Original Article

Comparative Effects of Instrument-Assisted Soft Tissue Mobilization (Iastm) and Muscle Energy Technique (Met) on Post-Operative Elbow Stiffness

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ABSTRACT

OBJECTIVE: This study aimed to compare the effectiveness of Muscle Energy Technique (MET) and Instrument-Assisted Soft Tissue Mobilization (IASTM) in reducing pain, improving range of motion (ROM), and enhancing function in individuals with post-operative elbow stiffness.

METHODOLOGY: A registered randomized clinical trial with NCT06575855 was conducted with 28 participants aged 30 to 50 with post-operative elbow stiffness from proximal radius-ulna or distal humerus fractures. Participants were randomly assigned to receive either MET or IASTM interventions. Pain levels were measured using the Visual Analog Scale (VAS), functional status was assessed via the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, and ROM was evaluated. Statistical analyses included the Wilcoxon Signed Rank Test, Mann-Whitney U-test, and paired and unpaired t-tests.

RESULTS: MET and IASTM significantly reduced pain and improved ROM and function ($p < 0.05$). The IASTM group showed more significant pain reduction at rest and during activity (p-values of 0.050 and 0.039, respectively). No significant differences were found between the groups for improvements in ROM (elbow flexion/extension and forearm supination/pronation) and DASH scores, indicating similar effectiveness in these areas.

CONCLUSION: MET and IASTM effectively manage post-operative elbow stiffness, with IASTM demonstrating superior pain reduction. These findings suggest that IASTM may be more beneficial for pain management in post-operative elbow stiffness, while both techniques offer comparable benefits for ROM and functional improvement.

KEYWORDS: Elbow Stiffness, Functional improvement, Instrument-Assisted Soft Tissue Mobilization, Muscle Energy Technique, post-operative elbow stiffness, pain management, range of motion.

INTRODUCTION

Elbow stiffness, defined as difficulty moving a joint due to a reduced range of motion from injury or a condition, often leads to limited mobility and functional impairments[1]. This condition can make activities like bending or straightening the elbow and turning the palm up or down difficult. It is frequently associated with cubital tunnel syndrome, where the ulnar nerve is compressed[2,3]. The elbow's susceptibility to stiffness stems from its complex joint surfaces, tissue vulnerability, the tendency for the brachialis muscle to develop myositis ossificans, and prolonged immobilization when fixation is unstable[4]. This reduction in joint range of motion can severely impact daily activities, causing pain and fear of movement, thus reducing the quality of life[5].

Elbow function typically requires a ROM between -30 degrees of extension and 130 degrees of flexion. An elbow is considered "stiff" if it cannot extend beyond -30° or flex less than 120° [6]. Post-operative rehabilitation aims to maintain maximum ROM through early, aggressive mobilization within 24-48 hours, supported by effective pain management. Regaining muscle strength and integrating the elbow into daily activities are crucial[7]. Most improvements in range of motion (ROM) occur within the initial months of therapy. For resistant contractures, adjuvant splinting proves effective over 20 days to 3 months. Utilizing instruments designed to break down fascial restrictions and scar tissue can enhance this process by applying controlled microtrauma; this triggers an inflammatory response that helps reduce excess fibrosis and remodel injured tissues, leading to enhanced mobility and, ultimately, a complete functional recovery[8].

Muscle Energy Technique (MET) involves active patient participation through controlled muscle contractions against resistance, unlike static

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stretching[9]. This technique empowers patients and enhances collaboration in therapy. MET uses gentle isometric contractions to relax and lengthen muscles via autogenic and reciprocal inhibition. The Golgi tendon organ (GTO) detects tension and inhibits contraction, allowing deeper stretching, while muscle spindles induce the stretch reflex. MET is effective for enhancing muscle relaxation, increasing muscle length, and improving joint range of motion (ROM). It benefits conditions like limited ROM, shoulder discomfort scoliosis, sciatica, and chronic muscle pain by activating proprioceptors and mechanoreceptors to reduce discomfort, muscle spasm, and restore mobility[10,11].

