Journal of Hand Therapy 39 (2026) 236–244

Contents lists available at ScienceDirect

Journal of Hand Therapy

journal homepage: www.elsevier.com/locate/jht

Research Paper

Check for updates

Effectiveness of instrument-assisted soft tissue mobilization in patients operated for distal radius fracture: A randomized controlled blinded clinical study

Basak Cigdem-Karacay, MD [a,*,1], Levent Horoz, MD [b,2], Ismail Ceylan, PT, PhD [c,3], Halil Alkan, PT, PhD [d,4]

[a] Department of Physical Medicine and Rehabilitation, Kirsehir Ahi Evran University Faculty of Medicine, Kirsehir, Turkey
[b] Department of Orthopedics and Traumatology, Kirsehir Ahi Evran University Faculty of Medicine, Kirsehir, Turkey
[c] School of Physiotherapy and Rehabilitation, Kirsehir Ahi Evran University, Kirsehir, Turkey
[d] Faculty of Health Science, Department of Physiotherapy and Rehabilitation, Mus Alparslan University, Mus, Turkey

A R T I C L E I N F O

Article history:
Received 31 October 2024
Revised 30 April 2025
Accepted 14 May 2025
Available online 5 July 2025

Keywords:
Wrist fractures
Wrist joint
Edema
Pain
Joint range of motion

A B S T R A C T

Background: Data on the effectiveness of Instrument-Assisted Soft Tissue Mobilization, one of the mobilization methods, in Distal Radius Fracture rehabilitation are quite limited.
Purpose: The aim of this study was to investigate the effectiveness of Instrument-Assisted Soft Tissue Mobilization on pain, range of motion and edema, grip strength and functionality in patients who underwent surgery with open reduction and internal fixation due to Distal Radius Fracture.
Study Design: Randomized controlled blinded trial.
Methods: Forty-eight patients who underwent open reduction and internal fixation with volar plate due to Distal Radius Fracture were randomized into two groups as Instrument-Assisted Soft Tissue Mobilization and control group. While all patients received conventional rehabilitation (CRP), patients in the Instrument-Assisted Soft Tissue Mobilization group additionally received Instrument-Assisted Soft Tissue Mobilization with the Graston method. Circumference measurement, Patient-Rated Wrist Evaluation, Visual Analog Scale, grip strength, wrist joint range of motion measurements were performed at the beginning, fourth week and sixth week.
Results: When the changes in Visual Analog Scale (rest, activity), range of motion (Flexion, Extension, Supination and Pronation), Edema, Handgrip Strength and Total Patient-Rated Wrist Evaluation data of the Instrument-Assisted Soft Tissue Mobilization group and the control group over time (intra-group changes) were compared, a statistically significant change was found for all parameters except the Handgrip Strength variable ($p < 0.05$). In time-group comparisons, no statistical difference was found in Visual Analog Scale activity, range of motion extension, edema and Total Patient-Rated Wrist Evaluation parameters ($p > 0.05$), while a statistical difference was found in Visual Analog Scale rest, range of motion flexion, supination and pronation and hand grip strength parameters ($p < 0.05$).
Conclusions: Adding Instrument-Assisted Soft Tissue Mobilization applied to the CRP of patients who underwent surgery for Distal Radius Fracture is effective on grip strength and pronation. The addition of Instrument-Assisted Soft Tissue Mobilization application to the conventional rehabilitation application did not provide additional effect on edema and functionality. Conventional rehabilitation alone is more effective on rest pain.

Introduction

Distal radius fracture (DRF) is frequently associated with osteoporosis and is one of the most common fractures of the upper extremity.[1] Although majority of the patients are successfully treated with conservative methods, 26% require surgery.[2,3] The most common method used in DRF surgery is open reduction and internal fixation.[1] The importance of early rehabilitation after DRF surgery is well known.[4,5] The most common problems encountered after DRF

* Corresponding author. Department of Physical Medicine and Rehabilitation, Kirsehir Ahi Evran University Faculty of Medicine, Bagbasi Discret, 40100 Kirsehir, Turkey. Tel.: +905445094803; fax: +90 386 280 50 07.
E-mail address: basakcigdem@hotmail.com (B. Cigdem-Karacay).
[1] Orcid: 0000-0001-6422-5450
[2] ORCID: 0000-0002-7052-207X
[3] ORCID:0000-0002-6465-0243
[4] ORCID: 0000-0001-6895-2495

0894-1130/
https://doi.org/10.1016/j.jht.2025.05.009

surgery are stiffness, persistent neuropathy, arthritis, and nonunion.[6] Poor results have been reported due to contractures after volar plate applications.[7] In DRF rehabilitation, the aim is to control edema and pain, improve joint range of motion, and thus resume activities at the earliest opportunity.[8,9] Research on DRF rehabilitation has increased in recent years.[8,10] A review of the literature revealed a number of studies that investigated the effectiveness of various forms of postoperative rehabilitation following a diagnosis of DRF. These include home exercises, supervised exercises, and telerehabilitation applications.[11,12] Mobilization methods, such as neural mobilization, joint mobilization, and Mulligan mobilization are used in the rehabilitation of patients who have undergone surgery for DRF.[10,13]

