comprehensive, standardized evaluation of oral-motor and feeding function has been recognized [31]. The MFP is the first statistically developed protocol for patients who are dependent feeders.

The content validity of this protocol was addressed by the clinicians of a multidisciplinary team experienced in the assessment and treatment of children with feeding disorders. Content validity depends upon the extent to which an empirical measurement reflects a specific domain of content. A content-valid protocol for the assessment of feeding disorders must have enough items to satisfy the full domain of content that is relevant to the assessment. It is impossible to determine the exact number of items required to satisfy the domain of content, but it is always better to begin with the construction of too many test items rather than too few, since inadequate items can always be

Fig. 1. Multidisciplinary Feeding Profile

Section 1: Physical/Neurological
An examination of the person with respect to postural factors, tone, reflex activity, and basic motor skills important for feeding. Begin with the child in his or her most typical feeding position.

1.1 Feeding Position (Check manual for desired feeding position)
Do you feel this seating position is appropriate for feeding? Yes ____ No ____
If yes, the person is tested in this position for the remaining sections of the protocol.
If no, specify why: _____

Then, attempt to place the child in the more desirable feeding position described below, before proceeding with the assessment. Record changes attempt and changes achieved.

	Attempted		Achieved	
	Yes	No	Yes	No
(a) Buttocks well back into seat, hips flexed	NA	NA	NA	NA
(b) Head forward, in midline	NA	NA	NA	NA
(c) Shoulders and arms forward	NA	NA	NA	NA

	Upright	Forward	Backward	Sideways	Variable/Inconsistent
1.2 Head position	4	1	1	1	1
1.3 Trunk position	4	1	1	1	1

1.4 Upper limb control Observe for type of grasp and hand preference. In addition, observe for tone and record in 1.6.

	Normal	Awkward (slow/unsteady)	Absent	Unable to determine
(a) Arms to midline	4	2	1	1
(b) Reach and grasp	4	2	1	1
(c) Hand to mouth	4	2	1	1

	Opposed (fine prehension)	Palmar (whole hand)	Reflex
(d) Type of grasp	4	3	1

	Right	Left	Mixed	Unable to determine
(4) Hand preference	NA	NA	NA	NA

1.5 Reflexes Note and record presence or absence of the following reflexes.

	Absent	Present	Variable
(a) ATNR (asymmetrical tonic neck reflex)	5	2	2
(b) Extensor thrust	5	2	2
(c) Startle reflex	5	2	2

	Normal	Increased	Decreased	Fluctuating
1.6 Muscle tone	5	2	2	2

1.7 Physique

	Very thin	Slim	Normal	Rounded	Fat
(a) Appearance	3	4	4	4	3

(b) Skin fold: Pick up the skin from the back of the upper arm between the thumb and forefinger. How thick is the skin fold? <1.0 cm NA; 1.0–1.5 cm NA; >1.5 cm NA

Section 2. Oral-Facial Structure
An evaluation of the face and mouth at rest to identify variations from the normal, using surface anatomy exclusively. Observe for involuntary oral movements and note in 2.11.
There may be more than one appropriate choice per category. Check as necessary.

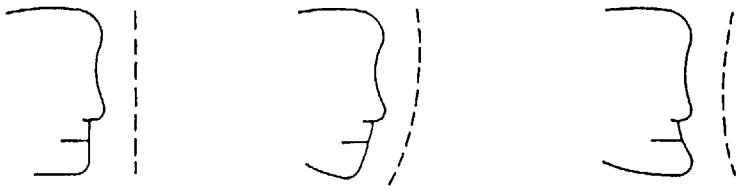
Extraoral

2.1 Frontal view

Symmetrical	Assymetrical	
(a)	Right (b)	Left (c)
4	increased facial volume 1	increased facial volume 1
	decreased facial volume 1	decreased facial volume 1

