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Effectiveness of instrument-assisted soft tissue mobilization and cupping applications in individuals with cervical disc herniation: A randomized controlled trial

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Abstract

This study investigated the effectiveness of instrument-assisted soft tissue mobilization (IASTM) and cupping therapy on neck awareness, grip strength, pain, balance, and sleep quality in patients with cervical disc herniation. This study was conducted with 27 individuals with cervical disc herniation aged between 18 and 65. The participants were randomly assigned to the intervention (n=13) or control group (n=14). While both groups received conservative treatment, the intervention group also received both IASTM and cupping therapy once a week on non-consecutive days. Intervention efficacy was evaluated by the Fremantle Neck Awareness Questionnaire to evaluate neck awareness, a Visual Analogue Scale to assess pain, a hand dynamometer to quantify grip strength, the Jenkins Sleep Scale to evaluate sleep quality, and the Single Leg Standing Test to determine balance. All assessments were made at baseline and the end of treatment. No significant discrepancy was identified between the intervention and control groups regarding pain, neck awareness, grip strength, sleep quality, and balance scores, both at rest and during activity. A significant difference was observed in all measures for the intervention group in the initial and final test comparisons. In the control group, a significant variation was detected in the VAS score for both rest and activity conditions and no significant difference was observed in the neck awareness, grip strength, sleep quality and balance scores. In the intervention group, neck pain decreased, neck awareness, grip strength and sleep quality increased, and balance improved after IASTM and cupping therapy. Alternative modalities such as IASTM and cupping therapy may be beneficial for individuals with cervical disc herniation; however, further research is recommended.

Keywords: Cupping therapy, Graston technique, pain, cervical disc herniation

1. Introduction

Neck pain resulting from a multitude of potential causes can lead to a range of adverse outcomes, including disability and dysfunction (1). Cervical disc herniation is a prevalent cause of neck discomfort. Cervical disc herniation is defined as the displacement of the nucleus pulposus from its position within the intervertebral disc. This can result in pressure being exerted on the spinal cord within the spinal canal or on the nerves passing through the neural foramen. It is more prevalent in women in their 30s and 40s, with an increasing prevalence with age (2). A variety of treatment options are currently available, although all of them entail some degree of disc excision (3). A minor alteration in volume results in a significant alteration in pressure, which releases the pressure on the compressed nerve roots or spinal cord (4). There is a definitive correlation between the presence of chronic pain and the functional status of individuals diagnosed with cervical disc herniation (5). Chronic neck pain has been demonstrated to result in the inhibition of deep flexor and extensor muscle groups, which in turn leads to a reduction in functional capacity (6). The impact of the reduced function may be observed in the context of individuals' basic and instrumental activities of daily living (7). It can be reasonably deduced that potential secondary psychosocial disorders, such as anxiety and depression, may have more concerning actual clinical consequences (8).

Various treatment modalities such as medication, invasive techniques, and conventional physiotherapy have been widely used to improve these common symptoms in patients with cervical disc herniation (9, 10). In recent years, Instrument Assisted Soft Tissue Mobilization (IASTM) has emerged as a popular technique with a favorable impact on soft tissue pathologies (11). IASTM is based on the principles of the Cyriax friction massage technique (12). Tools such as GuaSha, Graston, Ergon, Hawk Grips and Rock Tapes are used for IASTM. These instruments have different sizes, shapes and specific treatment and gripping sides (13, 14). Recent studies have demonstrated the impact of IASTM on a range of cervical symptoms, including cervicogenic pain, pain threshold, and disability (15-17). The IASTM technique has been demonstrated to be an efficacious and cost-effective approach for the management of low back and neck pain (11, 18). Nevertheless, the existing literature on the impact of IASTM in the context of neck pathologies remains scarce.