Instrument-Assisted Soft Tissue Mobilization (IASTM) is a mobilization method developed toward the end of the 20th century.[14] Stainless steel instruments are used in the IASTM method. A lubricating gel (such as ultrasound gel, petrolatum gel) is applied to the skin before the instrument is applied, thus reducing irritation on the skin.[15] An experienced therapist is required for IASTM application.[16,17] Since the IASTM method has instrument support, less load is placed on the therapist's extremity. It has also been reported that there is better force transfer compared to other manual methods.[16,18] It has been reported that vascularity and local inflammation increase in the tissue where IASTM is applied, thus increasing the nutrient supply to the applied area and the migration of fibroblasts, thus enhancing healing. Additionally, it has been reported that skin temperature increases after IASTM application.[19,20] In recent years, research on the impact of IASTM application in various musculoskeletal problems, such as neck pain, muscle stiffness, myofascial pain, knee osteoarthritis, adhesive capsulitis has increased.[21-24] A recent meta-analysis reported that there is very low to low certainty evidence that IASTM has a positive effect on range of motion in both healthy individuals and those with musculoskeletal disorders.[17] However, another systematic review reported that there is no supporting evidence for the use of IASTM to improve pain, range of motion, and function.[25] The effectiveness and use of IASTM in healthy individuals and various musculoskeletal diseases in clinical practice remain controversial.[17,25] There are limited studies on the use of IASTM in the rehabilitation of patients who underwent surgery. The effectiveness of IASTM in the stiffness that occurs after total knee arthroplasty has been evaluated.[26] In terms of fracture rehabilitation, only one study has examined the effectiveness of IASTM in patients with fractures. The aforementioned study reported that the application of IASTM in elbow fractures was effective on pain and functions.[27] However, to the best of the authors' knowledge, no study has been conducted examining the effectiveness of IASTM in operated DRF patients.

The aim of this study was to investigate the effectiveness of IASTM on pain, range of motion and edema, grip strength, and functionality in patients who underwent surgical treatment with open reduction and internal fixation due to DRF.

Patient and method

Study population

This randomized controlled clinical trial was conducted with 48 patients in the Orthopedics and Traumatology Clinic and Physical Medicine and Rehabilitation Clinic of a Training and Research Hospital between January 2024 and September 2024. Patients over the age of 18 who underwent open reduction and internal fixation with volar plate by an orthopedist (LH) due to DRF and who did not develop neurovascular complications were included in the study. The exclusion criteria for the study were determined as the presence of multiple trauma, patients who underwent a surgical procedure other than volar plate, having previous surgery on the same extremity, and the presence of plegia or contracture in the affected extremity (Fig. 1).[28]

Surgery procedure

All patients underwent surgery under general anesthesia. All patients were subjected to tourniquet control during surgery. All patients were operated on using the Modified Henry Approach. Accordingly, the tendon bed toward the Flexor Carpi radialis muscle was opened. Then the pronator quadratus muscle was dissected from its attachment to the distal radius, and the fracture line was reached. After reduction was achieved with traction, temporary fixation was performed using a K-wire. A variable-angle distal radius plate was positioned under fluoroscopic guidance. The screw lengths and reduction were checked by fluoroscopy to ensure screw suitability. Unsuitable screws were replaced.

All patients were given 50 mg diclofenac sodium tablets twice daily for 14 days after surgery. Patients were not allowed to take NSAIDs after the 14th postoperative day. They were instructed to take paracetamol 500 mg tablets when they needed analgesics. Patients were given a chart to calculate the number of tablets they took and were asked to note their paracetamol use on the chart. Patients were placed in the postoperative neutral position with a short arm splint. Patients were only allowed to make finger movements while using the splint. The wrists of the patients were splinted for 2 weeks. At the end of the second week, the splint was removed and the wound was checked. All patients were restricted from weight-bearing activities for 6 weeks and sports activities for 12 weeks after surgery. All surgical interventions, splint applications, and postoperative follow-ups up to the third week were performed by the same orthopedist (LH) who had 8 years of experience in the field of trauma surgery at the Orthopedics and Traumatology Clinic.

Patients who consented to participate in the study and did not meet the exclusion criteria were referred to the Physical Medicine and Rehabilitation Clinic for evaluation and rehabilitation 1 week after the splint removal day, that is, at the third postoperative week. All patients were shown passive range of motion, stretching, and active assisted range of motion, stretching exercises for the forearm, wrist, and finger by the orthopedist (LH). Patients were instructed to take care not to cause any pain while exercising and were asked to perform the exercises they were taught at home for 1 week.

Randomization and blinding

Randomization was performed in the Hand Rehabilitation Unit of the Physical Therapy and Rehabilitation Clinic. Patients were divided into two groups, the IASTM Group and the Control Group, using the sealed envelope randomization method. For the sealed envelope method, a white opaque envelope and small white note paper of equal size and color were used. The names of the groups were written on the papers inside the envelopes with a pencil. The papers were folded so that the writings were inside and placed in the envelope. The envelope was sealed and signed on the back.[29] The envelopes were prepared by the researcher (BCK) who was unaware of the group distribution and were given to the researcher (IC) who performed the applications on the date when the patient recruitment for the study started. The researcher who performed the randomization was the hand therapist (IC), who was aware of the group assignments and prepared the envelope and performed the interventions. Thus, the researcher (BCK) who assessed the outcome measures remained unaware of the group assignments. Additionally, for the person who made the statistics of the study not to be aware of the groups, the group names were not included in the dataset shared with the statistician.