2.2 Profile view

Straight	Convex	Concave
NA	NA	NA



2.3 Mandible and lips Choose "most frequent head position" and then check appropriate mandible and lip position.

	Closed	Apart		
(a) Typical position of lips	4	1		
	Front teeth 2–3 mm apart		Front teeth > 3 mm apart	
(b) Typical mandibular position	NA		NA	
(c) Involuntary movements of mandible	Yes 2		No 5	
(d) Involuntary movements of the lips	Yes 2		No 5	

2.4 Structure of lips (at rest)

	Normal	Short
(a) Upper lip	5	2
	Normal	Enlarged/soft
(b) Lower lip	4	1

2.5 Nostrils

Free	Blocked	
	Right	Left
NA	NA	NA

Begin by closing the subject's mouth and then check blockage of right nostril by placing your finger firmly against the left nostril and have the person breathe. Repeat process for the left nostril. Listen for airflow.

Intraoral

2.6 Tongue

Stops at lower incisor teeth	5
Protrudes onto lower lip	3
Protrudes over lower lip	2
Variable/inconsistent	2

2.7 Teeth

	Primary	Mixed Dentition	Permanent	
(a) Stage	NA	NA	NA	
	Appear normal	Poor oral hygiene	Obvious decay	Enlarged gums
(b) Health of teeth	4	3	2	2

Occlusion (more than one category may apply)

(c) Upper and lower back teeth fit together	5
(d) Upper/lower front teeth apart	2
(e) Front teeth missing	3
(f) Protruding upper teeth	3
(g) Lower teeth ahead of upper teeth	2

2.8 Hard palate

Normal	High arched	Abnormal opening
4	3	2

2.9 Soft palate

Normal	Long and droopy	Unable to determine
4	2	3

2.10 Drooling at rest

Absent	Excess saliva in mouth	Wet lips	Wet chin to overt drooling
5	3	3	2

2.11 Involuntary movements

(a) Head	2	(d) Tooth grinding	2
(b) Mandible	2	(e) Tongue gross	2
(c) Lips	2	(f) Tongue intrinsic	NA

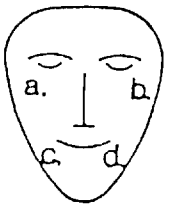
Section 3. Oral-Facial Sensory Inputs

A subjective of sensation and reflex motor activity produced by stimulation of selected cranial nerves. If the child is unable to understand or cooperate, please fill out the "Unable to determine" categories of this section.

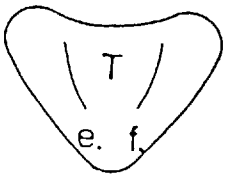
Trigeminal

3.1 Cutaneous sensation (soft touch) Requires Q-Tips

Face



Tongue Tip



	Present	Absent	Unable to determine
(a)	4	1	1
(b)	4	1	1
(c)	4	1	1
(d)	4	1	1

	Present	Absent	Unable to determine
(e)	NA	NA	NA
(f)	NA	NA	NA

Glassopharyngeal-Vagus complex

3.2 Gag reflex (touch with tongue depressor) As soon as gag reflex is elicited, stop and record.

(a) Stimulus applied to:

	Present	Absent	Unable to determine
Tonsillar pillar (right)	NA	NA	NA
Tonsillar pillar (left)	NA	NA	NA
Posterior 1/3 dorsum of tongue (right)	NA	NA	NA
Posterior 1/3 dorsum of tongue (left)	NA	NA	NA

(b) If gag reflex is hypersensitive, mark the following stimulus categories

	Present	Absent
Visual	NA	NA
Within mouth but not touching structures	NA	NA
Within mouth and touching oral structures	NA	NA
Soft palate	NA	NA

If there is no gag reflex does the person attempt to protect the airway in other ways?

