PERINATAL JOURNAL

Original Article

Perinatal Journal 2025; 33(1):1001-1010

https://doi.org/10.57239/prn.25.033100108

Effectiveness of high tone power therapy versus interferential current therapy in mothers with breastfeeding-related neck pain

Heba Ahmed Abd Elazeem Haridy[1*], Menna Allah Mohammed Abbas[2], Mohamed S. Zidan[3], Maha Gamal Ibrahim[4]

[1]Lecturer of Physical Therapy for Basic Science, Faculty of Physical Therapy, October 6 University, Giza, Egypt
[2]Lecturer of Physical Therapy for Women's Health, Faculty of Physical Therapy, October 6 University, Giza, Egypt
[3]Assistant professor, Department of Physical Therapy, Faculty of Applied Medical Science, Al-Zaytoonah University of Jordan, Amman, Jordan
[4]Lecturer of Physical Therapy for Basic Science, Faculty of Physical Therapy, Modern University for Technology and Information, Cairo, Egypt

Abstract

Breastfeeding-related neck pain has a high prevalence among nursing women. In most cases, it manifests as when the mother adopts an abnormal posture while feeding sessions. Pain prevents some mothers from continuing to breastfeed, which is harmful to their health and the health of their infants. This study was designed to examine the effectiveness of high tone power therapy versus interferential current therapy in mothers with breastfeeding-related neck pain. Single-blind randomized clinical trial. Sixty mothers with breastfeeding-related neck pain, age 18 to 35 years old, body mass index 18.5 to 24.9 kg/m2. They were recruited and assigned randomly into three equivalent groups. Group A (High tone power therapy): 20 mothers received high tone power therapy, along with traditional physiotherapy program. Group B (Interferential current therapy): 20 mothers received interferential current therapy, along with traditional physiotherapy program, and Group C (Traditional physiotherapy): 20 mothers received traditional physiotherapy program only (hot packs and isometric strengthening exercises). Treatment were conducted three sessions per week for six weeks. The outcome measures were pain level (visual analogue scale) and neck functional ability (neck disability index), as well as cervical range of motion (cervical range of motion device), measurements were done before treatment as well as after 6 weeks of intervention.Groups didn't differ significantly from one another regarding baseline data ($p<0.05$). There were statistically significant differences favoring Group A (High Tone Power Therapy) across all assessed variables when comparing groups following 6 weeks of intervention ($p>0.0001$). Adding high tone power therapy to traditional physiotherapy program for mothers with breast feeding-related neck pain could provide an additional improvement in pain, neck functional ability and CROM. Therefore, high tone power therapy can be recommended as a non-invasive therapeutic option for mothers with breast feeding-related neck pain.

Keywords: Breastfeeding-related neck pain, High tone power therapy, Interferential current therapy, Neck functional ability, Cervical range of motion

Introduction

Breastfeeding is an essential period for both the mother as well as baby. It ensures the infant's optimal psychological and physiological well-being, along with optimal developmental and psychosocial results.[1] For the first six months of a baby's life, the World Health Organization suggests exclusive lactation for optimal growth. Breastfeeding typically lasts between fifteen and twenty minutes and is done every two to three hours. Breastfeeding typically occurs between eight and twelve times per day. So collectively 5-6 hours in an entire day are spent while feeding the baby.[2] Breastfeeding-related neck pain has a high prevalence among nursing women. In most cases, it manifests as when the mother adopts an abnormal posture while feeding sessions. By assuming an unsupported head/neck posture and maintaining a continuous neck flexion, nursing women are able to better observe their infants as they feed. Neck strain is common from holding such an abnormal posture for long periods of time.[3] The resulting pain can hamper baby care as well as self-care.[2] Pain prevents some mothers from continuing to breastfeed, which is harmful to their health and the health of their infants. Thus, it is crucial to manage the pain and encourage mothers to continue breastfeeding to protect the health of the mother and the infant, while having all the advantages of breastfeeding.[4] High tone power therapy is a valuable, effective as well as non-invasive method for enhancing functional abilities and pain in patients with cervical pain.[5] It has special properties similar to electrotherapy; it sends energy into the body to excite cells, revitalize the body, and create a resonance effect that causes the tissues to vibrate, reducing pain

Correspondence: Heba Ahmed Abd Elazeem Haridy, Lecturer of Physical Therapy for Basic Science, Faculty of Physical Therapy, October 6 University, Giza, Egypt, **e-mail:** menaabbas14@gmail.com, **Received:** August 23, 2025 **Accepted:** October 7, 2025

and improving metabolism. Redistributing nutrients, waste products, and pain mediators with high tone power therapy can help restore cellular homeostasis, metabolic order, and neuron regeneration.[6]

On the contrary, interferential current therapy has been utilized for a long time as a safe physiotherapy approach for treating musculoskeletal system conditions. It is a simple, non-invasive and non-pharmacological treatment that has a significant analgesic effect in patients with neck pain. Moreover, it has an anti-inflammatory, sympatholytic, local vasodilatory, and muscle stimulatory actions.[7,26]

So, the need for this study arises from the lack of studies with appropriate outcome measures comparing the effect of high tone power therapy versus interferential current therapy on pain intensity level, neck functional ability and cervical range of motion in mothers with breastfeeding-related neck pain.