Instrument-assisted soft tissue mobilization (IASTM) uses stainless steel tools to manipulate tendons, myofascial muscles, and skin through direct compressive strokes[12]. This technique promotes collagen production, alignment, and fibroblast proliferation by gliding the instrument over damaged tissue to detect and treat adhesions. The pressure and rate of strokes are adjusted based on the issue, followed by stretching and ice packs if needed. Patients typically receive IASTM treatments twice weekly, often experiencing relief by the third or fourth session. IASTM is effective for early rehabilitation, reducing discomfort and the need for surgery compared to manual methods[13]. It is beneficial for treating elbow stiffness alongside other therapies like electrotherapeutic modalities, exercises, and splinting. Tools are designed to fit specific body contours, reducing the therapist's risk of hand injury. While promising, more high-quality research is needed to confirm its efficacy compared to other treatments[14].

This study aimed to assess the impact of Muscle Energy Technique (MET) and Instrument-Assisted Soft Tissue Mobilization (IASTM) on pain, range of motion, and function in individuals with post-operative elbow stiffness. Patients with elbow stiffness often seek conservative treatments. As physiotherapists, we aimed to compare MET and IASTM efficacy in managing this condition, providing insights into the most effective treatment strategies for improving patient outcomes.

Hypothesis / Null Hypothesis

The comparative efficacy of muscular energy technique (MET) and instrument-assisted soft tissue mobilization (IASTMT) on post-operative elbow stiffness will not differ.

Alternate Hypothesis

There will be some variation in the relative efficacy of the muscle energy technique (MET) and instrument-assisted soft tissue mobilization (IASTMT) concerning post-operative elbow stiffness.

METHODOLOGY

A registered randomized clinical trial with NCT06575855 was conducted over four months with ethical approval and data collected from Allied Hospital and DHQ Hospital Faisalabad from 17-02-2024 to 17-04-2024. Twenty-eight participants were randomly allocated into two groups to minimize bias using a single-blinded design[14].

The study included male and female participants aged thirty to fifty years who had fractures of the proximal radius/ulna or distal humerus (either extra-articular or intra-articular) without ligament damage and experienced post-operative elbow stiffness. Participants were required to have a minimum loss of 30 degrees in elbow extension or less than 120 degrees of flexion and needed to be medically stable and able to understand commands. Informed consent was obtained from all participants willing to comply with the study protocol and follow-up assessments[15]. Exclusion criteria involved patients with conditions like heterotrophic ossification, bilateral upper limb injuries, pathological fractures, deformities, or any contraindications to IASTM or MET techniques, such as open wounds or severe osteoporosis. Additionally, those with neuromuscular diseases, a history of allergies to intervention materials, or those who were non-cooperative were excluded from the study. The outcome measures utilized in the study included the Visual Analog Scale (VAS) for assessing pain, elbow range of motion (ROM) for flexibility evaluation, and the Disabilities of the Arm, Shoulder, and Hand (DASH) scale for functional assessment.

Participant consent, safety, confidentiality, privacy, equitable recruitment, and scientific rigor were ensured, adhering to ethical guidelines. Materials used included Graston tools for IASTM and various supplies for MET, with standard clinical supplies for hygiene and infection control. Participants were randomly assigned to MET or IASTM, with standardized protocols, documented treatment sessions, and outcome assessments. Adverse events were monitored, and long-term follow-ups evaluated treatment effects and potential symptom recurrence.

Group 1 participants receive Instrument Assisted Soft Tissue Mobilization (IASTM) interventions, using specialized instruments like the Graston tools technique to address stiffness and improve range of motion in soft tissue structures around the elbow joint. The treatment protocol may involve specific sessions over a defined period.

Group 2 participants receive Muscle Energy Technique (MET) interventions to address elbow stiffness. MET techniques involve controlled muscle engagement to relax and release tension in soft tissues around the elbow joint. These techniques are tailored to individual needs and may include specific muscle contractions, stretches, and mobilizations. The treatment protocol for Group 2 may consist of particular sessions over a defined period with standardized techniques and parameters.