(c) Tongue	Yes	NA	No	NA
Jaw clenching	Yes	NA	No	NA
Other resistive movements	Yes	NA	No	NA

Section 4: Oral-Facial Motor Function

All voluntary motor functions except those of actual sucking, mastication, or swallowing. Observe for involuntary movements during testing of 4.1, 4.2, and 4.3 and note results at end of 4.3.

Trigeminal

4.1 Voluntary jaw opening (perform three trials if necessary)

	Yes	No	Unable to determine
(a) Maintain for 2 s	5	1	1

If Yes, check the appropriate category below

	Midline	Right deviation	Left deviation	Inconsistent
(b)	4	1	1	1

	Normal	Weak	Unable to perform
(c) Open against resistance	NA	NA	NA
(d) Close against resistance	NA	NA	NA

4.2 Voluntary jaw protrusion

	Yes	No	Unable to determine
(a)	NA	NA	NA

If "yes" check the appropriate category below for front view

	Midline	Right deviation	Left deviation	Inconsistent
(b)	NA	NA	NA	NA

4.3 Voluntary lateral jaw movements

	Yes	No	Unable to determine
(a) Right	4	1	1
(b) Left	4	1	1

(c) Are there involuntary jaw movements? Yes 2 No 5

4.4 Rapid coordinated jaw movements Movements are to be performed continuously and rhythmically for 3 s to be scored "present." Observe for associated movements during all rapid motor tests and note at end of 4.12.

	Present	Rhythm slow	Rhythm slows with time	Rhythm irregular	Unable to perform	Unable to determine
(a) Tooth tap	4	3	1	1	1	1
(b) Rapid lateral excursion of jaw	4	3	1	1	1	1

4.5 Voluntary facial movements

	Symmetrical	Weakness Right/Left		Unable to perform	Unable to determine
(a) Show teeth	4	3	3	2	2
(b) Pucker lips	5	3	3	1	1

4.6 Lip muscle strength

	Present Strong	Present Weak	Unable to perform	Unable to determine
Puff out cheeks and maintain seal under pressure	4	3	1	1

4.7 Rapid coordinated lip movements Movements are to be performed continuously and rhythmically for 5 s to be scored "present."

	Present	Rhythm slow	Rhythm slows with time	Rhythm irregular/erratic	Unable to perform	Unable to determine
(a) Protrusion/retraction of lips	4	3	1	1	1	1
(b) Pa-pa-pa-pa-pa-pa-	4	3	1	1	1	1

Glossopharyngeal and vagal motor

4.8 Voluntary elevation of soft palate Have the patient say sustained "ah...".

Symmetrical	Weakness Right	Weakness Left	Unable to perform	Unable to determine
4	3	3	1	1

4.9 Rapid coordinated palatal movements Movements are to be performed continuously for 5 s with clear and distinct "m" and "b" sounds required to be scored as "adequate."

	Adequate	Poor	Unable to determine
mm-bah, mm-bah	4	3	1

Hypoglossal motor (voluntary tongue movements)

4.10 Voluntary protrusion of tongue

	Yes	No	Unable to determine
(a)	5	2	2

If "yes" check the appropriate category below.

	Midline	Right deviation	Left deviation	Inconsistent
(b)	4	1	1	1

4.11 Voluntary elevation and lateralization of tongue

(a) Lift tip of tongue to back of upper incisors and repeat "t-t-t-t"	Yes 5	No 2	Unable to determine 2
(b) Lift back of tongue to soft palate and repeat "ing-ing-ing"	Yes 5	No 2	Unable to determine 2
Move tongue to corners of mouth			
(c) Right corner	Yes 5	No 2	Unable to determine 2
(d) Left corner	Yes 5	No 2	Unable to determine 2

4.12 Rapid coordinated tongue movements Movements are to be performed continuously and rhythmically for 3 seconds to be scored "present."