Materials and Methods

Study design

This study is a single-blind, prospective, randomized clinical trial. The study did not begin until the necessary ethical approval was received, with the Approval Number [OCU.PT.REC/024/002007] from the institutional review board at the Faculty of Physical Therapy, October 6 University. Research involving human subjects was performed in agreement with the principles outlined in the Declaration of Helsinki. The present study is included in the PRS Registry of Clinical Trials.gov (NCT06573515). Written informed consent was given voluntarily by all participants. The research ran from September 2024 to March 2025 at the October 6 University Hospital Physical Therapy Department.

Subjects

Sixty mothers suffering from breastfeeding-related neck pain were enrolled in this study based on the subsequent inclusion criteria; Exclusive breastfeeding mothers, with up to 6 months old infant, age ranged from 18-35 years and their body mass index (BMI) varied from 18.5 to 24.9 kg/m. [3] Mothers were chosen if their pain intensity was ≥ 5 on the visual analogue scale (VAS) and score ≥ 30% on the neck disability index (NDI).[8] Mothers were excluded from this study if they had orthopedic or neurological disorders affecting the spine, upper extremities and shoulder regions before breastfeeding.[2] Mothers with cerebrovascular problems, or any disorder affect the goal of the study, mothers had caesarean delivery, mothers with preterm babies, or low-birth weight babies, mothers with chronic diseases like cancer, human immunodeficiency virus (HIV), tuberculosis and mothers with postpartum complications like postpartum hemorrhage were also excluded from this study.[1]

Randomization

Out of sixty-five initially screened mothers, sixty fulfilled the eligibility criteria for contribution in the study after screening. They were recruited as study participants and signed the consent form. Mothers were randomized into three equivalent groups. They were distributed into either Group A (High tone power therapy) n=20; Group B (Interferential current therapy) n=20; Group C (Traditional physiotherapy) n=20. Randomization took place as follows; sixty folded papers marked (A), (B) or (C) were put in a box; then each mother was asked to pick a paper out of that box. The mothers were then assigned to their group according to the letters chosen.

Sample size calculation

The G*power software 3.1.9 (G power program version 3.1, Heinrich-Heine-University, Düsseldorf, Germany) was used to compute the sample size for this study. We used F tests—ANOVA, type I error (alpha = 0.05), power (1-βeta = 0.80), and effect size d = 0.44 to calculate the sample size. The results revealed that a total sample size of N=60 was suitable for the present study.

Intervention

Interventions were conducted three sessions per week for 6 weeks.[8] Mothers in Group A (High tone power therapy) received high tone power therapy, along with traditional physiotherapy program. Mothers in Group B (Interferential current therapy) received interferential current therapy, along with traditional physiotherapy program. Mothers in Group C (Traditional physiotherapy) received traditional

physiotherapy program only. All the participant mothers in the three groups were instructed at the beginning of the study to practice appropriate breast-feeding position with proper use of pillows and cushions. The laid-back position is the suggested position for breastfeeding as it leads to successful breastfeeding and recommended by many organizations. As the mother sits into a semi-reclined position, the baby rests fully face down on her chest, with the mother's arms serving as rails rather than bearing the baby's weight. So mother's back, head, and neck are optimally supported in this posture. In addition to facilitating a deeper and more firm latch, gravity helps the baby maintain its position, which activates up to twenty primitive neonatal reflexes. Furthermore, it decreases difficulties with the breasts, including mastitis, engorgement, as well as cracked nipples. This position enables mothers to practice and attain skills themselves, as it requires minimal professional input, instead using mothers' intuitive breastfeeding skill partnered with innate infant reflex behaviors. Mothers may feel more empowered to take an active role in their breastfeeding experience through this mother-baby collaboration.[1,9]

Traditional physiotherapy program

All mothers in the three groups were given the same traditional physiotherapy program. This includes hot packs followed by isometric strengthening exercises. The mother was asked to lie prone with exposed cervical and upper trapezius region, then hot packs was applied on the cervical spine for 20 minutes. Then, while seated, perform isometric strengthening exercises targeting the neck's flexion, extension, lateral flexion, as well as rotation. Ten repetitions of a 5-second contraction followed by a 3-second rest were performed. 2 sets of exercises were performed, with a 1 to 2 minutes rest in between.[8]

High tone power therapy

High tone power therapy was administered to all mothers in Group A utilizing HiTop 191 (gboMedizintechnik of Rimbach, Germany). It is an electrotherapy device that is controlled by a microprocessor. Attachment box, screen, power switch, intensity/modification regulator, and output plug for patient cable connection make it up. It starts at 4,096 Hz and produces pulse widths of about 350 mA and 70 V. A down modulation from 32,768 to 4,096 Hz was applied after three seconds, bringing the maximum frequency down. An ideal level of electrical stimulation was found for each mother, one that did not produce any painful or uncomfortable paraesthesia. For operation, it employs sine waves of medium frequency. The targeted muscles are subjected to a strong tetanic contraction stimulus when the mother's electro-sensitive threshold curve crosses 20Hz (after a three-seconds ramp, three-seconds stimulation, and three seconds pause). The electrodes were placed para spinal on the cervical region.[6]

