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Original Research

Evaluation of the Effect of Oral Motor Stimulation Exercises on Feeding Skills in Premature Infants

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Abstract

Objectives: Oral feeding in preterm infants is a complex and dynamic process involving oral motor development and interaction between the neurological, cardiorespiratory, and gastrointestinal systems. Oral motor stimulation (OMS) is defined as stimulating the oropharyngeal components such as the lips, jaw, tongue, and soft palate with fingers in preterm infants to increase their feeding skills. In this study, we aimed to evaluate the effect of OMS exercises on the sucking and swallowing skills of preterm infants and demonstrate the utility of objective scales to evaluate infants' readiness for oral feeding.

Methods: This single-center, prospective cohort study was conducted between June 1st and December 31st, 2020, which included preterm infants born at ≤34 weeks of gestation and admitted to the neonatal intensive care unit of our hospital. All procedures of the OMS program were performed once a day, 5 times a week by a language and speech therapist who is an expert in oral feeding skills (OFS) staging and non-nutritive sucking (NNS) scoring. All infants were followed up until discharge with a weekly evaluation of OFS staging and NNS scoring.

Results: A total of 50 infants were included in this prospective cohort study. The mean birth weight was 1376.9±372 g, and the median gestational age was 30 weeks (interquartile range: 25–34). The comparison of OFS stages on day 5 and day 10 of OMS revealed a significant increase ($p<0.001$). Similarly, there was a significant improvement in the NNS scores on days 5 and 10 compared to the baseline.

Conclusion: In preterm infants, OMS during the transition from gavage feeding to oral feeding improves feeding skills.

Keywords: Feeding skills, oral motor stimulation, preterm

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Oral feeding in preterm infants is a complex and dynamic process involving oral motor development and interaction between the neurological, cardiorespiratory, and gastrointestinal systems.[1-3] Inability to reach adequate feeding delays hospital discharge, resulting in the infant having longer exposure to the adverse environmental conditions of the neonatal intensive care unit (NICU) and nosocomial infectious agents.[3-6] Causes of oral feeding difficulties in preterm infants include poor sucking organization, uncoordinated suck-swallow-breath pattern, and oral hypersensitivity to touch.[7-11] Although suck-swallow coordination begins in the intrauterine period, the integration of breathing to achieve successful feeding skills is not expected before 32–34 weeks of gestation.[12,13] The numerous adverse factors to which preterm infants are subjected during intensive care delay this period further. Oral motor

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stimulation (OMS) is motor stimulation of the lips, jaws, tongue, and soft palate with the finger to activate the oropharyngeal mechanism. Therefore, early OMS exercises are used in preterm infants to promote the attainment of oral feeding skills (OFS). Previous studies have shown that OMS can improve OFS and shorten the transition to oral feeding.[14] In this study, we aimed to evaluate the effect of OMS exercises on the sucking and swallowing skills of preterm infants and demonstrate the utility of objective scales to evaluate infants' readiness for oral feeding.

Methods

This single-center, prospective cohort study was approved by the Ethics Committee of our hospital (No: 09, dated February 11, 2021). Parental consents were obtained before the patients were included in the study. Our study was conducted in accordance with the Helsinki Declaration.

Participants

The study included preterm infants born at ≤34 weeks of gestation and admitted to the NICU of our hospital between June 1st and December 31st, 2020. Patients with major congenital anomaly, cleft palate-lip, gastrointestinal anomaly, small for gestational age, and severe asphyxia were excluded from the study. All patients were followed up from admission to discharge.

Assessment Tools and OMS Procedure

Two different assessment tools were used to evaluate the patients' OFS and monitor their development.

The OFS grading developed by Lau and Smith is an objective scale for assessing infants' OFS.[15] (Fig. 1) If the infant had no oral intake on evaluation on day 0 of the OMS program, they were evaluated as level 1. The patients were reevaluated on day 5 and day 10 of the program. Infants were reevaluated at 5-day intervals until they reached level 4, which is considered successful oral feeding.