	Present	Rhythm slow	Rhythm slows with time	Rhythm irregular	Unable to perform	Unable to determine
(a) t-t-t-t-	4	3	1	1	1	1
(b) k-k-k-k-	4	3	1	1	1	1

4.13 Presence of associated movements during rapid motor activity indicated by check.

Facial	NA	Upper limbs	NA
Tongue	NA	Lower limbs	NA
Head	NA		

Section 5. Ventilation/Phonation

A subjective evaluation of breathing and sound production

Ventilation

5.1 Predominant breathing state at examination

	Yes	No	Unable to determine
(a) Mouth breather	2	4	3
(b) Nose breather	NA	NA	NA

5.2 Voluntary deep breath on request? Yes 4 No 1

5.3 Depth of breathing

Appears normal	Excessively shallow and/or rapid	Excessively deep and slow
4	1	1

5.4 Breathing rhythm

Rhythmic NA Disrhythmic NA

5.5 Maximum prolonged production of s-s-s-s-

Unable to perform	< 5 s	5–10 s	10–15 s (child)	> 15 s (adult)
NA	NA	NA	NA	NA

Phonation

5.6 Ability to initiate voice Perform three trials if necessary. If unable to initiate voice, proceed to Section 6.

Say "ah" Yes 4 No 1

5.7 Maximum prolonged production of "ah..." Note quality and mark in section 5.8

Unable to perform	< 5 s	5–10 s	10–15 s (child)	> 15 s (adult)
NA	NA	NA	NA	NA

5.8 Quality of voice

Adequate	Breathy	Strained/strangled	Gurgly
NA	NA	NA	NA

5.9 Loudness of habitual voice

Adequate	Excessively low	Excessively loud
NA	NA	NA

5.10 Pitch of habitual voice

Adequate	Excessively low	Excessively high
NA	NA	NA

Section 6. Functional Feeding Assessment

An evaluation of oral-motor skills during specific feeding tasks. The person is tested in his or her typical feeding position.

Be cautious when introducing food or liquid into the mouth, particularly if there is a history of choking.

Swallowing (6.6) and Associated movements (6.7) can be assessed during each of the following feeding tasks, or, if necessary, repeat the activities to obtain information.

6.1 Spoon Feeding

Use of a soft consistency food such as pudding, yogurt, or pureed foods.
Observe for normal and abnormal patterns and associated movements during spoon feeding and be prepared to note observations in the appropriate grids.

Normal Patterns	Adequate	Poor	Absent	Unable to determine
(a) Holds head steady, slightly forward in midline	5	3	2	2
(b) Brings head forward to spoon	4	3	2	2
(c) Opens mouth to sight of spoon	5	3	2	2
(d) Keeps tongue still on floor of mouth	5	3	2	2
(e) Brings upper lip down and forward over spoon	5	3	2	2
(f) Holds jaw stable	5	3	2	2
(g) Pulls lower lip inwards under spoon	5	3	2	2
(h) Clears excess food off lips with tongue	4	3	2	2
(i) Keeps lips closed during swallowing	4	3	2	2
Abnormal Patterns	**Absent**	**Inconsistent**	**Present**	**Unable to determine**
(j) Suckle-swallow reflex	5	1	1	4
(k) Bite reflex	5	1	1	4
(l) Gag reflex	NA	NA	NA	NA
(m) Jaw thrust (down and forward)	5	1	1	4
(n) Tongue thrust	5	1	1	4
(o) Lip retraction	5	1	1	4
(p) Aversive withdrawal (lip retraction, or open mouth, or head turning	5	1	1	4

6.2 Biting

Food should be placed between the grinding surfaces of the molars. Use a strip of arrowroot cookie and cheese.
Observe for normal and abnormal patterns and associated movements during biting and be prepared to note on the appropriate grids.