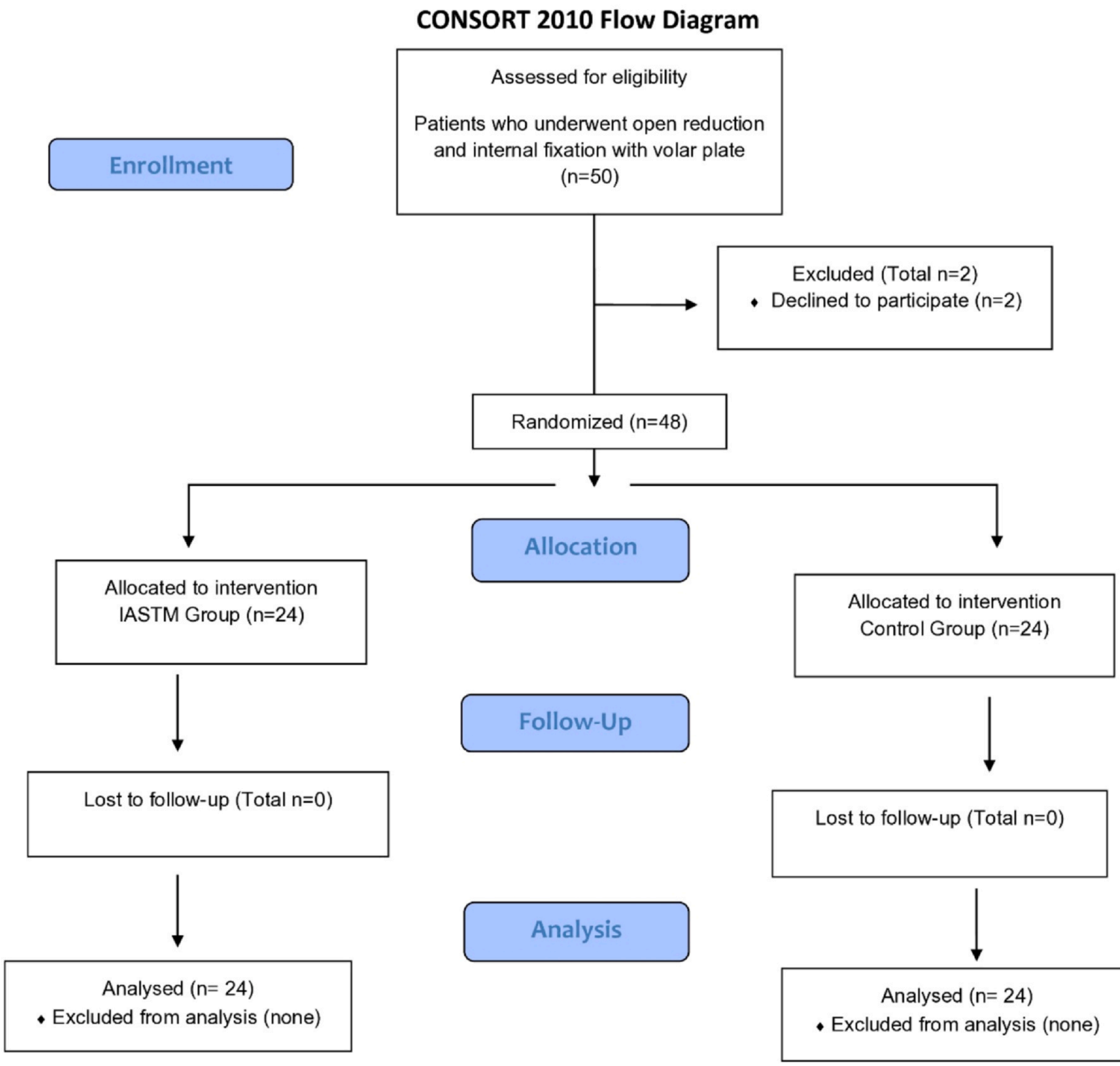

Fig. 1. CONSORT flow chart.

Interventions

IASTM application

IASTM application with Graston technique was applied to on patients in the IASTM group in addition to conventional rehabilitation. The IASTM procedure was performed with the patient in an upright sitting position and the patient's arm on the treatment table. A specially designed Graston GT5 stainless steel instrument was used throughout the procedure. Care was taken to apply the IASTM application after the conventional rehabilitation application. The application was made from the medial and lateral sides of the suture line. Special care was taken not to apply the instrument to bony areas. Adequate amounts of petrolatum gel were applied to all application areas to prevent skin irritation and reduce friction. Care was taken to not apply the ultrason gel and IASTM device to the suture line. The extensor muscle bodies, flexor muscle bodies, thenar region, and hypothenar region were mobilized using the sweeping technique by holding the instrument at a 45° angle. Mobilization was applied with 20 repetitions in each direction (Figs. 2-5 respectively).

While applying IASTM, the aim was for the patient not to feel any discomfort during the application. The patient was asked to report the discomfort/pain felt during the application on a 10-point Likert scale, with 10 indicating maximum discomfort/pain and 0 indicating no discomfort/pain. Patients were asked to report any discomfort to the practitioner by giving a score out of 10. The limit of this score was set at less than 5/10 to avoid unnecessary discomfort.

The IASTM application was applied in the Hand Rehabilitation Unit for a total of 18 sessions, 3 days a week. Each session lasted 5 minutes. The entire IASTM application was performed by an experienced hand therapist (IC) who has an IASTM practitioner certificate and has been involved in hand physiotherapy for 15 years.

Conventional rehabilitation application

In the third postoperative week, all patients received conventional rehabilitation application in the Hand Rehabilitation Unit, 5 days a week, 20 minutes per day, for 6 weeks. Passive range of motion (ROM) stretching and active assisted ROM stretching exercises of the forearm, wrist, and finger were performed under the supervision of a hand therapist for 3-4 weeks postoperatively.

Fig. 2. IASTM application to extensor muscles. IASTM = Instrument-Assisted Soft Tissue Mobilization.

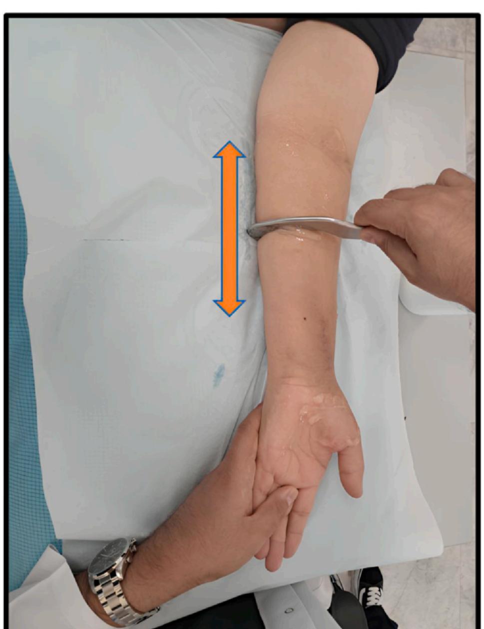

Fig. 3. IASTM application to flexor muscles. IASTM = Instrument-Assisted Soft Tissue Mobilization.