Before administering any intervention, measurements were taken from participants. Following the intervention, another set of measurements was taken. These measurements were carried out daily for 15 days, capturing the pre and post-treatment changes over this time frame.

The data was analyzed using SPSS version 23, and based on the Normality of data, different tests were applied. T-tests and paired sample t-tests were used for normally distributed data; a Wilcoxon and Mann-Whitney u test was performed for non-normally distributed data.

Trial registration: NCT06575855

RESULTS

Baseline demographic characteristics of participants

The results showed that the mean age of the participants was 40.18±11.099 years. However, about the gender distribution, a greater frequency of males 19 (67.86%) was observed while females were only 9 (32.14%). The graph below shows the types of fractures observed in the patients causing elbow stiffness. The majority of the patients had fractures of the distal humerus (35.71%); the second most common site of fracture was the proximal end of the radius and ulna (21.43%).

Within group analysis of VAS, ROM and DASH

The Normality of the data was assessed by the Kolmogorov-Smirnov test, which showed significant values for the DASH scale. Supination and pronation ROM were above 0.05, indicating a normal data distribution. Thus, parametric tests were used: the independent t-test for between-group analysis and the paired sample t-test for within-group analysis. Conversely, data for pain at rest and during activity, elbow extension, and elbow flexion had significance values below 0.05, indicating a non-normal distribution. Therefore, non-parametric tests were applied: The Mann-Whitney U-test for between-group analysis and the Wilcoxon signed-rank test for within-group analysis.

The Wilcoxon signed-rank test revealed significant improvements in pain reduction, elbow flexion, and extension ROM for the IASTM and MET groups, with p-values less than 0.05; this indicates that both interventions effectively alleviate pain during rest and activity and improve elbow range of motion. (**Table I**)

A paired sample t-test revealed significant improvements in forearm supination and pronation for both the Instrument Assisted Soft Tissue Mobilization (IASTM) and Manual Therapy (MET) groups, with p-values of 0.009 for IASTM and 0.033 for MET for supination and 0.000 for IASTM and 0.020 for MET for pronation. Significant improvements were observed in Disabilities of the Arm, Shoulder, and Hand (DASH) scores for both groups, with p-values of 0.025 for IASTM and 0.005 for MET. (**Table II**)

Table I: Within Group analysis (Wilcoxon signed Rank test)

Outcome Variable	IASTM (Pre-test) Median	IASTM (Post-test) Median	METS (Pre-test) Median	METS (Post-test) Median
VAS at Rest	2.00	1.50	2.00	1.00
Mean Rank	4.50	.00	6.50	.00
P-value		**0.010***		**0.002***
VAS at Activity	7.50	7.50	8.00	5.00
Mean Rank	4.00	.00	7.50	.00
P-value		**0.000***		**0.001***
Elbow Extension	-25.00	-10.00	-26.00	-15.00
Mean Rank	.00	7.50	0.00	7.50
P-value		**0.001***		**0.001***
Elbow Flexion	110.00	127.00	106.50	124.00
Mean Rank	.00	7.50	.00	7.50
P-value		**0.001***		**0.001***

**denotes significant results*
IASTM: Instrument-assisted soft tissue massage,
METS: Muscle energy techniques,
VAS: visual analogue Scale

Table II:
Within Group analysis (Paired Sample t-test)

Outcome Variable	IASTM (Pre-test) Mean±SD	IASTM (Post-test) Mean±SD	METS (Pre-test) Mean±SD	METS (Post-test) Mean±SD
Forearm Supination	69.50±2.534	76.79±3.118	68.21±3.662	78.14±4.036
P-value		**0.009***		**0.033***
Forearm Pronation	72.93±5.061	82.00±4.506	71.71±3.604	81.71±2.644
P-value		**0.000***		**0.020***
DASH	67.79±9.292	36.14±8.226	68.36±9.958	39.14±10.227
P-value		**0.025***		**0.005***