One of the forms of complementary therapy that may be employed in the treatment of neck pain is cupping. Cupping is a physical treatment, frequently employed by acupuncturists

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and other therapists specializing in complementary medicine. It involves the use of glass or plastic cups positioned on the skin over a painful area or acupuncture point to create negative pressure through suction. The rationale behind the use of cupping remains unclear. It is often described as a detoxification process, whereby waste matter and toxins are removed from the body. Additionally, it is believed to be a harmonization process, addressing the imbalance of Qi, which in traditional Chinese medicine is defined as 'vital energy' (19). The practice of cupping is currently employed as a holistic treatment modality for inpatients, as well as for the prevention and treatment of a range of ailments and the promotion of general health and well-being (20). There are two principal types of cupping: dry and wet. In dry cupping, cups are applied to the skin to create a vacuum for suction without drawing blood. In contrast, wet cupping involves drawing blood by scraping the skin before the cups are applied for suction. Cupping therapy is employed for post-stroke rehabilitation and hypertension, and has been demonstrated to be efficacious in the treatment of pain and musculoskeletal disorders (21, 22). A previously published systematic review of the literature on cupping for neck pain concluded that cupping is an effective method for reducing pain and improving function (23).

To the best of our knowledge, no comprehensive study has yet been conducted on the physical and psychosocial effects of IASTM and cupping on cervical disc herniation. A holistic approach to addressing the psychosocial status in conjunction with fundamental physical clinical parameters, such as pain, strength, and balance, can facilitate the attainment of significant clinical and practical outcomes (24). Therefore, it was hypothesized that IASTM and cupping would result in increased neck awareness, grip strength, balance, and sleep quality, and a reduction in pain in patients with cervical disc herniation.

The objective of this study was to examine the efficacy of IASTM and cupping on neck awareness, grip strength, pain, balance, and sleep quality in patients with cervical disc herniation.

2. Materials and Methods

This study is a prospective, randomized, controlled trial with a parallel group design conducted at a single center. The study was conducted in Kadıköy Medicana Hospital between September 2023 and December 2023. Each individual participating in the study was given a detailed explanation of the purpose, procedures, and measurements of the study, and written informed consent was obtained before participation.

2.1. Sample Size and Randomization

G*Power (v3.1) program was used to determine the sample size. The minimum sample size required for a significant difference between the groups was obtained as 24 under conditions where the effect level was 1.09 (large effect), the error level (a) was 0.05, and the power of the test (1-B) was 0.80 (16).

A total of 30 participants were included in the study, with 15 participants for each group. These groups were randomly assigned using a simple randomization method. The participants were randomly allocated to two groups using the 'Research Randomizer' website (https://www.randomizer.org/). The trial was ultimately concluded with 27 participants. A total of three patients were excluded from the study on the grounds of discontinuation of treatment. Ultimately, the study was concluded with 13 participants in the intervention group and 14 participants in the control group. Fig. 1 illustrates the flow of participants through the study.

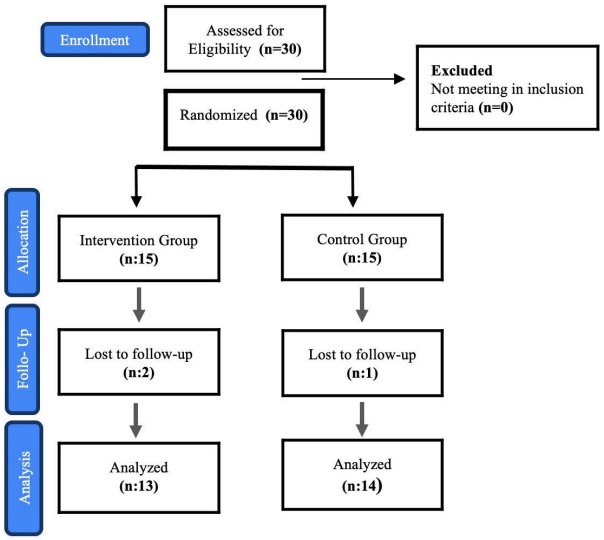

Fig. 1. CONSORT flow chart

2.2. Participants

The study was conducted with a sample of 27 individuals aged between 18 and 65 years, all of whom had a diagnosis of cervical disc herniation. In order to be eligible for inclusion in the study, participants had to be aged between 18 and 65 years, have been diagnosed with cervical disc herniation, and have been diagnosed with cervical disc herniation at the level of bulging or protrusion. Additionally, participants had to have volunteered to participate in the study. Individuals with a history of cervical spine surgery, primary or spinal metastatic malignancy, vascular problems, psychiatric drug use, or upper extremity pathologies (e.g., fracture, ganglion cyst) were excluded from the study.