Interferential current therapy

All mothers in Group B (Interferential current therapy) received interferential current therapy, it was administrated by Enraf-Nonius (ENDOMED 484, Germany), which has a constant current output, 100-240V power supply, intensity of 0-140mA, pulse duration of 0–1000us, and serial number 1520004661. All mothers in Group B were instructed to lie in a comfortable prone lying position on the treatment table during the treatment session. The interferential current therapy device was adjusted to a base frequency of 4,000 Hz, with a modulation frequency range between (10Hz - 20 Hz), spectrum mode (triangular Δ) in addition to slope 1/1 in quadripolar mode, a beat frequency of 80 Hz. The electrode size is 6x6cm and uses adhesive pads to provide interferential current conduction. Electrodes placement were as follows: two electrodes were placed on each side of cervical spine, just underneath skull. The second set of electrodes was positioned 5 centimeters apart from the first set and applied to the back of the neck (C5-C6-C7) for a duration of 25 minutes.[7]

Outcome measures the same therapist conducted assessments for all participants before treatment and following six weeks of intervention.

Pain level was assessed by the visual analogue scale (VAS); it is a 10-centimeter-long line with two ends, one representing no pain or discomfort and the other indicating the worst pain imaginable. The VAS is thought to be a valid and reliable method for measurement the severity of pain. For this study, mothers marked the area of the line that corresponded to the degree of pain they reported.[10]

Neck functional ability was assessed by the neck Disability Index (NDI). It is reliable and sensitive to variations in the level of pain. The NDI is a self-assessment tool that individuals with neck pain can use to measure their functional status in 10 areas: pain, personal care, weight, reading, headache, concentration, job, driving, sleep, as well as leisure. A score of 0 denotes "painless" and a score of 5 denotes "the worst pain imaginable" for each part. The index was determined by dividing the entire score by the total potential score, multiplying the result by 100, and then expressing it as a percentage.[8]

Cervical range of motion was evaluated utilizing the cervical range of motion device (CROM) which is represented as a beneficial parameter to measure functional limitations, physical impairment, establish a treatment plan, and monitor the patient's progress. The measurements made with the CROM were shown to be reliable in all movement directions. With the use of a Velcro strap, the CROM device attaches to the head using a plastic frame that covers the nose and ears. Connected to the frame are two separate inclinometers, one in the sagittal plane and an additional in the coronal plane, which show the head's position in relation to the line of gravity.

On the horizontal plane, a third inclinometer shows where the head is in relation to a fixed point as it rotates. It was requested that the mothers sit straight in the chair, with their feet flat upon the floor, and hands placed on their thighs.

Their shoulders and trunk were restrained by two straps, enabling just the neck to move. Mothers were instructed to maintain a straight look ahead before being asked to move their heads as much as they can according to the requested movement by the therapist, with no movement allowed in their trunk or shoulders. Flexion, extension, lateral flexion to the right and left, as well as rotation to the right and left were the six cervical range of motions collected. The mothers were given a chance to practice the movement that the range measurement was meant to record before any actual measurement was taken.[11,12]

Statistical analysis

The data were subjected to tests for homogeneity of variance as well as normality assumption. The data was found to follow a normal distribution (P>0.05) following the elimination of outliers identified by box and whiskers plots, according to a normality test of data utilizing the Shapiro-Wilk test. There was also no statistically significant difference (P>0.05) when tested for homogeneity of variance utilizing Levene's test. Parametric analysis was used and data followed a normal distribution.

For this statistical analysis, we used SPSS, Inc.'s (Chicago, IL) version 25 for Windows statistical package. The mothers' characteristics (age, weight, height, and body mass index factors) were compared among Group A, Group B, and Group C using a one-way analysis of variance (ANOVA) test. Multivariate analysis (3 x 2) of variance (MANOVA) used to compare the tested major variables of interest (VAS, NDI and CROM) at different tested groups (Group A, Group B, and Group C) and measuring periods (Pre-treatment and Post-treatment).

Pairwise comparisons of the investigated variables within and between groups were conducted using the Bonferroni correction test (Post hoc-tests) where the P-value was significant from the MANOVA test. There was statistical significance in all analyses at the 0.05 level of probability (P < 0.05).

Results

A total of sixty mothers took-part in this study and randomized into three equivalent groups (twenty mothers/group).