**denotes significant values*
DASH: disability of the arm, shoulder and hand. SD: Standard deviation

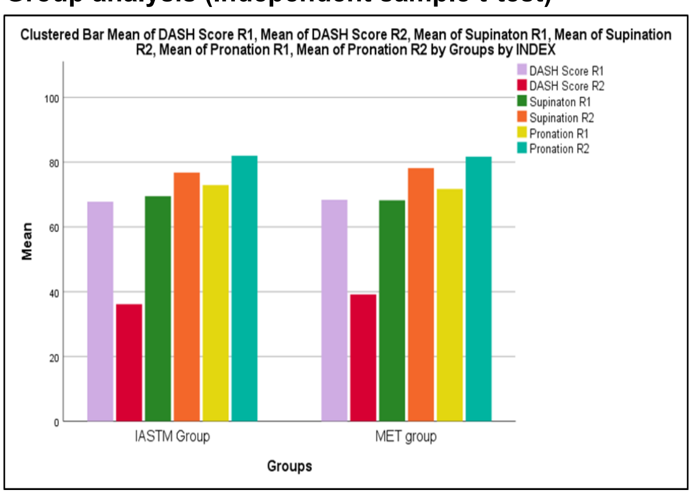
The Mann-Whitney U-test results indicated that the IASTM and MET groups had similar pre-test scores for VAS at rest and activity, with non-significant p-values. However, the post-test analysis revealed significant differences, with IASTM showing greater effectiveness in reducing pain at rest (p = 0.050) and during activity (p = 0.039), rejecting the null hypothesis. In contrast, post-test results for elbow extension and flexion ROM were non-significant (p > 0.05), suggesting both treatments were equally effective in improving these movements. (**Table III**) Independent Sample t-tests for forearm supination, pronation ROM, and DASH scores showed no significant differences between the IASTM and MET groups. Both groups had similar pre-test means and post-test improvements for forearm supination (IASTM: 69.50±2.534 to 76.79±3.118; MET: 68.21±3.662 to 78.14±4.036) and forearm pronation (IASTM: 72.93±5.061 to 82.00±4.506; MET: 71.71±3.604 to 81.71±2.644). Additionally, DASH scores improved similarly in both groups (IASTM: 67.79±9.292 to 36.14±8.226; MET: 68.36±9.958 to 39.14±10.227), with no treatment found superior. (**Graph I**)

Table III: Group analysis (Mann- Whitney u test)

Outcome Variable	IASTM Group	METS Group	P-value
VAS at Rest (Pre-test)			
Mean Rank	14.89	14.11	0.804
VAS at Rest (Post-test)			
Mean Rank	17.50	11.50	0.050*
VAS at Activity (Pre-test)			
Mean Rank	13.57	15.43	0.571
VAS at Activity(Post-test)			
Mean Rank	11.29	17.71	0.039*
Elbow Extension (Pre-test)			
Mean Rank	15.46	13.54	0.541
Elbow Extension (Post-test)			
Mean Rank	17.04	11.96	0.105
Elbow Flexion (Pre-test)			
Mean Rank	15.96	14.04	0.769
Elbow Flexion (Post-test)			
Mean Rank	17.36	11.64	0.069

**denotes significant values*

Graph I:
Group analysis (Independent sample t-test)



DISCUSSION

In the current randomized controlled trial, participants (average age 40.18 years) with elbow fractures showed significant improvements in pain, hand disability, and range of motion (ROM) with both instrument-assisted soft tissue mobilization (IASTM) and muscle energy technique (MET). However, IASTM was more effective in reducing pain at rest and during activity (p-values 0.050 and 0.039, respectively).

A study by Liu Y 2024[16] compared instrument-assisted soft tissue mobilization (IASTM) and massage therapy for treating lateral epicondylitis in 25 athletes over 4 weeks. Both treatments improved pain, elbow flexibility, and range of motion. However, those receiving IASTM had better grip strength gains than the massage therapy group; this aligns with current findings where IASTM outperformed muscle energy technique (MET) in reducing pain at rest and during activity ($p < 0.05$), suggesting it's more effective for post-operative elbow stiffness.

