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Original Article

Effect of Tuina Massage on Pain during Orogastric Tube Insertion in Premature Neonates: A Randomized Controlled Trial

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ABSTRACT

Background: Orogastric tube insertion is a painful procedure for neonates, particularly premature infants who are more vulnerable to pain and its consequences. Non-pharmacological, safe, and cost-effective pain management methods are essential in neonatal care. Tuina, a traditional Chinese massage technique, may reduce procedural pain in this population. This study aimed to evaluate the effect of Tuina massage on pain during orogastric tube insertion in premature neonates.

Methods: A randomized controlled trial was conducted on 70 premature neonates admitted to a maternal and neonatal hospital in Ahvaz, Iran. Participants were randomly assigned into intervention (Tuina massage) and control (routine care) groups (n=35 each) using block randomization with R software. Pain levels, heart rate, and oxygen saturation were assessed using the Premature Infant Pain Profile (PIPP) at three time points: five minutes before, during, and five minutes after tube insertion. The intervention group received Tuina massage three times, each lasting one minute with 30-second intervals during these phases.

Results: The intervention group showed a significant reduction in pain scores during and after tube insertion compared to the control group ($p = 0.001$, Cohen's $d = 0.927$). Heart rate decreased and oxygen saturation increased significantly post-intervention in the Tuina group ($p = 0.029$).

Conclusion: Tuina massage is an effective, accessible, and low-cost method for reducing procedural pain and improving physiological parameters in premature neonates, supporting its use as a valuable non-pharmacological intervention in NICU settings.

Keywords: Neonatal pain, Non-pharmacological intervention, Orogastric tube, Premature infant pain profile, Premature neonates, Tuina massage

Introduction

Pain perception and behavioral responses to pain in premature infants are well established. Numerous studies have demonstrated that premature infants before 26 weeks of gestation can feel pain and exhibit more acute and severe responses compared to term infants (1). Early painful experiences—such as immunizations, blood sampling, and orogastric feeding—occur within the first hours or days of life. Repeated exposure to painful stimuli before 38–40 weeks gestational age can cause long-term adverse effects, including behavioral changes, increased intracranial pressure, immune suppression, and cardiac arrhythmias (2, 3).

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Insertion of feeding tubes in premature infants is known to cause significant pain (4-7). The inability of premature infants to compensate for painful stimuli results in immediate consequences such as hemodynamic instability and hormonal stress responses, as well as long-term increased sensitivity to touch and environmental stimuli (8). Effective pain control provides physiological, behavioral, and hormonal benefits in this vulnerable population (9).

Pain-induced stress in neonatal intensive care units (NICUs) may impair neural and behavioral development in premature infants, highlighting the importance of pain management to prevent complications (10, 11). Pain management strategies include both pharmacological and non-pharmacological methods. Pharmacological approaches, such as topical or systemic analgesics, have limitations: topical analgesics are often ineffective in common neonatal procedures, and systemic drugs carry potential side effects and limited long-term safety (12-14).

In contrast, non-pharmacological interventions are safe, cost-effective, and well tolerated, often not requiring medical prescriptions. Common non-pharmacological techniques for pain relief during procedures like orogastric tube insertion include non-nutritive sucking, sucrose administration, and kangaroo mother care (KMC) (12, 15).

Limb massage is another effective non-pharmacological approach to reduce pain, particularly in premature infants hospitalized in NICUs (16). One such method is Chinese massage, known as Tuina, a widely used complementary therapy in traditional Chinese medicine. Tuina interventions include acupressure, rocking, rubbing, stroking, and spinal massage (17, 18).

According to traditional Chinese medicine, vital energy ("qi") flows through meridians in the body, and blockages cause pain. Massage at specific points can restore energy balance and relieve pain. The Hegu point, located between the first and second metacarpal bones (between the thumb and index finger), is an important acupressure site for pain relief (19, 20).

Tuina massage has shown benefits in improving respiration, weight gain, and peripheral perfusion. Studies on premature infants with brain injury reported improved neurodevelopment and reduced cerebral palsy incidence after Tuina massage (21). A retrospective study of 96 neonates with neurological damage found that Tuina combined with acupressure enhanced neurodevelopment and motor function by six months of age (22). Another trial demonstrated improved muscle function in neonates with congenital muscle damage following Tuina intervention (23).

Despite these promising results, research on Tuina massage in premature infants is limited, especially in the Iranian population. Given the growing number of premature infants requiring NICU care and the frequent use of orogastric tubes, exploring safe and effective pain management techniques is essential. Therefore, this study aimed to evaluate the effect of Tuina massage on pain during orogastric tube insertion in premature neonates.

Methods

Study Design and Setting

This randomized clinical trial was conducted on 70 premature infants hospitalized in the neonatal intensive care unit of a maternal and neonatal hospital with 50 NICU beds. The study duration was 60 days.