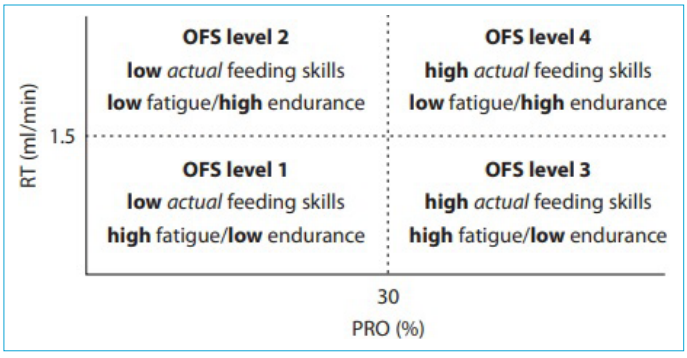

Figure 1. Oral feeding skill.

RT: Rate of milk transfer over an entire feeding; PRO: % volume taken during the first 5 min/total volume.

The non-nutritive sucking (NNS) scoring system developed by Neiva et al.[16] was implemented on days 0, 5, and 10 of the OMS programs (Fig. 2). Based on this assessment, oral feeding was not attempted for infants with scores ≤33. Infants with scores ≥50 were evaluated as ready for oral feeding. Moreover, the group in between (infants with scores of 33–49) was challenged once each day as recommended by the language and speech therapist (LST).

The OMS program was initiated at 30 weeks of corrected age for infants <30 weeks of gestational age and right after the 1st day of life for infants >30 weeks of gestational age if the infants are clinically stable and not intubated. Non-invasive ventilation was not a contraindication for the OMS program. The procedure was performed in these physiologically stable infants 15–30 min before tube feeding.[17] Painful and tiring interventions (e.g., ophthalmologic examination and blood collection) were not performed on the infants for at least 30 min before evaluation and the oral stimulation procedure. The procedures were based on the oral stimulation program described by Fucile et al.[17] (Fig. 3). The intervention included movements performed in the perioral and intraoral regions and lasted a total of 12 min. The exercises were performed once a day 5 times a week, after hand-wash and with the use of powder-free gloves. Before the procedure, the infants were awakened and placed in the supine position in the incubator. An LST performed the intervention through the doors of the incubator without removing the infant. Oral stimulation was followed by 3 min of NNS.[17]

Positive items	Mark the suitable				Converted value
1) rooting reaction	Yes ( ) (4)	No ( ) (0)			
2) easy beginning of sucking	Yes ( ) (4)	No ( ) (0)			
3) labial sealing	always ( ) (12)	most part ( ) (8)	sometimes ( ) (4)	never ( ) (0)	
4) tongue central groove	always ( ) (9)	most part ( ) (6)	sometimes ( ) (3)	never ( ) (0)	
5) peristaltic tongue movements	always ( ) (9)	most part ( ) (6)	sometimes ( ) (3)	never ( ) (0)	
6) jaw raising and lowering movements	always ( ) (9)	most part ( ) (6)	sometimes ( ) (3)	never ( ) (0)	
7) labial, tongue and jaw coordination	always ( ) (15)	most part ( ) (10)	sometimes ( ) (5)	never ( ) (0)	
8) sucking strength	always ( ) (12)	most part ( ) (8)	sometimes ( ) (4)	never ( ) (0)	
9) sucking rhythm	always ( ) (12)	most part ( ) (8)	sometimes ( ) (4)	never ( ) (0)	
	Total positive items:				
Negative items					
10) bites	always ( ) (-3)	most part ( ) (-2)	sometimes ( ) (-1)	never ( ) (0)	- .....
11) excessive jaw excursion	always ( ) (-3)	most part ( ) (-2)	sometimes ( ) (-1)	never ( ) (0)	- .....
12) stress signals	always ( ) (-15)	most part ( ) (-10)	sometimes ( ) (-5)	never ( ) (0)	- .....
	Total negative items:				
	TOTAL:				

Figure 2. Non-nutritive sucking scoring (NNS score).

