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Comparative Effect of Post-Isometric Relaxation and Dynamic Cupping on Non-Specific Neck and Upper Back Pain

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Abstract: ***Objectives**: To compare the effects of Post-Isometric Relaxation (PIR) and Dynamic Cupping on pain intensity, functional disability, and cervical range of motion in young adults with non-specific neck and upper back pain. **Methods**: A comparative experimental study was conducted among 60 individuals screened for eligibility, of whom 30 met the inclusion criteria. Participants were randomly allocated by computer-generated randomization into two groups of 15. One group received PIR and the other Dynamic Cupping. Both groups additionally received conventional physiotherapy comprising cervical isometric and stretching exercises. Interventions were administered three times per week for two weeks. Pain intensity, functional disability, and cervical range of motion were assessed before and after intervention using the Numeric Pain Rating Scale, Neck Disability Index, and universal goniometer, respectively. Data were analysed using paired- and independent-samples t-tests. **Results**: Both groups demonstrated statistically significant improvements in pain intensity, functional disability, and cervical range of motion following intervention ($p \leq 0.002$). No statistically significant differences were observed between the groups for any post-intervention outcome measure ($p > 0.05$). **Conclusions**: Both PIR and Dynamic Cupping, when provided alongside conventional physiotherapy, were associated with significant improvements in pain intensity, functional disability, and cervical range of motion. No statistically significant between-group differences were observed in any assessed outcome.*

Keywords: Post-Isometric Relaxation; Dynamic Cupping; Non-Specific Neck Pain; Upper Back Pain; Cervical Range of Motion

1. Introduction

Neck and upper back pain are common musculoskeletal complaints that can affect physical functioning and quality of life. Prolonged sitting, occupational demands, and poor ergonomic practices are recognized contributors to neck pain, particularly among working-age populations.[1,2] Among younger individuals, excessive smartphone use has also been associated with neck pain, while sedentary lifestyles may adversely affect spinal posture and mobility.[3,4] Non-specific neck pain refers to neck pain without an identifiable specific structural or pathological cause and may involve mechanical, postural, and myofascial factors.[5]

Physiotherapy management commonly includes therapeutic exercise and manual therapy aimed at reducing pain, improving muscle flexibility, and restoring cervical mobility. Post-Isometric Relaxation (PIR) is a muscle energy technique involving an isometric contraction followed by relaxation and subsequent stretching of the targeted muscle. Studies have reported improvements in pain, functional disability, and cervical range of motion following PIR in individuals with mechanical or non-specific neck pain.[6,7] A randomized controlled trial also reported significant improvements in pain, functional disability, cervical range of motion, and quality of life following PIR in individuals with non-specific neck pain.[8]

Dynamic cupping is a form of cupping therapy in which a cup is applied with negative pressure and continuously moved over the targeted soft tissues. The proposed effects of cupping include mechanical stimulation and stretching of the skin and underlying tissues.[9] Studies have reported improvements in pain following dynamic cupping in individuals with mechanical neck pain.[10] Recent research has also investigated dynamic cupping for neck and upper back pain associated with myofascial trigger points in the upper trapezius among computer users.[11]

Although PIR and dynamic cupping have each been investigated as interventions for neck-related musculoskeletal pain, limited evidence has directly compared these approaches in young adults with non-specific neck and upper back pain. Their different modes of application and proposed therapeutic effects provide a rationale for comparative evaluation. Therefore, the present study was undertaken to compare the effects of PIR and dynamic cupping, when provided alongside conventional physiotherapy, on pain intensity, functional disability, and cervical range of motion in young adults with non-specific neck and upper back pain.

2. Aim and Objectives

Aim

To compare the effects of PIR and dynamic cupping on pain intensity, functional disability, and cervical range of motion in young adults with non-specific neck and upper back pain.