Table 1. Mothers general characteristics among groups

Items	Groups (Mean ±SD)			*P*-value
	Group A (n=20)	Group B (n=20)	Group C (n=20)	
Age (year)	30.70 ±2.97	29.40 ±3.11	30.80 ±3.05	0.277
Weight (kg)	62.95 ±9.21	61.75 ±7.44	63.90 ±3.93	0.642
Height (Cm)	169.05 ±10.45	168.95 ±9.15	168.70 ±6.19	0.992
0.635	21.91 ±1.42	23.11 ±6.62	22.60 ±1.33	

Group A: (High tone power therapy); Group B: (Interferential current therapy); Group C: (Traditional physiotherapy)Data are reported as mean ±standard deviation and compared statistically by ANOVA test P-value>0.05: non-significant

Table 1 shows that there was no statistically significant difference (P>0.05) in the mothers: age (P=0.277), weight (P=0.642), height (P=0.992), as well as body mass index (BMI) (P=0.635).

The statistical analysis for main variable outcomes (VAS, NDI and CROM) within each group is presented in Table (2). A significant decline (P<0.05) in VAS and NDI after treatment compared to before treatment were observed within Group A (P=0.0001 and 0.0001, respectively), Group B (P=0.0001 and 0.0001, respectively), and Group C (P=0.0001 and 0.005, respectively). Moreover, there were a significant improvement (P<0.05) in flexion and extension after treatment compared to before treatment, improvement within Group A (P=0.0001 and P=0.0001, respectively), Group B (P=0.0001 and P=0.0001, respectively), while within Group C (P=0.001 and P=0.047, respectively). There were significant improvement (P<0.05) in the right as well as left lateral flexion after treatment compared to before treatment G roup A (P=0.0001 and P=0.0001, respectively), Group B (P=0.0001 and P=0.0001, respectively), as did Group C (P=0.002 and P=0.006, respectively). A significant improvement (P<0.05) was noted in right and left rotation after treatment when compared to before treatment in Group A (P=0.0001 for both), Group B (P=0.0001 for both), and Group C (P=0.005 for right rotation as well as P=0.039 for left rotation). Mothers in Group A showed more improvement in VAS, NDI and CROM, followed by mothers in Group B, and then mothers in Group C.

The statistical analysis for main variable outcomes (VAS, NDI and CROM) among Groups A, B, and C are revealed in Table (2). Among the three Groups, there were no significant differences (P>0.05) in the following measures collected before treatment: VAS (P=0.118), NDI (P=0.824), flexion (P=0.100), extension (P=0.058), right lateral flexion (P=0.066), left lateral flexion (P=0.211), right rotation (P=0.683), as well as left rotation (P=0.693). In terms of VAS (P=0.0001), NDI (P=0.0001), flexion (P=0.0001), extension (P=0.0001), right lateral

flexion (P=0.001), left lateral flexion (P=0.015), right rotation (P=0.0001), as well as left rotation (P=0.001), significant improvements were observed (P<0.05) among Groups A, B, and C after treatment.Thus, after treatment, Group A had the highest mean values for VAS and NDI decreases as well as CROM increases, followed by Group B and finally Group C.

Table 2 shows the results of the post hoc tests conducted on the major variable outcomes (VAS, NDI, and CROM) for each pairwise group comparison after treatment. Considerable variations (P<0.05) were observed in the VAS after treatment when comparing Group A with Group B (MD=1.53; P=0.0001), Group A with Group C (MD=2.68; P=0.0001), and Group B with Group C (MD=1.15; P=0.0001). We found significant differences (P<0.05) in NDI after treatment between Group A and Group B, Group A and Group C, in addition to Group B and Group C when comparing pairwise (MD=5.18; P=0.001, MD=8.94; P=0.0001, and MD=3.76; P=0.003, respectively). Comparing flexion after treatment, there were significant differences (P<0.05) when comparing Group A with Group B (MD=5.63; P=0.0001), Group A with Group C (MD=9.41; P=0.0001), and Group B with Group C (MD=3.78; P=0.001). When comparing Group A with Group B (MD=4.65; P=0.0001), Group A with Group C (MD=7.83; P=0.0001), as well as Group B with Group C (MD=3.18; P=0.017) in terms of extension after treatment, there were significant differences (P<0.05) identified. Group A compared to Group B (MD=2.75; P=0.001), Group A compared to Group C (MD=6.54; P=0.0001), and Group B compared to Group C (MD=3.79; P=0.001) in terms of right lateral flexion after treatment, showing significant differences (P<0.05). There were notable variations (P<0.05) in left lateral flexion after treatment when comparing Group A with Group B (MD=3.79; P=0.009), Group A with Group C (MD=6.80; P=0.0001), as well as Group B with Group C (MD=3.01; P=0.007). Group A vs Group B (MD=8.06; P=0.0001), Group A vs Group C (MD=12.67; P=0.0001), and Group B vs Group C (MD=4.61; P=0.002) showed significant differences (P<0.05) for right rotation after treatment. Results showed significant differences (P<0.05) in left rotation among Group A and Group B, Group A and Group C, and Group B and Group C when compared pairwise (MD=3.83; P=0.001, MD=9.28; P=0.0001, and MD=5.45; P=0.0001, respectively). The post-hoc test as well as mean differences between groups revealed that the Group A (High tone power therapy) provided the best values of VAS, NDI and CROM followed by Group B (Interferential current therapy) and then Group C (Traditional physiotherapy).