Participants

Premature infants with gestational age between 28 and 36 weeks were included. Inclusion criteria were: hospitalization due to prematurity only, no maternal addiction or use of neuropsychiatric drugs, no mechanical ventilation, absence of congenital disorders, physician's order for orogastric tube insertion, and NPO status before and after tube insertion according to ward routine. Infants who received analgesics, sedatives, corticosteroids, or muscle relaxants within 30 minutes before the procedure were excluded. Infants with sudden oxygen desaturation, clinical instability, or sudden death were also excluded.

Sample Size

Based on prior similar studies and assuming a 95% confidence level, a 0.05 significance level, and 85% power, a minimum of 31 infants per group was required. Considering possible dropouts, 35 infants were recruited in each group.

Sampling and Randomization

Convenience sampling was used. After obtaining informed consent from parents—contacted via phone and invited to visit the hospital—the infants were randomly allocated into control and intervention groups using block randomization (blocks of 4) with R software.

To avoid confounding factors, no painful procedures were performed within 30 minutes before the intervention, and mothers were not present at the bedside during the procedure (Figure 1).

Data Collection Tools

Demographic data were collected using a researcher-designed checklist from medical records and mothers. Pain was assessed using the Premature Infant Pain Profile (PIPP), which scores behavioral and physiological indicators on a scale of 0–21; scores <7 indicate mild pain, 7–12 moderate pain, and >12 severe pain.

The Persian version of PIPP has been validated with a content validity index of 0.88 and internal consistency (Cronbach's alpha) of 0.72. In this study, validity was confirmed by 10 nursing and neonatology experts. Inter-rater reliability was assessed by two blinded nurses rating 10 infants independently, yielding a Kappa coefficient of 0.85.