Objectives:

1) To determine the effect of PIR combined with conventional physiotherapy on pain intensity, functional disability, and cervical range of motion.
2) To determine the effect of dynamic cupping combined with conventional physiotherapy on these outcomes.
3) To compare the effects of the two interventions on the assessed outcomes.

3. Materials and Methods

Study Design and Participants

A pretest-posttest comparative experimental study was conducted in the outpatient department of SPB Physiotherapy College, Surat. Sixty individuals aged 20-40 years were screened for eligibility, of whom 30 participants who fulfilled the inclusion criteria were recruited. Participants were randomly allocated using computer-generated randomization into two groups of 15 participants each. Participants included males and females with non-specific neck and upper back pain, an active trigger point in the upper trapezius, pain duration of less than six months, a Numeric Pain Rating Scale score of at least 4, and a Neck Disability Index score of at least 7. Participants were excluded if they had cervical spine fracture, pain radiating to the upper extremity, diagnosed cervical disc prolapse, neurological impairment, cervical tumour, structural deformity, cervical spine surgery within the previous 12 months, or were currently taking analgesic medication.

Intervention

Both groups received conventional physiotherapy consisting of cervical isometric exercises in flexion, extension, bilateral lateral flexion, and bilateral rotation, performed for 10 repetitions with a 5-second hold, along with stretching of the upper trapezius and levator scapulae muscles for 30 seconds for three repetitions. Treatment was administered three times per week for two weeks, resulting in six treatment sessions.

Group A received Post-Isometric Relaxation (PIR) in addition to conventional physiotherapy. For the upper trapezius, the participant was positioned supine while the therapist stabilized the shoulder and head. The participant performed an isometric contraction against resistance for 10 seconds, followed by relaxation and a gentle 10-second stretch. The procedure was repeated three times. The same principle was applied to the levator scapulae with appropriate positioning.

Group B received Dynamic Cupping in addition to conventional physiotherapy. A 36-mm silicone cup was applied over the upper trapezius using oil and was continuously moved in clockwise, counterclockwise, vertical, and horizontal directions for approximately three minutes, followed by proximal-to-distal and distal-to-proximal movements for approximately three minutes.

Outcome Measures

Pain intensity was assessed using the Numeric Pain Rating Scale at rest and during activity. Functional disability was assessed using the Neck Disability Index. Cervical range of motion, including flexion, extension, right and left lateral flexion, and right and left rotation, was measured using a Universal Goniometer. All outcome measures were assessed at baseline and reassessed following completion of the two-week intervention period.

Ethical Considerations

Digital informed consent was obtained from all participants. Confidentiality was maintained, and participants were informed of their right to withdraw from the study at any time.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using the Statistical Package for the Social Sciences (SPSS) version 23.0. Descriptive statistics were used to summarize demographic and baseline characteristics. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage.

An independent-samples *t*-test was used to compare post-intervention outcome measures between the Post-Isometric Relaxation and Dynamic Cupping groups. A paired-samples *t*-test was used to compare pre-intervention and post-intervention values within each group. The level of statistical significance was set at $p < 0.05$, with a 95% confidence interval.

4. Results

Baseline Characteristics The baseline characteristics of the participants are presented in Table 1. No statistically significant differences were observed between the two groups for age, pain intensity, neck disability, or cervical range of motion at baseline (all $p > 0.05$), indicating comparable baseline values.

Table 1: Baseline characteristics of participants in the PIR and Dynamic Cupping groups

Variable	PIR (n = 15), Mean ± SD	Dynamic Cupping (n = 15), Mean ± SD	p-value
Age (years)	25.40 ± 6.12	26.73 ± 7.36	0.594
NPRS at rest	1.93 ± 1.71	2.67 ± 1.95	0.283
NPRS during activity	5.00 ± 0.85	5.33 ± 1.23	0.395
NDI	14.47 ± 6.32	15.00 ± 6.74	0.825
Cervical flexion (°)	42.33 ± 11.93	35.13 ± 8.17	0.064
Cervical extension (°)	40.00 ± 12.10	39.33 ± 8.21	0.861
Right lateral flexion (°)	38.67 ± 5.82	39.00 ± 7.12	0.889
Left lateral flexion (°)	38.67 ± 8.12	37.67 ± 7.76	0.733
Right rotation (°)	54.00 ± 12.85	54.00 ± 14.17	1.000
Left rotation (°)	57.00 ± 14.49	51.33 ± 14.70	0.297

Values are presented as mean ± SD. PIR: Post-Isometric Relaxation; NPRS: Numeric Pain Rating Scale; NDI: Neck Disability Index.