2.3. Intervention and Procedure

While both groups received conservative treatment, the intervention group also received both IASTM and cupping therapy once a week on non-consecutive days (Fig. 2). The Fremantle Neck Awareness Questionnaire was employed to assess neck awareness, while the Visual Analogue Scale (VAS) was utilized to evaluate pain. Grip strength was quantified with a hand dynamometer, sleep quality was assessed with the Jenkins Sleep Scale, and balance was evaluated with the Single Leg Standing Test (SLST). All assessments were conducted at the outset of the study and its conclusion.

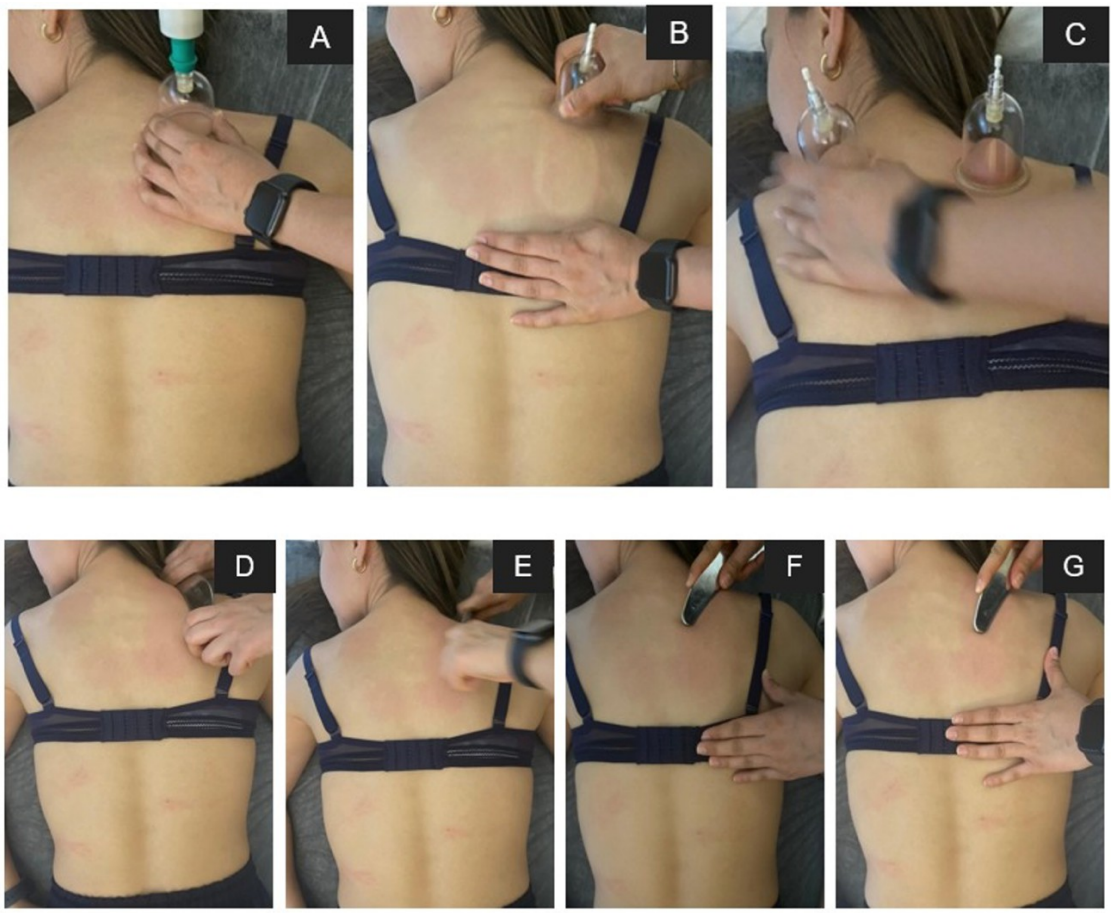

Fig. 2. A, B, C: Cupping therapy, **D, E, F, G**: IASTM technique

2.4. Treatment Method

A conventional physical therapy program was implemented for both groups, comprising ultrasound (Chattanooga Intelect Ultrasound - 1MHz, 1.0 W/cm2, 5 min), NMES (Compex rehab 400 - 20 min), Hotpack (20 min), and Transcutaneous Electric Nerve Stimulation (TENS) (Compex rehab 400 - 20 min), administered five days a week for three weeks.