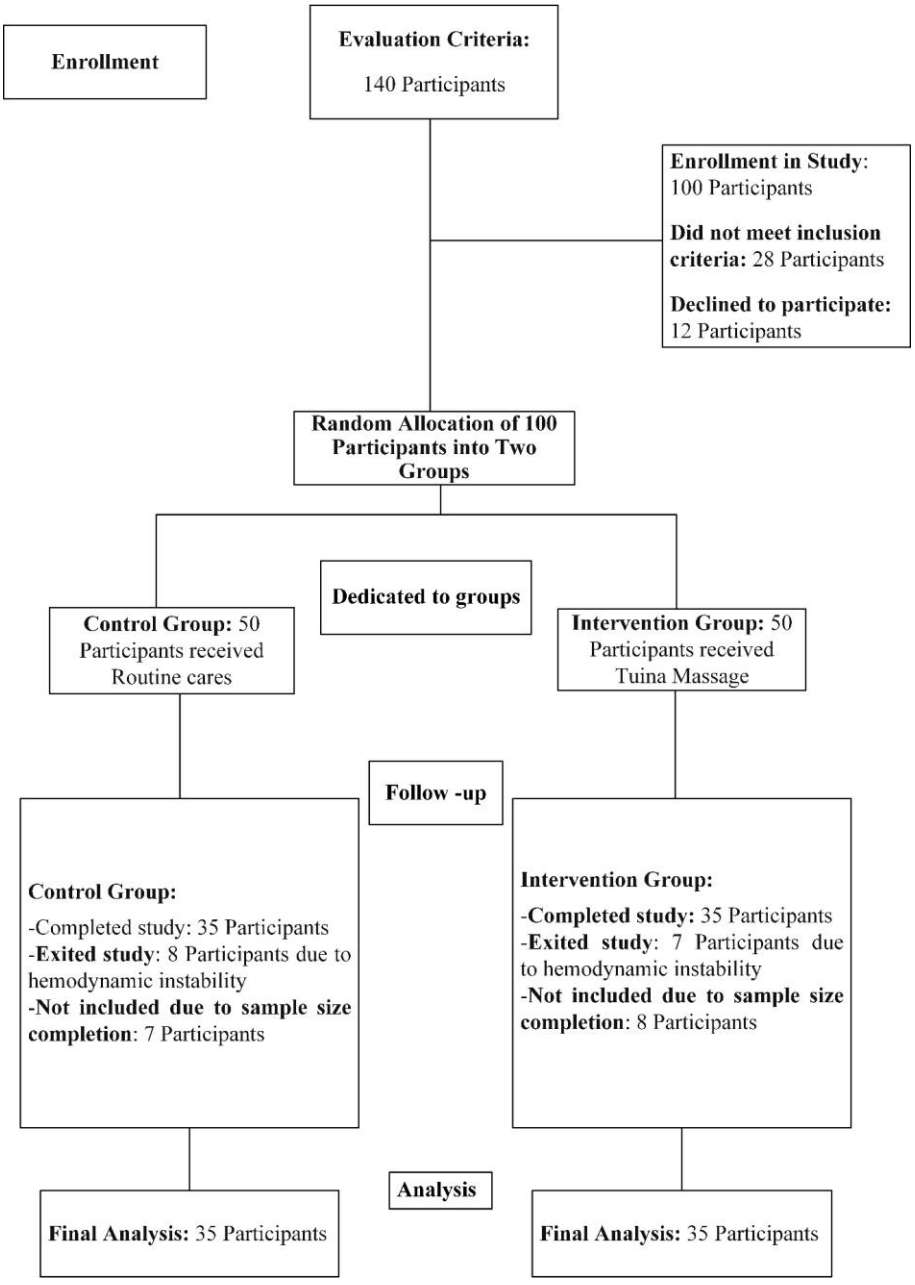

Figure 1. Consort Flow Diagram Study

Intervention Procedure

The intervention was performed by a trained researcher certified in Tuina massage. The procedure involved gentle massage of the Hegu point (LI4) on the infant's hand, applying light pressure with the thumb for 30 seconds, repeated three times with 30-second intervals. The massage was administered five minutes before, during, and five minutes after orogastric tube insertion. The control group received routine care without massage.

Pain scores, heart rate, and oxygen saturation were recorded at the three time points.

Statistical Analysis

Data were analyzed using SPSS version 25. Descriptive statistics (mean, SD, frequency) and inferential statistics (independent t-test, chi-square, repeated measures ANOVA) were used. Normality was checked with the Kolmogorov-Smirnov test. Significance was set at $p < 0.05$.

Ethical approval

This study was approved by the Ethics Committee of Joundishapoor University of Medical Science (registration ID: IR.AJUMS. REC.1402.198), and is registered at the Iranian Registry of Clinical Trials (registration ID: IRCT20230706058694N1).

Results

The demographic characteristics of participants showed no statistically significant differences between the intervention and control groups (Table 1).

Pain scores were assessed at three time points: before, during, and after the intervention. Before the intervention, the mean pain scores did not differ significantly between the intervention group (1.92 ± 1.07) and the control group (2.46 ± 1.52) ($p = 0.084$). During the intervention, the intervention group demonstrated a significantly lower mean pain score (10.78 ± 1.80) compared to the control group (14.97 ± 1.60) ($p < 0.001$). This significant reduction in pain continued after the intervention, with the intervention group scoring 7.11 ± 1.49 versus 11.16 ± 2.04 in the control group ($p < 0.001$). Repeated measures analysis showed significant changes over time in both groups (intervention: $p < 0.001$; control: $p = 0.001$). The effect size was large (Cohen's $d = 0.927$) (Table 2).

Specifically, the independent t-test showed no significant difference in mean PIPP scores before the intervention ($p = 0.084$), but significant differences during ($p = 0.001$) and after ($p = 0.001$) the intervention, with lower pain intensity in the intervention group (Table 3).

Heart rate measurements before the

Table 1. Comparison of demographic variables of premature infants in control and intervention groups

variable		Mean ± SD Test Group (n=35)		Control Group (n=35)		P-value
Gestational age at Birth (weeks)		235.13±21.59		224.51±24.38		0.053
Birth Weight		2153.47±715.92		1838.51±734.71		0.06
Calendar Age at Study Entry (days)		246.33±19.92		238.21±17.48		0.06
Apgar Score at 1 minute		6.05±2.02		5.67±1.73		0.39
Apgar Score at 5 minutes		7.52±1.76		1.63±7.18		0.39
Gender (Number, Percentage)	Boy	21	58.3	16	43.2	0.24
	Girl	15	47.1	21	56.8	
Type of Delivery (Number, Percentage)	Natural	5	13.9	8	21.6	0.54
	Cesarean	31	86.1	29	78.4	

Table 2. Mean and Standard Deviation (SD) of Pain Scores in Premature Infants Before, During, and After Orogastric Tube Insertion in the Two Groups

variable	Time of intervention	Intervention Group (n=35) Mean± SD	Group control (n=35) Mean± SD	P-value
Pain score	Before	1.07 ± 1.916	1.52 ± 2.459	0.084
	During	1.80 ± 10.777	1.60 ±14.937	0.001
	After	1.49 ± 7.111	2.04 ±11.162	0.001
	P-value	0.001	0.001	
	Size Effect	0.927		
P-value		<0.001		

Table 3. Mean and Standard Deviation (SD) of PIPP Scores in Premature Infants Before, During, and After Orogastric Tube Insertion in the Two Groups.

Time of intervention	Intervention Group (n=35)		Group control (n=35)		Independent T-test	
	Mean	SD	Mean	SD	t	P-value
Before	1.916	1.079	2.459	1.520	1.755	0.084
During	10.777	1.806	14.973	1.607	-10.490	0.001
After	7.111	1.498	11.162	2.048	-8.435	0.001

Table 4. Mean and Standard Deviation (SD) of heart rate score in Premature Infants Before, During, and After Orogastric Tube Insertion in the Two Groups.

