Premature infant oral motor intervention (PIOMI) with and without massage therapy on social emotional development in preterm infants

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Background: Feeding functions are generally affected in preterm infants. This has long-term impact on emotional development, social learning, and health. Occupational therapists use a variety of interventions such as premature infant oral motor intervention (PIOMI), Infant massage (IM) for improving oral motor control and neuro-behavioral status of preterm infant. PIOMI has positive effects on oral motor functions. IM is recognized as a developmentally supportive intervention aimed at decreasing infant stress and optimizing the infant's sensory experience on long-term development. The current study intends to observe the effect of PIOMI and combined effect of PIOMI with IM on social and emotional development of preterm infants. Objective: The aim was to evaluate the effect of PIOMI and combined effect of PIOMI with IM on social-emotional development of preterm infants. Study Design: Prospective, experimental, design was chosen for this research. Methods: Preterm infants (32-36 weeks) who were hemodynamically stable and satisfying the inclusion criteria were allocated into Group A and Group B randomly divided into 30 subjects in each group. Group A received PIOMI of 10 min session, twice a day. Group B received PIOMI along with IM therapy (IM) of 10 min session twice a day, till they achieved full oral feeds. The infants were evaluated at 2 and 6 months of corrected age on Ages and Stages Questionnaire Social Emotional-2 (ASQ: SE-2) scale to evaluate the long-term effect of intervention on social-emotional development of preterm infants. Results: Thirty infants from Group A enrolled for study, 25 infants followed up at 2 months of corrected age. On social emotional-2 (ASQ: SE-2), they scored mean score of 30.4 [+ or -] standard deviation (SD) 7.4, 95% confidence interval CI: (27.66, 33.14), On follow-up at 6 months of corrected age, there was an increase in mean scores to 46.2 [+ or -] SD 11.2, 95% CI: (41.7, 50.7). Out of thirty infants, the twenty-eight infants from Group B followed up at 2 months of corrected age. On ASQ: SE-2 they scored as mean 18.4 [+ or -] SD 4.5, 95% CI: (16.66, 20.14).This group also showed increase of mean scores at 6 months of corrected age to 28.2 [+ or -] SD 8.14, 95% CI: (25.04, 30.36). Infants receiving PIOMI with IM showed better social-emotional development in preterm infants as compared to those received only PIOMI at 2 and 6 months. The marked improvement was seen in components such as social interaction, self-regulation, and communication. Conclusion: Preterm infants from both the groups showed good social emotional development, whereas preterm infants who received PIOMI along with IM therapy showed better self-regulation and interaction due to graded tactile stimulations received during therapy, which also enhanced interaction with caregivers.

Introduction

Many infants born moderate and late preterm (MLPT) between 32 and 36 weeks infants may exhibit deficits in cognitive and motor domains, as well as social functioning.[1],[2] Preterm infants are observed to have some social and cognitive delays.[3] Preterm infants are most frequently referred for feeding intervention. During feeding intervention, central pattern generator (CPG) networks and their neuromuscular targets attain development in various areas along with feeding.[4],[5]

Occupational therapists use variety of techniques such as Premature Infant Oral Motor Intervention (PIOMI), which shows positive effects on feeding and the growth of preterm infants. This further contributes to the improved neurobehavioral organization.[6] PIOMI involves tactile and proprioceptive stimulation of oral motor structure with therapist interacting with infants. This may lead to social interaction, bonding, and hence better emotional development. The infant massage (IM) technique leads to better neuro-behavioral regulation. The IM technique is a gentle, structured stroking technique aimed at reducing stress and anxiety in fragile intensive care patients and can be delivered based on infant cues. IM technique has led to various advantages such as good caregiver-infant bonding, development of autonomy etc.[7] The literature suggests evidence of early achievement of oral feeds on PIOMI and massage therapy on neurobehavioral regulation,[6],[7] but there are no studies which have analyzed combined effects of PIOMI and

IM therapy on social-emotional development. The study was done to evaluate the combined effects of PIOMI with IM on the social-emotional development of preterm infants.