Table 2. Within and between groups' comparisons for VAS, NDI and CROM before and after treatment

Variables	Items	Groups (Mean ±SD)			Effect size	*P*-value[2]	Post-hoc test (after treatment)		
		Group A(n=20)	Group B (n=20)	Group C (n=20)			Pairwise groups	MD	P-value[3]
VAS	Before treatment	6.95 ±0.99	7.05 ±0.68	6.50 ±0.82	0.04	0.118			
	After treatment	2.27 ±0.58	3.80 ±1.05	4.95 ±0.99	0.22	0.0001*	Group A *vs.* Group B	1.53	0.0001*
	MD (Change)	4.68	3.25	1.55			Group A *vs.* Group C	2.68	0.0001*
	95% CI	2.99 – 6.37	2.69 – 3.80	0.99 – 2.10			Group B *vs.* Group C	1.15	0.0001*
	Improvement %	67.34%	46.10%	23.85%					
	Effect size	0.61	0.54	0.21					
	P-value[1]	0.0001*	0.0001*	0.0001*					
NDI	Before treatment	23.95 ±3.25	24.30 ±3.82	24.75 ±3.44	0.003	0.824	Group A vs. Group B	5.18	0.001*
	After treatment	12.16 ±3.65	17.34 ±5.25	21.10 ±3.52	0.29	0.0001*		8.94	0.0001*
	MD (Change)	11.79	6.96	3.65			Group A vs. Group C	3.76	0.003*
	95% CI	5.95 – 17.63	4.53 – 9.39	1.10 – 6.20					
	Improvement %	49.23%	28.94%	14.75%			Group B vs. Group C		
	Effect size	0.35	0.28	0.07					
	P-value[1]	0.0001*	0.0001*	0.005*					
Flexion	Before treatment	45.20 ±3.48	45.40 ±3.08	47.50 ±3.44	0.04	0.100			
	After treatment	59.80 ±5.49	54.17 ±5.68	50.39 ±2.74	0.35	0.0001*	Group A *vs.* Group B	5.63	0.0001*
	MD (Change)	14.60	8.77	2.89			Group A *vs.* Group C	9.41	0.0001*
	95% CI	11.22 - 17.98	7.12 – 10.42	1.67 – 4.11			Group B *vs.* Group C	3.78	0.001*
	Improvement %	32.30%	19.32%	6.08%					
	Effect size	0.59	0.51	0.09					
	P-value[1]	0.0001*	0.0001*	0.001*					
Extension	Before treatment	52.45 ±4.59	53.50 ±3.66	55.95 ±3.85	0.06	0.058			
	After treatment	66.58 ±3.97	61.93 ±5.81	58.75 ±3.85	0.31	0.0001*	Group A *vs.* Group B	4.65	0.0001*
	MD (Change)	14.13	8.43	2.80			Group A *vs.* Group C	7.83	0.0001*
	95% CI	9.23 – 19.03	6.63 – 10.23	0.03 – 5.56			Group B *vs.* Group C	3.18	0.017*
	Improvement %	26.94%	15.76%	5.00%					
	Effect size	0.47	0.39	0.03					
	P-value[1]	0.0001*	0.0001*	0.047*					
Right lateral flexion	Before treatment	38.30 ±5.01	38.00 ±4.41	41.60 ±5.67	0.05	0.066			
	After treatment	50.69 ±6.03	47.94 ±5.67	44.15 ±5.09	0.25	0.001*	Group A *vs.* Group B	2.75	0.001*
	MD (Change)	12.39	9.94	2.55			Group A *vs.* Group C	6.54	0.0001*
	95% CI	7.84 – 16.94	6.39 – 13.49	1.94 – 3.16			Group B *vs.* Group C	3.79	0.001*
	Improvement %	32.35%	26.16%	6.13%					
	Effect size	0.40	0.23	0.07					
	P-value[1]	0.0001*	0.0001*	0.002*					
left lateral flexion	Before treatment	39.00 ±3.83	38.40 ±6.21	41.25 ±5.35	0.03	0.211			
	After treatment	52.75 ±7.15	48.96 ±5.20	45.95 ±4.79	0.27	0.015*	Group A *vs.* Group B	3.79	0.009*
	MD (Change)	13.75	10.56	4.70			Group A *vs.* Group C	6.80	0.0001*
	95% CI	6.40 – 21.10	5.70 – 15.42	1.35 – 8.05			Group B *vs.* Group C	3.01	0.007*
	Improvement %	13.75%	10.56%	11.39%					