Fig. 4. IASTM application to the muscles in the thenar region. IASTM = Instrument-Assisted Soft Tissue Mobilization.

Fig. 5. IASTM application to the muscles in the hypothenar region. IASTM = Instrument-Assisted Soft Tissue Mobilization.

Isometric and isotonic strengthening was started between 4 and 6 weeks postoperatively. The rehabilitation program was standardized by the physiatrist (BCK), orthopedist (LH), and hand therapist (IC) before starting the study, and the program was individualized for each patient. While patients in the control group received only the Conventional Rehabilitation Application, patients in the IASTM group received the IASTM application in addition to the Conventional Rehabilitation Application.

Outcome measurements

Patients were evaluated three times in total: at baseline (postoperative third week), fourth week (postoperative seventh week), and sixth week (postoperative ninth week). The measurements were made in the hospital by an investigator (BCK) who was unaware of the group assignment. However, a separate location was chosen for measurements outside the hand rehabilitation unit where the patients' interventions were applied.

Numeric Rating Scale (NRS)

In this study, the NRS was used to assess pain intensity. In this scale, patients are asked to give their pain a score between 0 and 10. While number 10 describes unbearable pain (such as toothache, labor pain), number 0 is indicates no pain.

Wrist joint range of motion

The wrist joint range of motion was measured passively with a goniometer, a method that has been validated intrarater and interrater.[30] During the measurement, the investigator passively advanced the joint with the same force throughout the range of motion and recorded the angle on the goniometer at the end of the range of motion. The wrist flexion, extension, ulnar deviation and radial deviation, and forearm supination and pronation were measured.

Circumference measurement

A tape measure was used for circumferential measurements. The aim of this study was to evaluate skin and subcutaneous edema on the back of the hand using the figure of eight method. Circumferential measurements were made on both hands and recorded in cm.[31]

Grip strength

Hand grip strength was quantified using a Jamar hydraulic dynamometer (Sammons Preston Incorporated, Bolingbrook, IL) in accordance with the position recommended by the American Hand Therapists Association. Both hands were measured, and the results were recorded in kilograms. A 30-second rest period was provided once the measurement of one hand was completed. Then, the measurement of the other hand was started. The measurement was performed after the patient was seated in a supported chair and the upper extremity was placed in the standard measurement position. The shoulder was positioned in adduction and the elbow in 90-degree flexion. During the measurement, the wrist was held in an extension position between 0-30 degrees and also in ulnar deviation between 0-15 degrees. Care was taken to ensure that the patient was in the aforementioned position during the measurement.[32] Prior to each measurement, a trial was conducted to ensure the accuracy and precision of the subsequent measurement. The aim of the trial measurement was for the patient to become aware of the device and position it correctly. The measurements were repeated on three occasions, and the mean value was calculated. During the measurements, the patient was given verbal motivation in the form of "Squeze, Squeze, Squeze!."

The Patient-Rated Wrist Evaluation (PRWE)

In this study, the PRWE questionnaire was used to assess the pain and disability experienced by patients during their daily activities. Pain and disability can be assessed separately or together with the total PRWE score. Higher PRWE scores indicate greater pain and disability. The questionnaire has cultural adaptation, and validity, and reliability.[33]

NRS, wrist joint range of motion, and circumference measurements were considered primary outcome measures. Grip strength and PRWE were the secondary outcome measures.

Sample size calculation

The G*Power program version 3.1.9.4 (Heinrich-Heine-Universität Düsseldorf, Germany) was used to determine the sample size of the study.[34] According to the two-way repeated measures Anova with a mixed model test and based on wrist joint range of motion values similar articles,[27] the power rate of the sample calculated was determined as 20 people for each group, with $\beta = 90\%$ (type II error rate = 20%) and type I error rate $\alpha = 0.05$ $d = 0.2$. Considering the loss of 20% of the sample for follow-up, a total of 48 participants were included in the study (24 people for each group).

Statistical analysis

Statistical analyses were conducted using SPSS version 25 software. The relevance of variables to normal distribution was examined using visual (histogram and probability graphs) and analytical processes (Shapiro-Wilk tests). Descriptive analyses were conducted using mean and standard deviation for normally distributed variables. Numbers and percentages were given for nominal variables. The Independent groups *t* test was used to compare the values determined by measurement of the groups. Pearson chi-square test was used to compare groups for categorical variables. Mixed design repeated measures ANOVA was used to evaluate the change in the variables determined by measurement of the treatment groups over time and the group-time interactions (the covariate factor "Weight" variable in the groups was checked). In cases where the sphericity assumption was not met (for 2x3 measurements), Wilks' Lambda test was preferred from Multivariate tests. The statistical significance level was accepted as $p < 0.05$.

Ethical approval

Before starting this study, ethics committee approval was obtained from the university clinical research ethics committee (Approval Date/Number: 11.12.2023/120915). Following the granting of ethical approval by the relevant committee, the study was registered on Clinicaltrials.gov prior to the recruitment of the first patient (NCT06194604). This study was designed and conducted in accordance with the Consort 2010 guidelines.[28]

Results

When the descriptive characteristics of both groups were compared in the study, a statistical difference was found in terms of the "weight" variable ($p < 0.05$), but there was no significant difference for the other variables ($p > 0.05$). According to this result, the distribution of the groups included in the study was similar in terms of descriptive characteristics, except for the weight variable. Comparisons of the descriptive characteristics of the groups included in the study are given in Table 1.