In addition to the standard physiotherapy programme, participants in the intervention group received Graston and cupping applications in the prone position three days a week, with one day between each application (25). The Graston technique was applied using a sweeping motion for five minutes to observe the presence of hyperemia without forming a hematoma (26). The instrument was used at a 30° to 45°angle with moderate pressure using sweeping strokes across the upper trapezius area in all directions. During the dry cupping technique, a thin layer of liquid paraffin was applied to the skin. This was followed by a single, full traction with a manual pump, which created negative pressure and ensured cup penetration into the skin. Subsequently, the cup was slid in a longitudinal direction for five minutes, during which time the trapezius muscle was massaged. The cup was then left in situ for five minutes. It was ensured that the negative pressure was maintained at a level that would not increase pain (Figure 2). All subjects received IASTM and cupping therapy treatments, with one intervention administered per side of the body, but the order of treatment and side was randomized in advance. After each treatment, the measurements were repeated in the same order. The treatment was administered by a qualified physiotherapist.

2.5. Outcome measurements

A sociodemographic information form was employed to ascertain the demographic characteristics of the study group. Additionally, the Visual Analogue Scale (VAS), Jenkins Sleep Scale, Fremantle Neck Awareness Questionnaire, Hand Dynamometer and Single Leg Standing Test (SLST) were utilized at the commencement and conclusion of the study.

2.6. Socio-demographic Information Form

Participants' age, gender, and dominant hand were questioned.

2.7. Visual Analog Scale (VAS)

It is a methodology employed for the assessment of variables that cannot be quantified numerically. The scale necessitates the inscription of the definitions of the endpoints of the parameter to be evaluated on a 100 mm line, accompanied by the marking of the patient's condition on this line. In the case of pain assessment, the term 'no pain' was inscribed at one end of the line, while 'very severe pain' was inscribed at the other. The patient then marked the point representing their current condition, and the distance from the starting point to this mark indicated the degree of pain. Individuals were questioned about their pain at rest and during activity (27, 28).

2.8. Jenkins Sleep Scale (JSS)

JSS is employed in clinical trials for the assessment of patients'

sleep-related issues. The patients were presented with four questions regarding their sleep difficulties over the previous month and were invited to provide their responses. The options ranged from 0 (almost none) to 5 (23-31 days per month), with 1 (1-3 days per month), 2 (4-7 days per month), 3 (8-14 days per month), and 4 (15-21 days per month) representing intermediate levels of frequency. As the score increases, it is understood that the quality of the individual's sleep declines. This scale is a research tool that is used to assess sleep disorders associated with a range of medical conditions (29). The reliability and validity of this scale in our country was evaluated by Duruöz et al (30).

2.9. Fremantle Neck Awareness Questionnaire (FNAQ)

The questionnaire comprises nine questions and is designed to assess how individuals perceive the communication between the neck and the body, as well as their own body position. The questionnaire evaluates the perception that differs according to the individual. It is a Likert-type questionnaire, with responses ranging from 0 (indicating that the individual never feels this way) to 4 (indicating that the individual always or most of the time feels this way) (31). Turkish validity and reliability have been conducted (32).

2.10. Hand Dynamometer

The patient was positioned in an upright sitting position on a flat surface, with the use of a fixed chair equipped with a backrest. The knee and hip were positioned in 90° flexion, the forearm in a neutral position, the wrist in 0° to 30° extension, and 0° to 5° ulnar deviation. During the measurement, the patient was instructed to squeeze the handles of the dynamometer with maximal force. Three measurements were taken, and the mean values were recorded. Subsequently, the force was recorded in kilograms (33).

2.11. Single Leg Standing Test (SLST)

In this test, one foot was elevated to a position that did not make contact with the supporting leg, and the eyes were initially open. The patient's eyes were then directed towards the head, and he was instructed to close his eyes. The time taken to maintain this position was recorded with a stopwatch, and the test was conducted with the lifted leg in contact with the supporting leg. If the foot made contact with the floor, if there was a bounce or jump, or if any external object was touched for support, this was considered to indicate a balance disorder (34).