Methods

The prospective experimental study was conducted after the Institutional Ethics committee permission was sought (IEC/68/18). Hemodynamically stable, preterm infants with oral motor difficulties were referred to the occupational therapy department. The 60 preterm infants fulfilling inclusion criteria were randomly assigned to two groups of 30 using lottery method at the premature care unit of tertiary care hospital. Primigravida, low birthweight infants (weight between 1000 and 2000 g), born between 32 and 36 weeks of gestation (MLPT), with APGAR Score more than six, after 5 min of birth and infants having nonnutritive sucking score <3 were included in the study. The preterm infants with congenital anomalies or with mothers having postpartum depression (mothers scoring more than 10 on the Edinburg Postnatal Depression scale [EPDS]) were excluded from the study.[7] The written informed consent was taken from the parents of infants. The infants recruited in Group A received PIOMI, consisting eight steps-C-Stretch, lip roll, lip curl, gum massage, cheek massage or lateral border of the tongue, mid-blade of the tongue stimulation, eliciting suck, nonnutritive sucking. The protocol was administered in the mentioned order for a total duration of 10 min twice a day.[6] When preterm infants are admitted to the hospital, as usual care, only handling techniques are used, and massage on the body is not allowed for preterm infants. The permission to was sought from the head of the neonatology department and IEC, to administer IM before starting protocol for group B. Thirty infants in Group B received IM with graded massage on head, neck, back, swaddling in prone and supine followed by graded massage on all extremities (30 s each step) for total time 5 min,[7] This was followed by PIOMI for 5 min twice a day. Both groups received intervention till they achieved full oral feed. The intervention was provided by the principal and the corresponding author. The intervention was provided by the principal and the second author. The principal author is certified for M-technique and is using PIOMI as intervention tool in the premature unit of the tertiary care hospital. The second author was trained for 20 hours (theory and videos), with 5 hours hands on training by the principal author. Parents were blinded for the groups. Infants were evaluated at 2 and 6 months of corrected age on outcome measure using Ages and Stages Questionnaire Social and Emotional-2(ASQ: SE-2).

At the initial phase, i.e., the gestational age at birth, gestational age at the time of enrollment (baseline) in the study, number of days to achieve full feed after the commencement of intervention was collected.

Assessment Tools

Edinburgh Postnatal Depression Scale

EPDS was used as screening tool to assess the level of depression in mothers of preterm infants. It is a 10-item screening tool questionnaire that was developed to identify women who have postpartum depression. In 57 studies, many addressed concurrent validity of the scale (47.4%), predictive validity (51%), and internal consistency (52.6%). The maximum score was 30 and possible depression of 10 or greater.[8]

Nonnutritive Sucking Ordinal Scoring System with good predictive validity was used for initial feeding and maturity assessment. It evaluates suck consistency on three-point Likert scale as 0-jagged, 1-odd shaped, 2-uniformly shaped and burst organization as 1-Recognizable sucks, no bursts, 2-One or more bursts, not occurring in regularly spaced 'trains,' 3-Trains of three or more bursts taking up 50% of tracing.[9]

Ages and Stages Social Emotional Questionnaire-2

The ASQ: SE-2 is a brief parent-report questionnaire designed to identify young children and infants in need of further evaluation for social and emotional problems. It assesses seven categories, such as self-regulation, compliance, communication, adaptive functioning, autonomy, affect, interaction with people with six questions in each category. As per the behaviors observed it is graded on Three-point Likert scale as often, sometimes, rarely or never, as scores 0-5-10 respectively, i.e., Never observed behavior is scored as 10. The cutoff score for the indication of delay and special reference is 35 for 2 months questionnaire and 45 for 6 months questionnaire. Higher the score on questionnaire indicates more delay in the development of the expected response. It has sensitivity 81% overall agreement; the range of 76% for the 6-month questionnaire, Specificity 83% overall agreement and overall positive predictive value 0.59.[10],[11]

Data Analysis

The demographic data were analyzed using Student's t -test as the parametric values with P [less-than or equal to] 0.05 and for comparing days of achieving full feeds. Further infants were evaluated at 2 and 6 months of corrected age on outcome measure using ASQ: SE-2. Mann-Whitney U -test was used to compare the scores between two groups at 2 months and 6 months. The level of significance was set at 0.05.

Results

On total 60 preterm infants with mean gestational age of 32.64 [+ or -] 1.9 and 32.78 [+ or -] 2.21 respectively, were randomly assigned in Group A and Group B in the study, respectively, showing matched age group with P = 0.40. The enrolment age also was matched for both the groups. Infants receiving PIOMI include 52% (16) male infants and 48% (14) female infants whereas infants receiving PIOMI + IM include 68% (20) male infants and 32% (10) female infants. The average days required to achieve full feeds were 14.08 [+ or -] 5.46 days for Group A and 8.6 [+ or -] 3.7 days for Group B, with a significant difference in the number of days of achieving full feeds between them with P [less-than or equal to] 0.01 [Table 1].{Table 1}

The nonnutritive suck scores [Table 2] for Group A were 1.36 [+ or -] 0.84 and for Group B was 1.56 [+ or -] 0.47 respectively at the initiation of the study, with P [less-than or equal to] 0.60. Thus, showing nonsignificant difference in nonnutritive scores means similar oral motor abilities at the baseline, i.e., baseline development in infants were matched in both the groups.{Table 2}