	Effect size	0.22	0.20	0.06					
	P-value[1]	0.0001*	0.0001*	0.006*					
Right rotation	Before treatment	56.00 ±5.75	55.25 ±6.17	57.00 ±5.23	0.01	0.683			
	After treatment	73.79 ±7.86	65.73 ±6.20	61.12 ±6.58	0.41	0.0001*	Group A *vs.* Group B	8.06	0.0001*
	MD (Change)	17.79	10.48	4.12			Group A *vs.* Group C	12.67	0.0001*
	95% CI	12.77 – 22.81	6.32 – 10.48	1.77 – 6.47			Group B *vs.* Group C	4.61	0.002*
	Improvement %	31.77%	18.97%	7.23%					
	Effect size	0.52	0.31	0.07					
	P-value[1]	0.0001*	0.0001*	0.005*					
Left rotation	Before treatment	59.00 ±5.75	57.75 ±5.73	59.50 ±5.82	0.01	0.693			
	After treatment	71.53 ±7.05	67.70 ±8.61	62.25 ±6.38	0.33	0.001*	Group A *vs.* Group B	3.83	0.001*
	MD (Change)	12.53	9.95	2.75			Group A *vs.* Group C	9.28	0.0001*
	95% CI	6.34 – 25.06	5.79 – 14.11	1.41 – 4.09			Group B *vs.* Group C	5.45	0.0001*
	Improvement %	21.24%	17.23%	4.62%					
	Effect size	0.38	0.17	0.05					
	P-value[1]	0.0001*	0.0001*	0.039*					

Group A (High tone power therapy); Group B (Interferential current therapy); Group C (Traditional physiotherapy) Data are expressed as mean ±standard deviation (SD) MD: Mean difference CI: confidence interval P-value: probability value * Significant (P<0.05) P-value[1]: Probability value within each group; P-value[2]: probability value among groups; P-value[3]: probability value between pairwise groups (post-hoc test)

Discussion

Musculoskeletal pain, particularly neck pain, is common among nursing mothers.[3] There are no studies employing the effect of high tone power therapy versus interferential current therapy in mothers with breastfeeding-related neck pain. Thus, the current academic work was conducted to examine the effect of high tone power therapy versus interferential current therapy in mothers with breastfeeding-related neck pain. Our study revealed that high tone power therapy appears to be more effective to decrease neck pain, improve neck functional ability and CROM in mothers with breastfeeding-related neck pain.

The study's findings corroborated those of previous studies showing that high tone power therapy can increase cervical ROM and alleviate pain in patients suffering neck pain. Kulis et al. (2017) documented that high-tone power therapy is an efficient modality to increase the neck mobility and reduce pain levels in patients with cervical pain.[5] Al-Azab et al. (2022) found a clinical and statistical significant improvement in neurophysiological measures and the Oswestry Disability Index (Functional outcome) in diabetic patients suffering from lumbar radiculopathy that underwent high tone power therapy.[6]

The underlying mechanism explaining the positive impact of high tone power therapy on pain as well as function is that high tone power therapy can enhance all bodily processes by increasing cell metabolism, mitochondrial size, in addition to the balance among cell catabolism and anabolism.[13] Moreover high-tone power therapy can increase tissue perfusion, and increase blood flow dynamics in peripheral microcirculation.[14] It also can increase vasodilation through increasing nitric oxide bioavailability locally and systemically. Furthermore, it can reduce transmission of pain to the brain through suppression of sympathetic afferent activity. [15]

The results of this study align with those of Mohamed, (2017) who demonstrated that high tone power therapy has a greater capacity for achieving a decrease in lower limb pain associated with peripheral radiculopathy, as well as enhancing performance in lower limb functions compared to TENS, potentially providing a novel opportunity for better functionality. High tone power therapy may present alternative treatment approaches for enhancing functionality when compared to TENS.[16,27]

In addition, individuals with peripheral neuropathy experienced a statistically significant improvement in

functional outcome, quality of life, as well as physical health after receiving treatment with high-tone power therapy. [17]

However, the current study's findings contradict those of Ogrodzka-Ciechanowicz et al. (2021), who found no statistically significant differences within the maximum knee extensor muscle torque measurements among the control group and the group that received high tone power therapy. High tone power therapy, which is used to treat patients with anterior cruciate ligament (ACL) repairs, did not have any apparent effect on quadriceps muscle strength or knee joint function, according to the researchers. Possible reasons for the results discrepancy are the variations of frequency of treatments during the week, and the length of treatment program. [18]

Concerning interferential current therapy, studies have shown that it has a generally positive body of evidence, particularly when it comes to pain-based management. [19,20] Our study results corroborate this. Albornoz-Cabello et al. (2019) reported that interferential current can enhance the efficacy of exercise for those suffering from chronic neck pain. Incorporating interferential current stimulation led to more significant enhancements in perceived pain intensity, the extent of neck disability, symptoms of anxiety and depression, levels of apprehension, as well as both active and passive right neck rotation compared to therapeutic exercise.[21] Interferential current reduce pain intensity, improves pressure pain threshold, as well as active cervical lateral flexion ROM when treating participants with latent myofascial trigger points in upper trapezius muscle.[22]