Gender distribution was identical in both groups, with 11 (73.3%) female and 4 (26.7%) male participants in each group (Table 2).

Table 2: Gender distribution of participants

Gender	PIR (n = 15), n (%)	Dynamic Cupping (n = 15), n (%)
Male	4 (26.7)	4 (26.7)
Female	11 (73.3)	11 (73.3)

Values are presented as n (%).

Within-Group Comparison

The PIR group demonstrated statistically significant pre- to post-intervention improvements in all assessed outcome measures (Table 3). NPRS scores at rest and during activity and NDI scores decreased significantly, while cervical flexion, extension, lateral flexion, and rotation increased significantly ($p \leq 0.002$ for all outcomes).

Table 3: Pre- and post-intervention comparison in the PIR group (n = 15)

Outcome	Pre-intervention, Mean ± SD	Post-intervention, Mean ± SD	Mean change	p-value
NPRS at rest	1.93 ± 1.71	0.33 ± 0.62	1.60	0.001
NPRS during activity	5.00 ± 0.85	2.07 ± 1.53	2.93	<0.001
NDI	14.47 ± 6.32	6.07 ± 5.69	8.40	<0.001
Flexion (°)	42.33 ± 11.93	55.67 ± 15.80	13.33	0.001
Extension (°)	40.00 ± 12.10	54.33 ± 13.87	14.33	0.002
Right lateral flexion (°)	38.67 ± 5.82	54.67 ± 12.74	16.00	<0.001
Left lateral flexion (°)	38.67 ± 8.12	51.67 ± 10.97	13.00	0.001
Right rotation (°)	54.00 ± 12.85	78.33 ± 8.59	24.33	<0.001
Left rotation (°)	57.00 ± 14.49	72.00 ± 13.86	15.00	0.001

Similarly, the Dynamic Cupping group demonstrated statistically significant improvements in all assessed outcome measures following intervention (Table 4). NPRS and NDI scores decreased, while all measured cervical range-of-motion parameters increased significantly ($p \leq 0.001$ for all outcomes).

Table 4: Pre- and post-intervention comparison in the Dynamic Cupping group (n = 15)

Outcome	Pre-intervention, Mean ± SD	Post-intervention, Mean ± SD	Mean change	p-value
NPRS at rest	2.67 ± 1.95	0.53 ± 0.92	-2.13	0.001
NPRS during activity	5.33 ± 1.23	1.67 ± 1.45	-3.67	<0.001
NDI	15.00 ± 6.74	5.67 ± 4.58	-9.33	<0.001
Cervical flexion (°)	35.13 ± 8.17	58.33 ± 16.11	23.20	<0.001
Cervical extension (°)	39.33 ± 8.21	58.00 ± 10.49	18.67	<0.001
Right lateral flexion (°)	39.00 ± 7.12	56.33 ± 10.93	17.33	<0.001
Left lateral flexion (°)	37.67 ± 7.76	51.67 ± 8.38	14.00	<0.001
Right rotation (°)	54.00 ± 14.17	74.33 ± 6.78	20.33	<0.001
Left rotation (°)	51.33 ± 14.70	72.67 ± 7.53	21.33	<0.001

Values are presented as mean ± SD. Mean change represents pre-intervention minus post-intervention values.

Between-Group Comparison

Post-intervention comparisons between the PIR and Dynamic Cupping groups are presented in Table 5. No statistically significant differences were observed between groups for NPRS at rest or during activity, NDI, or any cervical range-of-motion parameter ($p > 0.05$).