When the changes in Visual Analog Scale (VAS) (rest, activity), ROM (Flexion, Extension, Supination and Pronation), Edema, Handgrip Strength and Total PRWE data of the IASTM group and the control group over time (intra-group changes) were compared, a statistically significant change was found for all parameters except the Handgrip Strength variable ($p < 0.05$).

The VAS, ROM, Edema, Handgrip Strength and Total PRWE outcome measurements of the IASTM group and control group were compared according to the Mixed design repeated measures ANOVA test. According to this test result, the change in these variables over time for each group is shown in the "time" column. The column showing which group had more change or the superiority of the IASTM group and control groups over each other for the VAS, ROM, Edema, Handgrip Strength and Total PRWE outcome measurements is expressed as "Group*Time." Accordingly, while no statistical difference was found in VAS activity, ROM extension, edema, and Total PRWE parameters ($p > 0.05$), a statistical difference was found in VAS rest, ROM flexion, supination and pronation and handgrip strength parameters ($p < 0.05$) (Table 2) (Figs. 6, 7).

Discussion

The findings of this study indicate that, both conventional rehabilitation application alone and the addition of IASTM to conventional rehabilitation improved pain, range of motion, edema and functionality. In particular, significant improvements were observed

Table 1
Comparison of descriptive characteristics of the groups

	IASTM group (*n* = 24)		Control group (*n* = 24)		t	*p*
	X	SD	X	SD		
Age (y)	48.8	16.4	56.8	10.9	−1.991	0.052
Height (cm)	169.1	9.8	163.6	8.7	2.1	0.064
Weight (kg)	80.3	13	72.4	7.7	2.6	**0.014**
	n	(%)	*n*	(%)	X^2	*p*
Gender						
Female	12	50.0	16	66.7	1.4	0.242
Male	12	50.0	8	33.3		
Smoking						
No	18	75.0	18	75.0	0.00	1.000
Yes	6	25.0	6	25.0		
Dominant hand						
Right	22	91.7	18	75.0	2.4	0.121
Left	2	8.3	6	25.0		
Operated hand						
Right	20	83.3	15	62.5	2.6	0.104
Left	4	16.7	9	37.5		

IASTM = Instrument-Assisted Soft Tissue Mobilization; t = T-test in independent groups; X^2 = chi-square analysis; X = Mean; SD = standard deviation.
Bold values indicates statistical significance of $p < 0.05$.

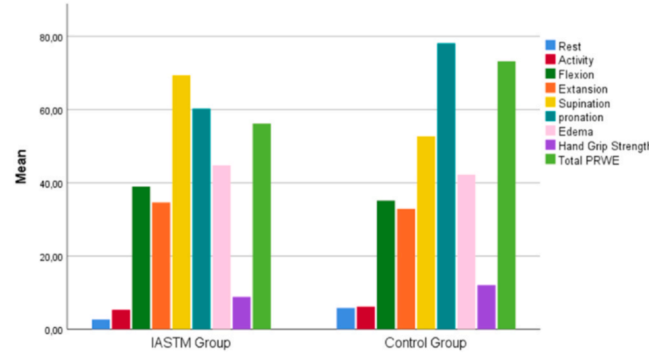

Fig. 6. VAS, wrist ROM, edema, hand grip strength and total PRWE values of IASTM and control groups at week 3. IASTM = Instrument-Assisted Soft Tissue Mobilization; PRWE = Patient-Rated Wrist Evaluation questionnaire; ROM = range of motion; VAS = Visual Analog Scale.

in both groups over time in edema and functionality. However, adding IASTM, which was applied using the Graston method, to the conventional rehabilitation application of patients who underwent surgery for DRF had no significant effect on edema and functionality. Adding IASTM to the conventional rehabilitation application provided a better increase in muscle strength in these patients. However, according to the results of this study, the rest pain and range of motion in patients rehabilitated after DRF surgery were improved better with conventional rehabilitation alone.

There are only few studies in the literature that evaluated the effectiveness of IASTM in postoperative patients.[26,27] Chughtai et al the effectiveness of IASTM with Augmented Soft Tissue Mobilization method was evaluated in patients with limited knee joint range of motion after total knee arthroplasty, and it was reported that it was effective for joint range of motion and functionality.[26] Bhosale et al examined the effectiveness of the IASTM method in patients with elbow limitations.[27] According to the results of the Bhosale et al study, there was reported that there was an improvement in the range of motion of both groups.[27] When Chughtai et al study is examined, it was conducted with 23 patients (29 knees) and did not

Table 2
Comparison of the VAS, ROM, edema, handgrip strength and total PREW measurement data of the study groups in the third week, seventh week and ninth week values