Structure	Stimulation steps	Purpose	Frequency	Duration
Cheek	1. Place index finger at the base of the nose. 2. Compress the tissue, move finger toward the ear, then down and toward the corner of the lip (ie, C pattern). 3. Repeat for other side.	Improve range of motion and strength of cheeks, and improve lip seal.	4× each cheek	2 min
Upper lip	1. Place index finger at the corner of the upper lip. 2. Compress the tissue. 3. Move the finger away in a circular motion, from the corner toward the center and to the other corner. 4. Reverse direction.	Improve lip range of motion and seal.	4×	1 min
Lower lip	1. Place index finger at the corner of lower lip. 2. Compress the tissue. 3. Move the finger away in a circular motion,from the corner toward the center and to the other corner. 4. Reverse direction.	Improve lip range of motion and seal.	4×	1 min
Upper and lower lip curl	1. Place index finger at center of lip. 2. Apply sustained pressure, stretchdownward toward the midline. 3. Repeat for lower lip-apply sustained pressure, and stretch upward toward the midline.	Improve lip strength, range of motion, and seal	2× each lip	1 min
Upper gum	1. Place finger at the center of the gum, with firm sustained pressure slowly move toward the back of the mouth. 2. Return to the center of the mouth. 3. Repeat for opposite side.	Improve range of motion of tongue, stimulate swallow, and improve suck.	2×	1 min
Lower gum	1. Place finger at the center of the gum, with firm sustained pressure slowly move toward the back of the mouth. 2. Return to the center of the mouth. 3. Repeat for opposite side.	Improve range of motion of tongue, stimulate swallow, and improve suck.	2×	1 min
Internal cheek	1. Place finger at inner corner of lips. 2. Compress the tissue, move back toward the molars and return to corner of lip. 3. Repeat for other side.	Improve cheek range of motion and lip seal.	2× each cheek	2 min
Lateral borders of the tongue	1. Place finger at the level of the molar between the side blade of the tongue and the lower gum. 2. Move the finger toward midline, pushing the tongue towards the opposite direction. 3. Immediately move the finger all the way into the cheek, stretching it.	Improve tongue range of motion and strength	2× each side	1 min
Midblade of the tongue	1. Place index at the center of the mouth. 2. Give sustained pressure into the hard palate for 3 seconds. 3. Move the finger down to contact the center blade of the tongue. 4. Displace the tongue downward with a firm pressure. 5. Immediately move the finger to contact the center of the mouth at the hard palate.	Improve tongue range of motion and strength, stimulate swallow, and improve suck.	4×	1 min
Elicit a suck	1. Place finger at the midline, center of the palate, gently stroke the palate to elicit a suck.	Improve suck, and soft palate activation.	N/A	1 min
Pacifier	1. Place pacifier in mouth.	Improve suck, and soft palate activation	N/A	3 min

Figure 3. Oral motor stimulation program.

The procedure was terminated if infants showed any signs of distress, such as desaturation, bradycardia, and apnea. To assess the patients' oral motor skills, NNS scoring was done before OMS and on days 5 and 10 of OMS, and OFS level was determined on day 5 of OMS.[15,16]

The achievement of full oral feeding was accepted when patients were fed orally with 150 mL/kg for 72 h.

Statistical Analysis

All statistical analyses were performed using the SPSS version 21.0 (IBM Corp, Armonk, NY, USA) statistical software. Data were presented as mean±standard deviation for normally distributed continuous variables, median and interquartile range (IQR) for non-normally distributed continuous variables, and n (%) for categorical variables. Statistical significance was accepted at $p<0.05$. Non-normally distributed data were analyzed with the Wilcoxon signed-rank test. After the Bonferroni correction, statistical significance was accepted at <0.016.

Sample Size

Based on our previous data from our NICU, we hypothesized that to reveal a 20% decrease in corrected age at full enteral feeding, with a two-sided alpha error of 0.05 and a beta error of 0.2 (80% power), the estimated sample size was 34.

Results

A total of 50 infants were included in this prospective cohort study as shown in the study flowchart (Fig. 4). Of these, 66% were born by cesarean section. The mean birth weight was 1376.9±372 g, and the median gestational age was 30 weeks (range: 25–34). The demographic characteristics of the patients are given in Table 1.

Initial evaluation and OMS initiation occurred on the mean postnatal day 25.8±23 (range: 2–80). Only 8 patients were evaluated as OFS level 2 at initial evaluation; all other patients were evaluated as level 1. The mean time of transition to level 4 was day 16.7±10.1 (range: 6–39), and the transition to full oral feeding occurred on day 19 (IQR: 7–107) at a median corrected age of 35 weeks (range: 31–37).