Table 5: Between-group comparison of post-intervention outcomes

Outcome	PIR, Mean ± SD	Dynamic Cupping, Mean ± SD	p-value
NPRS at rest	0.33 ± 0.62	0.53 ± 0.92	0.489
NPRS during activity	2.07 ± 1.53	1.67 ± 1.45	0.469
NDI	6.07 ± 5.69	5.67 ± 4.58	0.833
Cervical flexion (°)	55.67 ± 15.80	58.33 ± 16.11	0.651
Cervical extension (°)	54.33 ± 13.87	58.00 ± 10.49	0.421
Right lateral flexion (°)	54.67 ± 12.74	56.33 ± 10.93	0.704
Left lateral flexion (°)	51.67 ± 10.97	51.67 ± 8.38	1.000
Right rotation (°)	78.33 ± 8.59	74.33 ± 6.78	0.168
Left rotation (°)	72.00 ± 13.86	72.67 ± 7.53	0.871

Values are presented as mean ± SD. Between-group comparisons were performed using an independent-samples *t*-test.

5. Discussion

The present study evaluated the effects of Post-Isometric Relaxation (PIR) and Dynamic Cupping on pain intensity, functional disability, and cervical range of motion in young adults with non-specific neck and upper back pain. Both groups demonstrated statistically significant improvements in all assessed outcomes following the two-week intervention period. However, no statistically significant differences were observed between the groups for any post-intervention outcome. Thus, the present findings demonstrated improvement within both treatment groups but did not demonstrate a statistically significant difference between the two approaches.

PIR combines a brief isometric contraction with subsequent relaxation and stretching, which may reduce muscular tension and facilitate movement. However, the present study did not directly investigate the physiological mechanisms underlying these changes.

Similarly, significant improvements were observed following Dynamic Cupping, proposed mechanisms include mechanical and sensory stimulation of the tissues and changes in local circulation. However, these mechanisms were not directly measured in the present study and therefore cannot be confirmed from the observed clinical outcomes.

An important consideration is that both groups received the same conventional physiotherapy programme, including cervical isometric exercises and stretching of the upper trapezius and levator scapulae. These interventions may have contributed to the improvements observed in both groups. Therefore, the changes cannot be attributed solely to PIR or Dynamic Cupping. The present findings should be interpreted as the outcomes associated with adding either intervention to conventional physiotherapy.

The absence of a statistically significant between-group difference should not be interpreted as evidence of equivalence between the two interventions, as the study was not designed as an equivalence or non-inferiority trial. The relatively small sample size may also have limited the ability to detect smaller differences between groups.

The study had several limitations, including a small sample size, recruitment from a single clinical setting, a short two-week intervention period, and absence of long-term follow-up. Blinding of participants and therapists was not feasible, and factors such as physical activity, lifestyle, pain tolerance, and adherence may have influenced the outcomes. Future studies with larger samples, longer follow-up, and a conventional-physiotherapy-only comparison group are warranted to better determine the additional effects of PIR and Dynamic Cupping.

Future studies should include larger samples, longer follow-up, and a conventional-physiotherapy-only comparison group to determine the additional effects and sustainability of PIR and Dynamic Cupping.

Overall, both treatment programmes were associated with improvements in pain, disability, and cervical range of motion; however, the present study did not demonstrate a statistically significant difference between PIR and Dynamic Cupping when used alongside conventional physiotherapy.

6. Conclusion

Both Post-Isometric Relaxation and Dynamic Cupping, when combined with conventional physiotherapy, were associated with significant improvements in pain intensity, functional disability, and cervical range of motion in young adults with non-specific neck and upper back pain. No statistically significant between-group differences were observed for any assessed outcome. These findings should be interpreted considering the small sample size, short intervention period, absence of long-term follow-up, and lack of a conventional-physiotherapy-only comparison group.

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