			IASTM group (*n* = 24)		Control group (*n* = 24)		Time	Group*Time	Pairwise comparisons (week)**	η^2
			X	SD	X	SD	*p*	F/p		
VAS	Rest	Week 3	2.6	2.7	5.8	1.7	**0.000**	18.9/**0.000**	3-7, 7-9, 3-9	0.291
		Week 7	1.1	1.6	1.9	1.4				
		Week 9	0.33	0.73	0.55	0.62				
	Activity	Week 3	5.3	2.7	6.2	2	**0.000**	2.9/0.061	3-7, 7-9, 3-9	0.059
		Week 7	2	2	1.6	1.4				
		Week 9	0.66	1	0.48	0.80				
ROM	Flexion	Week 3	39	18.4	35.1	16	**0.000**	5.6/**0.005**	3-7, 7-9, 3-9	0.109
		Week 7	55	14.5	61.9	9				
		Week 9	65	10.7	65.9	6.8				
	Extantion	Week 3	34.6	18.1	32.9	12.1	**0.000**	1.7/0.184	3-7, 7-9, 3-9	0.036
		Week 7	50.3	11.8	54.3	7.1				
		Week 9	60.5	9.1	59.7	6.3				
	Supination	Week 3	69.3	19.2	52.7	12.3	**0.000**	8.5/**0.000**	3-7, 7-9, 3-9	0.156
		Week 7	81.9	11.9	78.5	8.4				
		Week 9	87.2	6.9	82.8	8.2				
	Pronation	Week 3	60.3	20.4	78.1	9.4	**0.000**	9.9/**0.000**	3-7, 7-9, 3-9	0.178
		Week 7	75.3	16.3	84.2	7.6				
		Week 9	85.7	7	87.7	5				
Edema (cm)		Week 3	44.8	2.7	42.3	2.4	**0.049**	1/0.312	3-7	0.022
		Week 7	44	2.9	41.8	2.2				
		Week 9	42.1	8.5	41.5	2				
Hand grip strength		Week 3	8.8	6.6	12.1	2.8	0.207	3.4/**0.036**	-	0.071
		Week 7	19.2	16.5	15.9	3.5				
		Week 9	22	8.8	19.7	3.7				
Total PRWE		Week 3	56.2	21.1	73.2	20.1	**0.000**	1.3/0.272	3-7, 7-9, 3-9	0.028
		Week 7	28.3	18.9	37.8	19.4				
		Week 9	6.7	7.1	17.6	16.9				

IASTM = Instrument-Assisted Soft Tissue Mobilization; VAS = Visual Analog Scale; PRWE = Patient-Rated Wrist Evaluation questionnaire; ROM = range of motion; SD = standard deviation; η^2 = effect size.
Bold values indicates statistical significance of $p < 0.05$.
* Two-way Analysis of Variance in Repeated Measures [Mixed design repeated measures ANOVA.
** 3: Measurement at week 3; 7: Measurement at week 7; 9: Measurement at week 9.

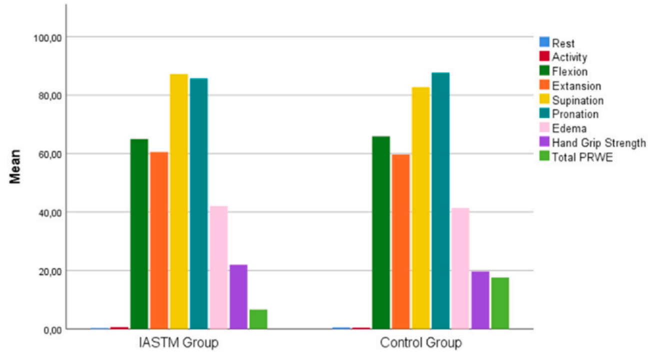

Fig. 7. VAS, wrist ROM, edema, hand grip strength and total PRWE values of IASTM and control groups at week 9. IASTM = Instrument-Assisted Soft Tissue Mobilization; PRWE = Patient-Rated Wrist Evaluation questionnaire; ROM = range of motion; VAS = Visual Analog Scale.

include a control group. In Bhosale et al study, all patients received conventional rehabilitation application, but no patient group received only conventional rehabilitation application. In other words, the effectiveness of IASTM was compared with the muscle energy technique in the study in question, and no control group was used. The effect of IASTM in increasing joint range of motion was explained as the mechanical pressure of the device increased blood flow, causing inflammation and reorganization of collagen fibers.[35,36] In this study, unlike previous studies in the literature, it was determined that the range of motion of the joint was better developed and that the resting pain was less in the group that did not receive IASTM application in patients with operated DRF. The reason for this difference that emerged with the literature may be due to the application site, application method, and surgical procedure applied, as well as the difference in the study design. The mechanical effect of the device in the wrist area may have resulted in increased inflammation and blood flow, resulting in increased resting pain. In addition, the authors thought that due to increased resting pain in the IASTM group, patients' exercise compliance was impaired, and this situation negatively affected the improvement in joint range of motion.

The results of this study demonstrate that, the increase in grip strength was greater with the IASTM application. A recent study evaluated the effects of IASTM on grip strength and tissue stiffness with ultrasound in healthy adults. No significant improvement was observed in grip strength and tissue stiffness in pre- and post-treatment evaluations.[37] It has been reported that there is an improvement in grip strength when IASTM is applied with the Astym method in patients with lateral epiconilitis.[38] One of the mechanisms of action of IASTM is that IASTM application causes an increase in the number and activation of fibroblasts and the production of fibronectin. Thus, it has been reported that tissue healing and collagen organization are accelerated.[39,40] In this study, the authors explained the effect of IASTM application on increasing grip strength in patients operated on for DRF with the effect of IASTM on tissue healing and soft tissue.

According to the results of this study, significant improvement in edema was observed in the first 4 weeks of rehabilitation, that is, in the early period in both groups. This finding supports the information in the literature that edema is a significant problem, especially in the early period, during distal radius rehabilitation.[41] The researchers of this study designed this study on the hypothesis that IASTM may be effective on early edema in patients who underwent surgery for DRF. However, according to the results of this study, edema regresses with rehabilitation, especially in the early period, and adding IASTM to rehabilitation does not have an additional contribution on edema. One of the mechanisms of action of IASTM application is to increase local blood flow and inflammation.[19,20] Increased local inflammation in the postoperative period may have limited the effectiveness of IASTM on edema. According to the results of this study, although adding IASTM did not provide additional contribution to edema, it did not cause an increase in edema either. To the best of the authors' knowledge, no study has evaluated the efficacy of IASTM in patients undergoing surgery for DRF. Therefore, when designing this study, care was taken to avoid interventions close to the wound site and bony structures during IASTM application. Participants in the IASTM group did not report any adverse effects during the study therefore, they did not have to discontinue treatment.