Time of intervention	Intervention Group (n=35)		Group control (n=35)		Independent T-test	
	Mean	SD	Mean	SD	t	P-value
Before	141.416	8.100	138.848	8.885	1.390	0.169
During	149.888	6.149	153.621	6.400	-2.161	0.034
After	135.000	10.928	143.243	8.785	-3.557	0.001

Table 5. Mean and Standard Deviation (SD) arterial oxygen saturation score in Premature Infants Before, During, and After Orogastric Tube Insertion in the Two Groups

Time of intervention	Intervention Group (n=35)		Group control (n=35)		Independent T-test	
	Mean	SD	Mean	SD	t	P-value
Before	97.222	1.790	97.837	1.500	1.594	0.115
During	91.833	3.342	90.054	3.843	2.108	0.039
After	95.250	2.430	93.918	2.670	2.225	0.029

intervention did not differ significantly between groups (p = 0.169). However, during the intervention, the intervention group had a significantly lower heart rate compared to controls (p = 0.034). After the intervention, heart rates were 135.00 ± 10.93 in the intervention group and 143.24 ± 8.79 in the control group, a statistically significant difference favoring the intervention (p = 0.001) (Table 4).

Arterial oxygen saturation levels showed no significant differences before the intervention (p = 0.115). During the intervention, the intervention group had significantly higher oxygen saturation (91.83 ± 3.34) than the control group (90.05 ± 3.84) (p = 0.039). After the intervention, the difference remained significant, with the intervention group at 95.25 ± 2.43 and the control group at 93.92 ± 2.67 (p = 0.029) (Table 5).

Discussion

The primary objective of this study was to evaluate the effect of Chinese massage (Tuina) on pain and behavioral responses during orogastric tube insertion in premature infants. The findings showed a significant reduction in pain scores in the intervention group compared to the control group during and after the procedure. These results align with those of Landgren et al., who reported significant pain reduction following acupuncture therapy involving Chinese massage in infants with colic, although their study did not assess behavioral or physiological responses(22). Similarly, Liaw et al. reported pain reduction following traditional Chinese massage, although their population included infants and toddlers, unlike the premature infants in the present study (23).

Bagheri et al. examined the effect of massage on pain during umbilical venous catheter placement in premature infants, finding similar pain reduction using the PIPP tool, consistent with our findings (24). This suggests that Tuina massage could be beneficial in other invasive neonatal procedures. Harrison et al. reported decreased postoperative pain in infants undergoing congenital heart surgery who received massage therapy(25). Yang et al. also demonstrated reduced back pain in adults after Chinese massage, supporting the current results despite the difference in population (26). Furthermore, Bezgin et al. showed that abdominal massage reduced colic and constipation in preschool children, which aligns with the pain reduction observed in this study due to similarities in massage technique(27). Collectively, these findings support Tuina massage as an effective non-pharmacological intervention for neonatal pain management.

Regarding physiological responses, the intervention group exhibited significantly lower heart rates during and after massage compared to controls. This concurs with Jain et al., who

observed increased heart rates in premature infants who did not receive calf massage during heel blood collection(28). Although the focus of Tuina massage in the current research is not solely on the calf and includes other limbs, due to consistent tools and the population of premature infants, it aligns with Jain et al.'s study.

Although Tuina involves a broader massage area than calf massage alone, the consistency in population and assessment tools supports this alignment. Contrarily, Axelin's and Hauck et al.'s studies found no significant heart rate differences, possibly due to methodological differences such as the type of painful procedure, massage technique, or performer (parents vs. trained nurses(29, 30) Oxygen saturation levels were significantly higher in the intervention group during and after massage. Bagheri et al. similarly reported increased oxygen saturation following massage in premature infants(24).

Alinejad et al. showed that "M technique" massage increased oxygen saturation in infants, a finding consistent with this study given the technique's similarity to Tuina (31). Moreover, studies on non-pharmacological pain management emphasize that limb massage, particularly of the hands and abdomen, positively affects physiological parameters, including oxygen saturation(9). These converging evidences support the efficacy of Tuina in managing pain and improving physiological responses during invasive procedures such as orogastric tube insertion

Conclusion

Tuina massage significantly reduced pain intensity, heart rate, and improved oxygen saturation in premature infants undergoing orogastric tube insertion. Given its low cost, accessibility, and safety profile, Tuina represents a promising non-pharmacological intervention for neonatal pain relief. Unlike pharmacological methods such as sugar solutions, Tuina does not require special preparation, storage, or parental involvement, making it practical for routine use in neonatal intensive care units.

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Conflicts of interest

There are no conflicts of interest.

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