Normal Patterns	Adequate	Poor	Absent	Unable to determine
(a) Holds head steady, slightly forward in midline	NA	NA	NA	NA
(b) Grades mouth opening	4	3	2	2
(c) Keeps tongue still on floor of mouth	5	3	2	2
(d) Brings upper and lower molars together	4	3	2	2
(e) Exhibits controlled (graded) bite	4	3	2	2
(f) Breaks through arrowroot cookie	4	3	2	2
(g) Breaks through cheese 0.5 cm thick	4	3	2	2
Abnormal Patterns	**Absent**	**Inconsistent**	**Present**	**Unable to determine**
(h) Tonic bite reflex	NA	NA	NA	NA
(i) Gag reflex	NA	NA	NA	NA
(j) Jaw thrust (down and forward)	5	1	1	4
(k) Tongue thrust	5	1	1	4
(l) Sucking	5	1	1	4
(m) Phasic biting	5	1	1	4
(n) Aversive withdrawal (lip retraction, or open mouth, or head turning	5	1	1	4

6.3 Chewing

If the person is unable to bite, a piece of arrowroot cookie 1 cm × 2 cm can be placed between the grinding surfaces of the molars. Be aware and prepared for the possibility of choking. Observe for normal and abnormal patterns and associated movements during biting and be prepared to note on the appropriate grids.

Normal Patterns	Adequate	Poor	Absent	Unable to determine
(a) Holds head steady, slightly forward in midline	NA	NA	NA	NA
(b) Moves food from side to side with tongue (rotary jaw movement)	5	3	2	2
(c) Forms adequate bolus	5	3	2	2

	Abnormal Patterns	Absent	Inconsistent	Present	Unable to determine
(d)	Suckle-swallow reflex	5	1	1	4
(e)	Sucking	5	1	1	4
(f)	Munching (vertical jaw movements only)	5	1	1	4
(g)	Moves tongue from midline to side only	5	1	1	4
(h)	Jaw thrust (down and forward)	5	1	1	4
(i)	Tongue thrust	5	1	1	4
(j)	Lip retraction	5	1	1	4

6.4 Cup drinking

Use a cut-out disposable cup and any liquid the person likes.

Observe for normal and abnormal patterns and associated movements during biting and be prepared to note on the appropriate grids.

	Normal Patterns	Adequate	Poor	Absent	Unable to determine
(a)	Holds head steady, slightly forward in midline	NA	NA	NA	NA
(b)	Brings head forward to cup	4	3	2	2
(c)	Forms lip seal on cup	5	3	2	2
(d)	Keeps tongue within oral cavity	5	3	2	2
(e)	Keeps jaw and lower lip stable	5	3	2	2
(f)	Moves upper lip to draw in liquid	5	3	2	2
(g)	Able to take sequence of sips	4	3	2	2
(h)	Adjusts rate of inflow by pulling back	5	3	2	2
	Abnormal Patterns	Absent	Inconsistent	Present	Unable to determine
(i)	Suckle-swallow reflex	5	1	1	4
(j)	Bite reflex	5	1	1	4
(k)	Tongue thrust	5	1	1	4
(l)	Lip retraction	5	1	1	4
(m)	Jaw thrust (down and forward)	5	1	1	4
(n)	Aversive withdrawal (lip retraction, or open mouth, or head turning)	5	1	1	4

6.5 Straw drinking

Use a plastic straw of regular bore and length.

Observe for normal and abnormal patterns and associated movements during biting and be prepared to note on the appropriate grids.

	Normal Patterns	Adequate	Poor	Absent	Unable to determine
(a)	Holds head steady, slighty forward in midline	NA	NA	NA	NA
(b)	Brings head forward to straw	4	3	2	2
(c)	Forms lip seal around straw	5	3	2	2
(d)	Able to continuously draw in liquid	4	3	2	2
	Abnormal Patterns	Absent	Inconsistent	Present	Unable to determine
(e)	Suckle-swallow reflex	5	1	1	4
(f)	Holds straw grently between top and bottom teeth without lip seal	5	1	1	4
(g)	Takes only brief single sips	NA	NA	NA	NA
(h)	Bite reflex	5	1	1	4
(i)	Gag reflex	NA	NA	NA	NA
(j)	Tongue thrust	5	1	1	4
(k)	Lip retraction	5	1	1	4
(l)	Aversive withdrawal (lip retraction, or open mouth, or head turning	5	1	1	4

6.6 Swallowing

Repeat any of the previous tasks to facilitate completion of this section.