Limitations

All patients included in this study underwent surgical intervention performed by the same orthopedic surgeon employing the same surgical technique. The study was designed as a single-blind study, and the study team consisted of researchers with experience in orthopedic rehabilitation. Well-designed studies with longer follow-up periods are needed.

Conclusion

According to the results of this study, the addition of IASTM applied with the Graston method to the conventional rehabilitation application of patients who underwent surgery due to DRF is effective on grip strength and pronation. The addition of IASTM application to the conventional rehabilitation application did not provide additional effect on edema and functionality. Conventional rehabilitation application alone is more effective on rest pain.

Ethics approval and consent to participate

Before starting this study, ethics committee approval was obtained from the university clinical research ethics committee. (Approval Date/Number: 11.12.2023/120915) After ethics committee approval, this study was registered on Clinicaltrials.gov before the first patient was enrolled in the study (NCT06194604). Written informed consent was obtained from all patients participating in this study. The study was conducted in accordance with the 1964 Helsinki Declaration.

Author contributions

Basak Cigdem-Karacay: Writing – original draft, Project administration, Methodology, Formal analysis, Conceptualization. **Levent Horoz**: Writing – review & editing, Supervision, Software, Conceptualization. **Ismail Ceylan**: Investigation, Data curation, Conceptualization. **Halil Alkan**: Software, Formal analysis, Data curation.