In contrast, a 2023 study by Bhosale P 2023[14] found that IASTM and MET significantly improved. Although both groups showed progress, IASTM was more effective in reducing pain and improving function, consistent with current study results where IASTM also demonstrated more significant pain reduction improvements than MET ($p < 0.05$). Nazary-Moghadam S et al. [17] found that IASTM significantly improved hamstring flexibility compared to Modified Hold-Relax and MET in healthy athletes, aligning with our study's results showing notable improvements in elbow and forearm range of motion (ROM) with IASTM. Conversely, Elagamawy MI 2023[18] reported that while IASTM and MET improved pain, ROM, and disability in patients with upper trapezius trigger points, MET led to more significant disability reduction. In contrast, our study found IASTM more effective in pain reduction than MET (p-values of 0.050 and 0.039), though both treatments showed similar improvements in disability as measured by the DASH scale.

The current study's results align with the quasi-experimental study by Arshad MU 2023[19], which compared IASTM and Myofascial Release Technique (MFR) for chronic heel pain. Participants received three weekly sessions of either IASTM or MFR over four weeks. IASTM proved more effective in reducing pain and enhancing functional mobility in the foot and ankle. Similarly, a study by Nadeem K et al.[20] reported significant improvements in pain and dorsiflexion ROM with IASTM for plantar fasciitis. The current study corroborates these findings, showing that IASTM was more effective than MET in reducing pain, while both treatments showed comparable improvements in disability.

Rowlett CA et al.[21] demonstrated that Instrument-Assisted Soft Tissue Mobilization (IASTM) significantly improved dorsiflexion range of motion (ROM) in weight-bearing conditions compared to traditional stretching; this is consistent with our study, which showed IASTM's superior effectiveness in enhancing ROM, pain reduction, and disability improvement in post-operative elbow stiffness patients. Similarly, a study on Muscle Energy Techniques (MET) for post-surgical elbow stiffness indicated significant improvements in elbow flexion, extension, pain, and disability. MET showed notable benefits when applied early after immobilization removal[22]. In contrast, our findings revealed that while MET improved elbow ROM and disability, IASTM was more effective in pain reduction. Furthermore, Kin YK 2021[23] found that combining Transcutaneous Electrical Nerve Stimulation (TENS) and IASTM improved pain and function in chronic low back pain patients, supporting our results where IASTM outperformed MET in reducing pain associated with elbow stiffness. Seffrin CB 2019[24] conducted a systematic review highlighting IASTM's effectiveness in reducing chronic and acute pain across various conditions, including lower back pain, chronic neck pain, and lateral epicondylitis, while improving joint range of motion (ROM) in functional limitations. This review found significant improvements in ROM for uninjured individuals and pain reduction in injured participants, with similar effect sizes across different IASTM tools, analyzing thirteen randomized controlled trials. These findings align with our study, which also observed significant pain reduction in patients treated with IASTM compared to those receiving muscle energy techniques (MET), reinforcing IASTM's efficacy in managing pain and enhancing ROM.

CONCLUSION

The study found that Instrument-Assisted Soft Tissue Mobilization (IASTM) significantly improved hand disability, forearm range of motion, and pain reduction, with IASTM showing more significant pain reduction than Muscle Energy Technique (MET), suggesting it as a preferred treatment.

Ethical permission: University of Faisalabad, Faisalabad, Punjab, Pakistan, ERC letter No. TUF/ IRB/417124.

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Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Gohar N: Conceptualized the design, data collection, and literature search
Majeed S: Conceptualized the design, data collection, and literature search
Seher Z: Proofreading, critical revision of the final version
Azeem A: Data analysis, data interpretation, drafted results part in the main manuscript
Nadir F: Literature search, drafted the final version of the manuscript
Asif T: Questionnaire design, data assembly, manuscript drafting

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