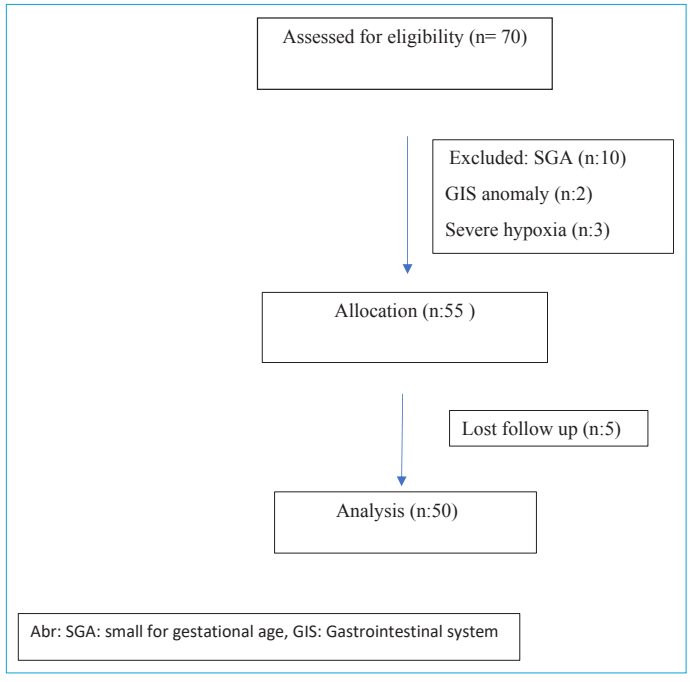

Figure 4. Study flow chart.

Table 1. Demographic characteristics of the patients

Patient characteristics	Study group (n=50)
Birth weight, g, mean±SD	1376.9±372
Gestational age, weeks, median (IQR)	30 (25–34)
Gender, male, n (%)	29 (58%)
5-min Apgar score, median (IQR)	7 (5–10)
Mode of birth, C/S, n (%)	43 (86%)
Intracranial hemorrhage (stage ≥3, %)	6%
NEC (stage ≥2)	4%
Postnatal day of transition to full oral feeding, mean±SD	34±27

SD: Standard deviation; IQR: Interquartile range; C/S: Cesarean section; NEC: Necrotizing enterocolitis.

The comparison of OFS levels on day 5 and day 10 of OMS revealed a significant increase ($p<0.001$) (Table 2). Similarly, there was a significant improvement in the NNS scores on days 5 and 10 compared to the baseline (Table 2).

When grouped according to gestational age, 21 patients were born at 24+0/7-29+6/7 weeks and 29 patients at 30+0/7-34+0/7 weeks.

In 18 infants who transitioned to full oral feeding before a corrected age of 34 weeks (mean 32.5±0.7 weeks), OMS was started on the mean postnatal day 12±7.8, and successful oral feeding was achieved on day 17.2±7.8.

The mean day of and adjusted age at discharge were day 56.4±35.3 and 36.9±3.1 weeks, respectively. In our study, the mean time to discharge was 8 weeks. In the subgroup analysis of born <30 weeks, the mean time to discharge was 10 weeks.

Discussion

The results of this study support the benefit of OMS exercises in improving preterm infants' feeding skills before the transition from gavage feeding to oral nutrition.

The OMS program has been described in detail in many studies.[17,18] Boiron et al.[18] demonstrated with a pacifier-mounted transducer that sucking performance increased after OMS by finger to the cheek, tongue, and palate for 12 min once a day for 14 days, 30 min before feeding. Say et al.[19] showed that stimulation with a pacifier alone resulted in an earlier transition to oral feeding and discharge. In our study, we implemented the OMS program as described by Fucile et al.[17] Unlike Boiron et al.,[18] we included a 3-min period of NNS after motor stimulation. Combined interventions have been found to be more effective in increasing OFS. Zhang et al.[20] showed that the combination of OMS and NNS was more effective than either intervention alone and accelerated the transition to full oral feeding.

Table 2. Evaluation of patients' feeding skills

Feeding skills	Mean±SD	Median (min-max)
NNS day 0*	5.9±4.1	6 (–4–13)
NNS day 5*,£	17.1±11.5	15 (10–67)
NNS day 10£	24.5±12.8	20 (10–67)
OFS day 0†	1.09±0.3	1 (1–2)
OFS day 5†,µ	1.9±0.62	2 (1–3)
OFS day 10µ	2.69±0.83	3 (1–4)

*: Comparison NNS day 0 and day 5 $p<0.01$; £: Comparison NNS day 5 and day 10 $p<0.01$; †: Comparison OFS day 0 and day 5 $p<0.01$; µ: comparison OFS day 5 and day 10 $p<0.01$. SD: Standard derivation; min: Minimum; max: Maximum; NNS: Non-nutritive sucking; OFS: Oral feeding skills.