	Normal Patterns	Adequate	Poor	Absent	Unable to determine
(a)	Holds head steady, slightly forward in midline	NA	NA	NA	NA
(b)	Transports solids to back of mouth	5	3	2	2
(c)	Keeps lips closed while swallowing solids	4	3	2	2
(d)	Transports liquids to back of mouth	5	3	2	2
(e)	Keeps lips closed while swallowing liquids	5	3	2	2

Abnormal Patterns	Absent	Inconsistent	Present	Unable to determine
(f) Suckle-swallow reflex	5	1	1	4
(g) Tongue thrust	5	1	1	4
(h) Gag reflex	NA	NA	NA	NA
(i) Coughing	5	1	1	4
(j) Choking	5	1	1	4
(k) Food loss	5	1	1	4
(l) Liquid loss	5	1	1	4
If present, specify amount	Mild	Moderate	Severe	
(m) Coughing	2	2	2	
(n) Choking	2	2	2	
(o) Food loss	2	2	2	
(p) Liquid loss	2	2	2	
6.7 Associated movements	Absent	Inconsistent	Present	Unable to determine
(a) Facial	NA	NA	NA	NA
(b) Tongue	NA	NA	NA	NA
(c) Head	NA	NA	NA	NA
(d) Upper limbs	NA	NA	NA	NA
(e) Lower limbs	NA	NA	NA	NA
(f) Others (specify)	NA	NA	NA	NA

6.8 Drooling during eating

Absent	Excess saliva in mouth	Wet lips	Wet chin to overt drooling
5	3	3	2

eliminated [32]. A total of 52 items were discarded from the pilot study and others were altered or reworded as a result of kappa coefficient analysis. Additional test items were discarded and reworded or altered and included as NA in the protocol shown here (Table 1).

Although the investigators consider the MFP to be content-valid based upon their experience, content validity has not been assessed in this study. The limitation of content validity is that there is no agreed-upon criterion for the determination of the extent to which a protocol has attained content validity [32]. Nunnally [25] stated that "content validity rests mainly on appeals to reason regarding the adequacy with which important content has been sampled and on the adequacy with which the content has been cast in the form of test items".

Each test item of the MFP has been judged for both its clinical and statistical value. Not only is the overall reliability of the assessment important, but the individual components (items) of the protocol should also be reliable. Measurement of the overall reliability of the protocol is pointless if there are significant weaknesses in the components. Therefore, in this case, individual items of the MFP were first analyzed for rater agreement to identify which items of the MFP gave rise to unacceptable levels of disagreement.

The reliability of this protocol is important in that it reflects consistency of results with repeated measurements. However, the question remains: Is the MFP valid and does it do what it is intended to? Validation of empirical results requires a set of accepted criteria against which the results of the MFP can be evaluated [33]. This "gold standard" does not exist for feeding assessment protocols. Today's gold standards for other clinical protocols had no standards to be compared with in their early development. The standards were accepted as valid based upon their content validity and then stood the test of time. Only after repeated tests did they gain credibility. The MFP may be in the same position. Since it is the first feeding assessment protocol to be designed with rigorous statistical analysis, no other feeding protocol has qualities that can be used to measure the MFP's criterion-oriented validity. Therefore, its criterion-based validity will have to be assessed against less exacting (nonquantitative) means such as clinical judgement. However, proving validity was not the purpose of this study and this problem will have to be addressed in the future. If colleagues who treat such patients use the MFP and find it to be content-valid, its validity will eventually be established by their independent critical evaluation.

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