Interferential current therapy demonstrated significant analgesic results in patients suffering from neck pain, low back pain, knee osteoarthritis, as well as post-operative knee pain. [7] Consistent with previous research by Fuentes et al. (2010), who documented that musculoskeletal pain can be effectively managed with interferential current therapy, moreover combining interferential therapy with other modalities is more effective than either treatment alone or a placebo in alleviating both acute and chronic musculoskeletal pain. [19] Furthermore, these results are consistent with those of Hussein et al. (2021), who found that compared to a placebo, interferential current therapy alone can alleviate musculoskeletal pain.[23]

The findings may be explained by interferential current therapy underlying mechanism of action, as it can induce stimulation of supraspinal level of pain killers that might lead to delayed onset but long-lasting pain relief.[7] The relaxation of muscle tension and consequently the improvement in ROM could be attributed to the secondary effects of pain relief. The reduction of pain could break the pain-spasm cycle and enhance normal pain-free movement. When the pain subsides, the patient could eventually move the neck in lateral flexion to the contralateral side without the burden of pain felt previously .[24,25]

The investigators wanted to confirm the implementation of high tone power therapy to serve as an electrotherapeutic modality for managing neck pain associated with breastfeeding. This was assessed through pain levels measured by the VAS, neck functional ability evaluated by the NDI, and objective improvement demonstrated by cervical ROM, measured utilizing the CROM.

The current study revealed that high tone power therapy in addition to traditional physiotherapy program and interferential current therapy in addition to traditional physiotherapy program could decrease neck pain, improve neck functional ability and CROM in mothers with breastfeeding-related neck pain in favor to high tone power therapy. Therefore, for mothers suffering breastfeeding-related neck pain, high tone power therapy is an affordable, practical, effective, and non-invasive treatment. Two issues could be considered a limitation of this study. Firstly, the results cannot be applied to a broader population due to the limited size of our sample. The second one is that mothers might not practice appropriate breastfeeding position accurately during study intervention. Additional studies are required to illustrate the impact of different therapeutic modalities on breast feeding-related neck pain with a large sample size.

Conclusion

High tone power therapy along with traditional physiotherapy program is more beneficial than interferential current therapy along with traditional physiotherapy program, to enhance pain, neck

functional ability and CROM outcomes in mothers with breastfeeding-related neck pain. Therefore high tone power therapy can be recommended as a non-invasive therapeutic option for mothers with breastfeeding-related neck pain.

References

1-Doshi M, Bangera A, Kumar A. (2022). Relationship Between Neck Pain, Disability and Head Posture in Women Six Months Post Delivery. International Journal of Science and Healthcare Research, 7(3), 4-8. https://doi.org/10.52403/ijshr.20220702

2-Dandekar, S. A., & Khatavkar, M. (2022). Impact of breastfeeding positions on neck pain in postpartum mothers. International Journal Of Community Medicine And Public Health, 9(10), 3791–3796. https://doi.org/10.18203/2394-6040.ijcmph20222573

3-Chidiebele Petronilla Ojukwu, Chinechendu Glory Okpoko, Adaora Justina Okemuo, Stephen Sunday Ede, Ijeoma Judith Ilo, Breastfeeding-related neck pain: prevalence and correlates among Nigerian lactating mothers, International Health, Volume 15, Issue 4, July 2023, Pages 383–388, https://doi.org/10.1093/inthealth/ihac050

4-Abeer A. Alazmi, Maha F. Algabbani. Musculoskeletal Pain Prevalence and Association with Breastfeeding Position in Lactating Mothers in Riyadh, Saudi Arabia: A Cross-Sectional Study. Clin. Exp. Obstet. Gynecol. 2023, 50(11), 250. https://doi.org/10.31083/j.ceog5011250

5- Kulis, Aleksandra & Meres, Radosław. (2017). High Tone Power therapy in the treatment of pain in the cervical spine. Health Promotion & Physical Activity. 2. 69-78. 10.5604/01.3001.0010.7723.

6-Al-Azab I, Badawy M, Sheir S, Abo Elyazed T, El Gendy A, Ateya R. The Impact of High Tone Power Therapy on Pain and Functional Abilities of Diabetic Patients with Lumbar Radiculopathy. NeuroQuantology. 2022, 20(10), 13188-13195| doi: 10.48047/nq.2022.20.10.NQ551282

7-Rampazo É.P., Liebano R.E. Analgesic effects of interferential current therapy: A narrative review. Medicina 2022; 58(1): 141- 155. doi: 10.3390/medicina58010141.

8-RAGIA M. KAMEL; GHADA S. SEDIK; MAHMOUD Y. IBRAHIM, and MARWA Sh.M. SALEH Effect of McKenzie Technique Combined with Ultrasound Therapy in Mechanical Neck Pain Med. J. Cairo Univ., Vol. 91, No. 2, June: 937-944, 2023

9- McGuigan, M., Larkin, P. Laid-back breastfeeding: knowledge, attitudes and practices of midwives and student midwives in Ireland. Int Breastfeed J 19, 13 (2024). https://doi.org/10.1186/s13006-024-00619-y

10-Joseph, Liya & Sasidharan Palappallil, Dhanya. (2016). Neck disability index, Visual analog scale, and Likert scale in patients receiving pharmacotherapy for neck pain: How good do they correlate?. National Journal of Physiology, Pharmacy and Pharmacology.7.10.5455/njppp.2017.7.1233917122016.