Meta-analyses have also shown that the length of hospital stay and parenteral treatment duration are shorter, and the transition to oral feeding is earlier in preterm infants that receive oral stimulation.[21] In our study, the mean time to discharge in infants born <30 weeks of gestation was 10 weeks. With advances in neonatal intensive care, the mean length of hospital stays for preterm infants born at <30 weeks of gestation is 11–12 weeks.[22] In a retrospective study by Majoli et al.,[23] the mean transition time to full oral feeding was 35.1±1.5 weeks for preterm infants born before 32 weeks of gestation; while in our study, this time was 34.4±1.9 weeks in infants born at gestational ages <30 weeks. According to the literature, the average discharge and transition to full oral feeding times were shortened in our study. However, randomized trials are needed to conclude that OMS exercises shorten the time to discharge and transition to full oral feeding, which is one of the limitations of our prospective cohort study.

Prolonged hospital stays and infections adversely affect physical growth and neurological development in premature infants.[24] Li et al.[24] concluded that premature infant oral motor intervention promoted neuromotor coordination by improving neurodevelopment, which was shown with the Infant Neurological International Battery (INFANIB) scale. We did not use a neurological development scale in our study, but it can be an example for future studies.

All neonatal intensive care procedures involve unpleasant stimuli around and inside the mouth (e.g., orogastric catheter insertion, intubation, and aspiration). Oral stimulation is generally the most overlooked practice during the period of growth after stabilization, and most preterm infants experience feeding difficulties later.[17] Properly implemented OMS within the infant's mouth can activate central pattern generators, which can affect the physiological function of the mouth and pharynx through stimulation of the lips, chin, tongue, soft palate, and throat, and then effects feeding.[25] The turning point for successful OFS in preterm infants is generally accepted as 33–34 weeks of gestation.[7, 26] In the literature, methods and approaches to promote a safe transition to oral feeding in preterm infants have been collected under headings such as cue-based feeding, oral stimulation interventions to support the development of oral motor functions, NNS, and positioning for oral feeding. One of the frequently asked questions for intensive care physicians and nurses is when preterm infants that have completed gestation are clinically stable, and are not receiving mechanical ventilation will transit from gavage feeding to oral nutrition.[15] In units with a large number of incubators, the process of removing a preterm infant's orogastric tube and transition to

oral feeding is generally evaluated by the attending nurse. This assessment is not objective, as it may vary based on experience. The use of objective and standard scales can provide a safer transition to oral feeding for preterm infants. In infants who do not demonstrate progress, early support can be given to shorten discharge time. In NICUs like ours with high numbers of patients, we believe that objective evaluation is important in the decision to start oral feeding and will guide clinicians in making this decision. The OFS staging by Lau and Smith is an objective, easily applicable assessment.[15] In addition, NNS scoring can be easily implemented by experienced staff and can provide guidance to the clinician and the caregiver team. In our study, feeding skill assessments and the OMI were successfully implemented by an LST.

Although LSTs are widely included in NICU settings and post-discharge follow-up in developed countries, to the best of our knowledge, this is the first report from our country of an LST being present in a NICU and implementing an OMS in preterm infants. In the survey conducted by Çiftci et al.,[27] it was determined that nurses had low awareness of the role of LSTs in the NICU. Evaluating the feeding skills of the infants in our NICU with an expert, increased awareness among the research team and the nurses. Assessing the feeding abilities of the neonates in our NICU with an experienced professional has raised awareness among the clinicians and nurses. While conducting this study, we observed that our breastfeeding success rate also increased and our duration to achieve full oral feeding and discharge was shortened. This study serves as a guide for prospective studies to support OMS and objective evaluation of OFS in the NICU.

Conclusion

In preterm infants, OMS during the transition from gavage feeding to oral feeding improves feeding skills. We believe that LSTs, who have graduated in increasing numbers in the past decade in our country, should take an active role in NICUs.

Disclosures

Ethics Committee Approval: Umraniye Training and Research Hospital Ethics Committee, Approval No: 09, 11/02/2021.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – F.Y.A.; Design – F.Y.A., H.B.C., I.M.A.; Supervision – I.M.A.; Materials – O.G., D.C.; Data collection and/or processing – F.Y.A., H.B.C.; Analysis and/or interpretation – F.Y.A., O.S., B.K.E.; Literature search – O.G., D.C., N.R.G.; Writing – F.Y.A.; Critical review – I.M.A.

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