2.12. Data Analysis

The data obtained in this study were subjected to analysis using the Statistical Package for the Social Sciences (SPSS) 27 package program. The results of the frequency analyses of the demographic findings are presented. The frequency analyses expressed as n and % values, were calculated for each group. A frequency analysis was conducted on the scale levels, mean, standard deviation (SD), minimum (min), and maximum (max) values of the groups. The Shapiro-Wilk test was employed to ascertain whether the variables were distributed normally. In instances where the scale scores were not deemed to be normally distributed, the Mann-Whitney U test, one of two independent group comparison tests, and the Wilcoxon signed-rank test were employed to examine the differences between dependent continuous variables. The level of statistical significance was set at 0.05.

3. RESULTS

Table 1 presents a comparison of the demographic characteristics of the intervention and control groups. No significant differences were observed between the intervention and control groups concerning gender, dominant hand, and age variables (p> 0.05) (Table 1).

Table 1. Socio-demographic information of the participants

Variable		Intervention Group (n=13)		Control Group (n=14)		p^a
		n	%	n	%	
Gender	*Woman*	7	53.85	8	57.14	0.585
	Man	6	46.15	6	42.86	
Dominant hand	*Right*	11	84.62	13	92.86	0.471
	Left	2	15.38	1	7.14	
		X ± SD	**Min-Max.**	**X ± SD**	**Min-Max.**	p^b
Age		39.85 ± 10.09	25-56	38.64 ± 8.47	28-53	0.923

*p<0.05; a=Chi-Square Test, b=Mann Whitney U Test, n: Number of participants, X: Mean, SD: Standard Deviation, Min: Minimum, Max: Maximum

Table 2 shows the distribution of measurement scores within and between groups. No significant differences were observed between the intervention and control groups in terms of pain at rest and during activity, sleep quality neck awareness, grip strength, and balance scores (p>0.05). However, a significant difference was noted in all measurement scores of the intervention group between the first and last test comparisons (p <0.05). Significant changes were observed in the VAS scores for the control group during rest and activity in the first and last test comparisons (p <0.05). No significant differences were observed in sleep quality, neck awareness, grip strength, and balance scores (p> 0.05) (Table 2).

Table 2. Intragroup and intergroup comparison of measurement scores

Variable		Intervention Group (n=13)		Control Group(n=14)		
		X	SD	X	SD	p[a]
VAS (Rest)	BI	5.12	3.33	6.07	3.10	0.463
	AI	0.85	1.21	1.93	1.98	0.152
	p[b]	**0.002***			**0.002***	
VAS (Activity)	BI	7.58	1.61	5.86	3.46	0.268
	AI	1.92	1.19	2.86	1.83	0.126
	p[b]	**0.001***			**0.005***	
JSS	BI	7.31	4.96	7.07	4.75	0.942
	AI	4.54	4.70	5.43	4.03	0.522
	p[b]	**0.019***			0.054	
FNAQ	BI	10.69	7.67	8.86	5.95	0.627
	AI	6.08	5.28	6.79	5.09	0.575
	p[b]	**0.009***			0.056	
Grip Strength (Right)	BI	34.13	14.30	33.17	13.72	0.923
	AI	38.97	14.67	36.05	13.92	0.611
	p[b]	**0.001***			0.249	
Grip Strength (Left)	BI	30.45	14.10	31.79	15.14	0.884
	AI	36.32	14.72	34.91	15.49	0.645
	p[b]	**0.001***			0.683	
SLST (Right)	BI	6.71	3.50	12.63	14.91	0.497
	AI	10.67	4.48	13.04	13.34	0.577
		0.001*			0.470	
SLST (Left)	BI	5.44	3.29	13.87	16.46	0.073
	AI	9.48	8.36	15.19	15.93	0.191
	p[b]	**0.013***			0.064	

*p<0.05; a: Mann Whitney U Test; b: Wilcoxon Sign Test, n: Number of participants, X: Mean, SD: Standard Deviation, BI: Before Intervention, AI: After Intervention, VAS: Visual Analogue Scale, JSS: Jenkins Sleep Scale, FNAQ: Fremantle Neck Awareness Questionnaire, SLST: Single Leg Standing Test

Table 3 presents a comparison of the discrepancies in measurement scores between the groups. A statistically significant difference was observed between the intervention and control groups in VAS (activity), right-left grip strength, and right SLST scores (p <0.05) (Table 3).