Funding

No financial support was received for this study.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Azad A, Kang HP, Alluri RK, Vakhshori V, Kay HF, Ghiassi A. Epidemiological and treatment trends of distal radius fractures across multiple age groups. *J Wrist Surg*. 2019;8(04):305–311.
2. O'Neill TW, Cooper C, Finn JD, et al. Incidence of distal forearm fracture in British men and women. *Osteoporos Int*. 2001;12(7):555–558.
3. Rundgren J, Bojan A, Mellstrand Navarro C, Enocson A. Epidemiology, classification, treatment and mortality of distal radius fractures in adults: an observational study of 23,394 fractures from the national Swedish fracture register. *BMC Musculoskelet Disord*. 2020;21(1):88.
4. Quadlbauer S, Pezzei C, Jurkowitsch J, et al. Immediate mobilization of distal radius fractures stabilized by volar locking plate results in a better short-term outcome than a five week immobilization: a prospective randomized trial. *Clin Rehabil*. 2022;36(1):69–86.
5. Ghaddaf AA, Abdulhamid AS, Alomari MS, Alquhaibi MS, Alshehri AA, Alshehri MS. Comparison of immobilization periods following open reduction and internal fixation of distal radius fracture: a systematic review and meta-analysis. *J Hand Ther*. 2023;36(1):23–32.
6. Gutow AP. Avoidance and treatment of complications of distal radius fractures. *Hand Clin*. 2005;21(3):295–305.
7. Kawamura K, Naito K, Suzuki T, et al. Factors that interfere with immediate return to activity following volar locking plate fixation for distal radius fractures. *Med Int*. 2024;4(6):65.
8. Zhou Z, Li X, Wu X, Wang X. Impact of early rehabilitation therapy on functional outcomes in patients post distal radius fracture surgery: a systematic review and meta-analysis. *BMC Musculoskelet Disord*. 2024;25(1):198.
9. Mehta SP, Karagiannopoulos C, Pepin ME, et al. Distal radius fracture rehabilitation. *J Orthop Sports Phys Ther*. 2024;54(9):Cpg1–cpg78.
10. Gutiérrez-Espinoza H, Araya-Quintanilla F, Olguín-Huerta C, Valenzuela-Fuenzalida J, Gutiérrez-Monclus R, Moncada-Ramírez V. Effectiveness of manual therapy in patients with distal radius fracture: a systematic review and meta-analysis. *J Man Manip Ther*. 2022;30(1):33–45.
11. Horoz L, Karaçay BÇ, Ceylan İ, Çakmak MF. Is home-based real-time video conferencing telerehabilitation as effective as conventional face-to-face rehabilitation in patients with operated for distal radius fracture? A single-blind, randomized prospective study. *Turkish J Phys Med Rehab*. 2024;70(4):506–516.
12. Soares F, Paranhos D, Campos F, Gasparini A, Fernandes L. Supervised exercise therapy program vs non-supervised exercise therapy program after distal radius fracture: a systematic review and meta-analysis. *J Hand Ther*. 2023;36(4):860–876.
13. Horoz L, Cigdem-Karacay B, Ceylan I, Alkan H. Effectiveness of mobilization with movement in patients operated for distal radius fracture: a single-blinded, randomized controlled study. *Rev Assoc Med Bras*. 2024;70(11):e20241190.
14. Melham TJ, Sevier TL, Malnofski MJ, Wilson JK, Helfst Jr RH. Chronic ankle pain and fibrosis successfully treated with a new noninvasive augmented soft tissue mobilization technique (ASTM): a case report. *Med Sci Sports Exerc*. 1998;30(6):801–804.
15. Ema R, Iino Y, Nomura Y, et al. Instrument-assisted soft tissue mobilization in healthy adults acutely changes the tissue stiffness. *Int J Sports Med*. 2024;46(2):137–143.
16. Mahmood T, Hafeez M, Ghauri MW, Salam A. Instrument assisted soft tissue mobilization - an emerging trend for soft tissue dysfunction. *J Pak Med Assoc*. 2021;71(3):977–981.
17. Tang S, Sheng L, Xia J, Xu B, Jin P. The effectiveness of instrument-assisted soft tissue mobilization on range of motion: a meta-analysis. *BMC Musculoskelet Disord*. 2024;25(1):319.
18. Agarwal S, Bedekar N, Shyam A, Sancheti P. Comparison between effects of instrument-assisted soft tissue mobilization and manual myofascial release on pain, range of motion and function in myofascial pain syndrome of upper trapezius - a randomized controlled trial. *Hong Kong Physiother J*. 2024;44(1):57–67.
19. Kim J, Sung DJ, Lee J. Therapeutic effectiveness of instrument-assisted soft tissue mobilization for soft tissue injury: mechanisms and practical application. *J Exerc Rehabil*. 2017;13(1):12–22.
20. Portillo-Soto A, Eberman LE, Demchak TJ, Peebles C. Comparison of blood flow changes with soft tissue mobilization and massage therapy. *J Altern Complement Med*. 2014;20(12):932–936.
21. Ikeda N, Otsuka S, Kawanishi Y, Kawakami Y. Effects of instrument-assisted soft tissue mobilization on musculoskeletal properties. *Med Sci Sports Exerc*. 2019;51(10):2166–2172.
22. Shewail F, Abdelmajeed S, Farouk M, Abdelmegeed M. Instrument-assisted soft tissue mobilization versus myofascial release therapy in treatment of chronic neck pain: a randomized clinical trial. *BMC Musculoskelet Disord*. 2023;24(1):457.
23. Anjum N, Sheikh RK, Omer A, et al. Comparison of instrument-assisted soft tissue mobilization and proprioceptive neuromuscular stretching on hamstring flexibility in patients with knee osteoarthritis. *PeerJ*. 2023;11:e16506.
24. Aggarwal A, Saxena K, Palekar TJ, Rathi M. Instrument assisted soft tissue mobilization in adhesive capsulitis: a randomized clinical trial. *J Bodyw Mov Ther*. 2021;26:435–442.
25. Nazari G, Bobos P, MacDermid JC, Birmingham T. The effectiveness of instrument-assisted soft tissue mobilization in athletes, participants without extremity or spinal conditions, and individuals with upper extremity, lower extremity, and spinal conditions: a systematic review. *Arch Phys Med Rehabil*. 2019;100(9):1726–1751.
26. Chughtai M, Mont MA, Cherian C, et al. A novel, nonoperative treatment demonstrates success for stiff total knee arthroplasty after failure of conventional therapy. *J Knee Surg*. 2016;29(03):188–193.
27. Bhosale P, Kolke Pt S. Effectiveness of instrument assisted soft tissue mobilization (IASTM) and muscle energy technique (MET) on post-operative elbow stiffness: a randomized clinical trial. *J Man Manip Ther*. 2023;31(5):340–348.
28. Schulz KF, Altman DG, Moher D. CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. *J Pharmacol Pharmacother*. 2010;1(2):100–107.
29. Clark L, Dean A, Mitchell A, Torgerson DJ. Envelope use and reporting in randomised controlled trials: a guide for researchers. *Res Methods Med Health Sci*. 2021;2(1):2–11.
30. Horger MM. The reliability of goniometric measurements of active and passive wrist motions. *Am J Occup Ther*. 1990;44(4):342–348.
31. Pellecchia GL. Figure-of-eight method of measuring hand size:: reliability and concurrent validity. *J Hand Ther*. 2003;16(4):300–304.
32. Fess E. The effect of Jamar dynamometer handle position and test protcol on normal grip strength. *J Hand Surg*. 1982;7:308–309.
33. Ozturk O, Sari Z, Ozgul B, Tasyikan L. Validity and reliability of the turkish" patient-rated wrist evaluation" questionnaire. *Acta Orthop Traumatol Turc*. 2015;49(2):120–125.
34. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods*. 2007;39(2):175–191.
35. Ikeda N, Otsuka S, Kawanishi Y, Kawakami Y. Effects of instrument-assisted soft tissue mobilization on musculoskeletal properties. *Med Sci Sports Exerc*. 2019;51(10):2166–2172.
36. Pianese L, Bordoni B. The use of instrument-assisted soft-tissue mobilization for manual medicine: aiding hand health in clinical practice. *Cureus*. 2022;14(8):e28623.
37. Cheatham SW, Martonick N, Krumpl L, Baker RT. The effects of light pressure instrument-assisted soft tissue mobilization at different rates on grip strength and muscle stiffness in healthy individuals. *J Sport Rehabil*. 2023;32(6):731–736.
38. Sevier TL, Stegink-Jansen CW. Astym treatment vs. eccentric exercise for lateral elbow tendinopathy: a randomized controlled clinical trial. *PeerJ*. 2015;3:e967.
39. Gehlsen GM, Ganion LR, Helfst R. Fibroblast responses to variation in soft tissue mobilization pressure. *Med Sci Sports Exerc*. 1999;31(4):531–535.
40. Davidson CJ, Ganion LR, Gehlsen GM, Verhoestra B, Roepke JE, Sevier TL. Rat tendon morphologic and functional changes resulting from soft tissue mobilization. *Med Sci Sports Exerc*. 1997;29(3):313–319.
41. Horoz L, Cigdem-Karacay B, Cakmak MF. Effect of Kinesio taping on edema and wrist functions in patients with distal radius fracture followed conservatively with a cast: a randomized controlled single-blinded study. *J Hand Ther Off J Am Soc Hand Ther*. 2024;37(3):479–488.

JHT Read for Credit

Quiz: # C38

Record your answers on the Return Answer Form found on the tear-out coupon at the back of this issue. There is only one best answer for each question.

#1. The study design was
- a. retrospective cohort
- b. qualitative
- c. RCTs
- d. n = 1

#2. What method of soft tissue mobilization was employed
- a. Graston
- b. Gordon
- c. Graham
- d. Gilman

#3. No significant effect on __________ was found
- a. pronation
- b. pain
- c. ROM
- d. edema

#4. The sweeping technique was applied at a ________ degree angle
- a. 25
- b. 30
- c. 45
- d. 60

#5. Conventional rehab is more effective on rest pain
- a. false
- b. true