ASQ: SE-2 questionnaire was used to assess the social emotional development. There were 5 dropouts from infants receiving PIOMI group, as one expired, two developed some GI complications after discharge, two parents opted not to follow up and two dropouts from group of infants receiving PIOMI with IM, as their parents preferred to opt-out during follow-up. Thus 53 infants followed up for ASQ; SE-2 questionnaire, 25 receiving PIOMI and 28 receiving PIOMI with IM. At 2 months of corrected age, as seen in [Table 3], at 2 months corrected age the infants receiving PIOMI scored mean as 30.4 [+ or -] 7.4 at 95% confidence interval (CI): (27.66, 33.14) and at 6 months of corrected age, 46.2 [+ or -] 11.57 at 95% CI: (41.7, 50.7), on ASQ: SE-2. These infants showed significant development, especially in autonomy and compliance, but had exhibited delay in giving expected response.{Table 3}

Infants receiving PIOMI with IM, at 2 months corrected age scored mean as 18.4 [+ or -] 4.5 at 95% CI: (16.66, 20.14) and at 6 months of corrected age mean score was at 28.2 [+ or -] 8.14,95% CI: (25.04, 31.36), on ASQ: SE-2. Both the groups showed good social-emotional development, when compared with their respective scores at 2 months. When scores on both the groups were compared at 2 and 6 months of corrected age, they showed a significant difference in scores with Z = -6.22, P [less-than or equal to] 0.00001, and Z = -6.24, P [less-than or equal to] 0.00001, respectively.

Further data were analyzed to find out the lag in the development in different components of social and emotional development at corrected age of 2 and 6 months in [Graph 1]. The infants from both the groups improved in all the social emotional skills, but infants who received only PIOMI had difficulties in communication and social interaction, whereas infants who received PIOMI with IM had markedly improved skills in self-regulation, communication, and interaction with people at 6 months.[INLINE:1]

Discussion

This study was conducted to analyze the effect of different interventions used for oral motor development of preterm infants on the social and emotional development in preterm infants. Initially, the effect of different oral motor interventions on achieving oral feeds was analyzed. Preterm infants received PIOMI, to increase functional response of the oral motor structure. Out of 60 preterm infants, male preterm infants were more than female preterm infants in both the groups receiving intervention. The existence of a male exceeds among preterm births is due to possible mechanisms including greater body weight, increased susceptibility to complications of pregnancy, sex-linked biochemical processes and earlier conception in the fertile cycle.[12]

Infants receiving PIOMI with IM achieved full feeds much faster than infants receiving only PIOMI. In another research, it was observed that the number of days to reach oral feeding in preterm babies receiving oral motor stimulation was decreased, which in turn conferred earlier hospital discharge.[13]

IM was used along with PIOMI, which aimed not only at decreasing infant stress due to unstructured handling and optimizing the infant's sensory experience but also enhance suck swallow breath coordination and to improve long-term development. The review on effects of massage therapy on preterm infants it is stated that Infants that received moderate pressure massage appeared to be more relaxed and less aroused by hospital neonatal intensive care unit noise and light, better neuro-behavioral regulation and the greater weight gain.[14]

The long term effects of both the interventions, i.e., PIOMI and PIOMI with IM was further analyzed using ASQ: SE-2 scores. On comparing using Mann-Whitney U -test, Preterm infants at the end of 2 months infants receiving PIOMI had more difficulties in social skills than infants receiving PIOMI with IM, indicating better development in infants from later group with P [less-than or equal to] 0.00001. Similar trend was observed at 6 months, both the groups improved at 6 months scores, when compared among the groups. In a study on review of the effect of Oral motor intervention (OMI) on feeding and swallowing, it is observed that six studies addressed the effects of OMI on the feeding/swallowing physiology outcomes of feeding efficiency or sucking pressure.[15] In the present study we observed the positive effect of oral stimulation on social-emotional development as well except in interaction and self-regulation.