Table 3. Comparison of the differences in measurement scores between groups

Variable	Intervention Group (n=13)		Control Group (n=14)		
	AI-BI		AI-BI		
	X	SD	X	SD	p*
VAS (Rest)	4.27	3.02	4.14	2.82	0.864
VAS (Activity)	5.65	2.17	3.00	2.63	**0.016***
JSS	2.77	3.77	1.64	2.73	0.365
FNAQ	4.62	5.88	2.07	4.27	0.223
Grip Strength (Right)	-4.84	2.41	-2.88	7.83	**0.008***
Grip Strength (Left)	-5.87	4.34	-3.13	10.72	**0.003***
SLST (Right)	-3.96	3.42	-0.41	2.22	**0.012***
SLST (Left)	-4.04	6.35	-1.32	2.48	0.145

*p<0.05; a=Mann Whitney U Test n: number of people, X: Mean, SD: Standard Deviation, BI: Before Intervention, AI: After Intervention, VAS: Visual Analogue Scale, JSS: Jenkins Sleep Scale, FNAQ: Fremantle Neck Awareness Questionnaire, SLST: Single Leg Standing Test

4. Dicussion

The objective of this study was to examine the impact of IASTM and cupping therapy on neck awareness, grip strength, pain, balance, and sleep quality in patients with cervical disc herniation. The present study concluded that IASTM and cupping applications increased neck awareness, grip strength, balance, and sleep quality, while simultaneously decreasing pain in patients with cervical disc herniation.

The existing literature investigating the effects of IASTM remains limited (35). Unuvar et al. (2024) investigated the immediate effects of Kinesio Tape and Instrument-Assisted Soft Tissue Mobilization on pain and proprioception in individuals with chronic neck pain, providing valuable insight into the therapeutic potential of IASTM compared to other manual techniques (36). Gercek et al. (2023) conducted a double-blind randomized controlled trial examining the acute effects of IASTM on pain and joint position error, highlighting

its influence on proprioceptive accuracy in chronic neck pain (37). In one study, IASTM using an M2T blade applied for 4 weeks in individuals with upper trapezius spasm was reported to be a useful tool in reducing pain.(11) Other studies have indicated that IASTM (Graston Technique) is an efficacious intervention for the alleviation of pain and enhancement of function (38, 39). The findings of our study align with those of previous research in this field. The present study indicates that the intervention group exhibited a greater post-treatment improvement in pain intensity compared to the control group. This may be attributed to the induction of tissue microtrauma by IASTM, which resulted in a regional inflammatory process and an increase in fibroblast release. The migration of fibroblasts accelerates the healing process by increasing the synthesis of collagen and the regeneration of tissue (40). Furthermore, the elevation of tissue temperature and blood flow resulting from friction between the instrument and the tissue can enhance tissue oxygenation and facilitate the removal of local waste metabolites (41, 42). The generation of heat results in a reduction in tissue constraints and viscosity, thereby increasing extensibility and imparting a softer texture to the tissue (12). The results of the study indicated a positive correlation between improved sleep quality and reduced pain severity (43). Similarly, there was an observed increase in sleep quality concurrent with a reduction in pain levels in our study cohort.

The application of force to soft tissue can result in the temporary reduction or elimination of pain, a phenomenon known as the analgesic effect. This effect can be achieved through soft tissue manipulation (44). Reduction of pain may lead to muscle relaxation and reduction of muscle protection may provide significant benefits in movement restoration (45, 46). In our study, the application of pressure with IASTM may have resulted in the inhibition of superficial muscles, thereby reducing pain and increasing awareness of the neck muscles.