11- Audette I, Dumas JP, Côté JN, De Serres SJ. Validity and between-day reliability of the cervical range of motion (CROM) device. J Orthop Sports Phys Their. 2010 May;40(5):318-23. doi: 10.2519/jospt.2010.3180. PMID: 20436238.

12-Gugliotti, Mark & Tau, Jessica & Gallo, Kelly & Sagliocca, Natalina & Horan, Michael & Sussman, Nicole & Wisnewski, Robert. (2020). Between-week reliability of the cervical range of motion (CROM) device for upper cervical rotation. Journal of Manual & Manipulative Therapy. 29. 1-5. 10.1080/10669817.2020.1805691.

13-Peckova M., Havlin J., Horackova M. Charvat J., and Schück O. Effects of high-tone external muscle stimulation on renal function in healthy volunteers. Clinical Nephrology, 78(1), 34-36. 2012.

14-Nowakowska I., Wodarska M., Szymańska J., Witkoś J., et al. The influence of high tone power therapy on the peripheral microcirculation in the lower limbs. Physiotherapy/Fizjoterapia, 17(4), 10-18. 2009.

15-Robinson AJ: Clinical electrophysiology: Electrotherapy and electrophysiologic testing. Baltimore: Lippincott Williams and Wilkins. 2008.

16-Mohamed E.D. High-tone external muscle

stimulation (HTEMS) for radicular leg pain compared to transcutaneous electrical nerve stimulation (TENS) Dissertation. Heinrich-Heine-Universität Düsseldorf. 2017.

17-Klassen A., Racasan S., Gherman- Kürner B., Caprioara M., et al. High tone external muscle stimulation in end stage renal disease: effects on quality of life in patients with peripheral neuropathy. Clinical Nephrology, 79(1), 28-33, 2013.

18-Ogrodzka-Ciechanowicz Katarzyna, Ślusarski Jakub, Głąb Grzegorz, Gądek Artur. Quadriceps Muscle Strength Recovery With the Use of High Tone Power Therapy After ACL Reconstruction: a Randomized Controlled Trial. OgrodzkaCiechanowicz et al. BMC Musculoskeletal Disorders (2021) 22:975. https://doi.org/10.21203/rs.3.rs-87392/v1 9(1), 28-33, 2013.

19-Fuentes CJ, Armijo-Olivo S, Magee DJ, et al. Does ampli tude-modulated frequency have a role in the hypoalgesic response of interferential current on pressure pain sensitivity in healthy subjects? A randomised crossover study. Physiotherapy 2010; 96(1): 22–29.

20-Shah SGS, Farrow A and Esnouf A. Availability and use of electrotherapy devices: a survey. Int J Therrehabil 2007; 14(6): 260–264.

21-Albornoz-Cabello M, Pérez-Mármol JM, Barrios Quinta CJ, Matarán-Peñarrocha GA, Castro-Sánchez AM, de la Cruz Olivares B. Effect of adding interferential current stimulation to exercise on outcomes in primary care patients with chronic neck pain: a randomized controlled trial. Clin Rehabil. 2019 Sep;33(9):1458-1467. doi: 10.1177/0269215519844554. Epub 2019 Apr 22. PMID: 31007047.

22-Alaa Samir Mohamed, Soheir Shehata RezkAllah, Ghada Abdelmoniem Abdallah, Amr Saadeldeen Shalaby. Effect of Interferential Current on Pain, Pressure Pain Threshold, and Cervical Range of Motion in Myofascial Pain Syndrome: A Randomized Clinical Trial. Afr.J.Bio.Sc. 6(Si3) (2024)

23-Hussein, H.M.; Alshammari, R.S.; Al-Barak, S.S.; Alshammari, N.D.; Alajlan, S.N.; Althomali, O.W. A systematic review and meta-analysis investigating the pain-relieving effect of interferential current on musculoskeletal pain. Am. J. Phys. Med. Rehabil. 2021.

24- Beinert H.C., Behrens B.J., Larkin S. Tissue response to injury. [In:] Behrens B.J., Beinert H. Physical agents theory and practice. FA Davis, Philadelphia 2014: 18-22.

25- Liebano R.E. Mechansms of pain and use of therapeutic modalities. [In:] Bellew J.W., Michlovitz S.L., Nolan Jr T.P. Michlovitz's modalities for therapeutic intervention. FA Davis, Philadelphia 2016: 346-348.

26- Jam, F. A., Singh, S. K. G., Ng, B. K., & Aziz, N. (2018). The interactive effect of uncertainty avoidance cultural values and leadership styles on open service innovation: A look at malaysian healthcare sector. International Journal of Business and Administrative Studies, 4(5), 208.

27- Abbas, M., Jam, F. A., & Khan, T. I. (2024). Is it harmful or helpful? Examining the causes and consequences of generative AI usage among university students. International journal of educational technology in higher education, 21(1), 10.