Socio-emotional development during infancy and early childhood has been described as 'the emerging capacity of the child to experience, control, and express feelings; form close and secure interpersonal connections; investigate the environment and learn, all in the setting of family, society and cultural anticipations' Early social relationships are characterized by the infant signaling the parent to take care of his or her immediate needs and the parent comforting the infant through feeding, touching, rocking, and soothing.[16] In the present study PIOMI with IM has provided closeness to caregivers through massage and has shown increased self-regulation, interpersonal relationship skills and better communication skills in preterm infants receiving PIOMI with IM.[17]

In 1950, Ainsworth and Bowlby defined Attachment as 'strong connection between two people.' Bowlby defined maternal attachment as 'warm, continuous and intimate relation between the mother and the baby; hence, early breastfeeding plays a significant role in the social and emotional development of the child.[17] The early achievement of breastfeeding skills may have facilitated maternal attachment in the infants leading to good compliance, adaptive functioning and affect in preterm infants. Niles Newton published the first observations on the difference at age three between children who had been breastfed beyond 6 months and those who had been bottle-fed since birth. The children who had been breastfed were more outgoing, socially secure and more advanced on the developmental scales.[18]

During therapy infants receiving PIOMI with IM experienced structured positive touch sensation on the trunk and extremities, which has helped them for better neurobehavioral organization and improved responses to the environment, showing good social-emotional development. This also follows 'Anokhin's developmental model of 'Systemogenesis.' This model relates to the heterochroneous

maturation of physiologic systems that a newborn organism needs to undergo positive changes to optimize its successful adaptation to outside environment. This model states that postnatal integrative processes or 'functional systems' should be used functionally, following birth to ensure the newborn's successful adaptation to its postnatal environment.[19] In the review on effects of massage therapy on neonates starting in early days, the massage intervention affects the maturation of brain electrical activity and favors a process more similar to that observed in-utero in full-term infants.[14] Both the groups showed improvement as touch sensation used for stimulations.

To survive outside the womb the infants must overcome the developmental challenges. PIOMI with IM has provided positive tactile stimulation to perioral, intraoral structure and on the trunk, extremities. This supports brain-oriented care recommended by Lisa Bader. It is the basic sensory system active in the developmental sequence of ladder rung for neonates. Lisa Bader has proposed that tactile and proprioceptive feedback is the basic need during the early infancy stage of preterm infants for environmental adaptations and self-regulation.[20],[21]

As proposed in Anokhin's developmental model of Systemogenesis, that the efficacy of a particular type of intervention will depend on the developmental stage an infant and at what time that intervention is offered, i.e., different physiologic functions being more receptive to 'change' at specific times.[18] Thus infants in this study received developmentally appropriate stimulation, i.e., PIOMI with IM, graded touch stimulation on the whole body, leading to social emotional development.

The infants receiving only PIOMI as well as PIOMI with IM showed reduced stress behavior due to CPG network during oral massage therapy. Thus showing good self-regulation, autonomy, and compliance at 6 months.[4],[5] At the age of 6 months of corrected age, adaptive functioning was better in infants receiving PIOMI with IM, they showed more acceptance to others touch and good social interaction. Juneau et al . 2015 concluded that IM has a protective effect on infants' sleep-wake cycle, which includes various techniques such as firm pressure, gentle stroking, containment hold due to which infants have increased sleep state and decreased awake state, good adaptability.[22] In another study, it is observed that IM to preterm infants leads to increased weight gains, improved developmental scores, and earlier discharge from the hospital. It enhances parents-child bonding and interaction skills.[23] Thus infants receiving PIOMI with IM were more adaptable and had good interaction skills.

Infants who received only PIOMI were slow in developing interaction with people, autonomy and communication. Infants receiving PIOMI with IM have achieved breastfeeding earlier than those receiving only PIOMI. Since early breastfeeding forms base for good maternal attachment that develop sense of trust and feel secure to the infants, which further leads to developing virtue of hope. This also goes in consistence with Erikson's views on the importance of trust quality of early attachment can affect relationships with others in later life.[19]

Advantage of this study was that the infants were recruited for prospective study with long-term follow-ups. The parental awareness about the effects of PIOMI and IM supported family-centered developmental care in special care nurseries at tertiary care center, as one of the recent policies in infant care. Initial information given to parents during the achievement of oral feeds made them more aware about their role in infants' development and they were trained for containment hold during handling.

However, we were limited by the inclusion of participants from a single tertiary center, which may have included sicker MLPT infants who were admitted to the neonatal nursery. While analyzing results various factors such as economic condition of family, cultural factors, education of parents, family support to mother were not considered. These could be confounding factors in the study outcomes. However infants showed consistent effects on their development at 2 and 6 months follow-up. However, our results are not generalizable to the population of MLPT children who were more unwell and needed admission to a neonatal nursery after birth.

Conclusion

When PIOMI was added with IM therapy, it showed good adaptive functioning, social interaction, and signifying less difficulty in emotional and social adjustments. Further research is needed to find the effect of the intervention on language and motor outcomes, specifically in the MLPT population. Furthermore, research directions are needed into potentially modifiable factors. In the study, consideration was given to facilitating structured handling to reduce distress and optimizing sensory awareness.

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Conflicts of Interest

There are no conflicts of interest.

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