A number of studies have demonstrated that IASTM can result in enhanced muscle performance (47, 48). In a single study, participants who received IASTM in conjunction with exercise therapy exhibited a more pronounced enhancement in muscle strength than those who underwent exercise therapy alone (48). The results of our study indicated an increase in both right- and left-hand grip strength in the intervention group, which had undergone treatment involving IASTM and cupping techniques. A further study compared the immediate effect of IASTM and kinesiotaping on maximal force output during a handgrip test. It was determined that both IASTM and kinesiotape resulted in significant enhancements in maximal grip strength, whereas the control group did not exhibit any improvement (49). A review of the literature suggests that neuromuscular facilitation (50), an increase in intracellular calcium in muscle tissue(51), and an increase in blood flow (52), may be potential mechanisms by which IASTM may enhance muscle performance.

In a single study, the effects of the IASTM technique and cupping therapy were investigated, and determined that both treatments were effective in improving both short- and long-term range of motion (ROM).(25) In particular, cupping therapy was found to significantly reduce pain (25). A systematic review and meta-analysis indicated that cupping may be a more efficacious treatment for chronic neck or lower back pain than medication (23). A single study employed cupping therapy on the lower trapezius muscle for a period of 10 to 15 minutes on individuals presenting with non-specific neck pain. The results demonstrated a reduction in pain levels on the visual analog scale (VAS) (0-10) at rest and during movement, with a mean decrease of 1.79 and 1.97, respectively, following cupping (53).

Cupping therapy has been demonstrated to be an effective method for manipulating physical structures, including fascia, skin, and musculocutaneous tissues. The underlying theory posits that cupping therapy exerts its beneficial effects by facilitating the elimination of toxins and harmful elements within the treated area. The application of negative pressure suction during cupping therapy facilitates the removal of toxins, stimulates the formation of granulation tissue, and supports the process of wound healing. A substantial body of evidence from numerous studies consistently supports the notion that cupping is beneficial for the early stages of healing in a range of conditions. Moreover, augmented muscle activity and enhanced muscle flexibility have been documented after cupping therapy, which may be attributed to the interplay between muscle length and tension (25). A study was conducted to compare the speed of IASTM results between cupping therapy and the Graston technique. The findings indicated that cupping provided faster pain relief and improved function due to the negative pressure mechanism. The application of cupping to the affected region results in the stimulation of blood flow, ion activity, and neuromuscular junction function. This process has been observed to reduce discomfort within three sessions and enhance flexibility throughout ongoing treatment (25). The application of cupping therapy has been demonstrated to result in vasodilatation and the stimulation of blood circulation, which in turn increases metabolic activity and facilitates the excretion of waste and toxins from the body. This effect has been demonstrated to enhance physical functionality (54). The study's limitations include the lack of clarity regarding the specific mechanisms through which the intervention group's outcomes were achieved. The study only includes short-term post-treatment outcomes. Additionally, the persistence of these outcomes beyond the treatment period remains uncertain. Another limitation is that the therapist is not blinded due to limited facilities. Since there were individuals who dropped out of the study, the study was completed with 27 participants slightly above the minimum threshold. This may compromise the power of the study. Therefore, it would be beneficial to conduct longer follow-up studies with a larger sample size in the future.

Despite the paucity of clinical evidence supporting the use of IASTM and cupping therapy, the findings of the present study indicate that these techniques may be beneficial for individuals with cervical disc herniation. Further studies are needed to recommend that therapists incorporate IASTM and cupping therapy into their treatment plans in addition to traditional physiotherapy. The findings of this study show that neck pain decreased, neck awareness, grip strength, and sleep quality increased, and balance improved in the intervention group after IASTM and cupping therapy without any adverse effects. Alternative methods such as IASTM and cupping therapy have the potential to eliminate the need for analgesics and reduce healthcare costs.

Conflict of interest

The authors declared no conflict of interest.

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None to declare.

Authors' contributions

Concept: B.İ., Ö.Ş., Design: B.İ., Ö.Ş., Data Collection or Processing: B.İ., Analysis or Interpretation: B.İ., B.D.H., Literature Search: B.İ., Ö.Ş., B.D.H., Writing: B.İ., B.D.H.

Ethical Statement

Ethical approval was obtained from the Üsküdar University Non-Interventional Research Ethics Committee (61351342/January 2023-28). The protocol is registered with http://clinicaltrials.gov/ (15/August /2023, Clinical Trial, NCT06003907). This study was conducted following the ethical rules specified in the World Medical Association (WMA) Declaration of Helsinki.

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