



Effect of a geminate treatment protocol using acupuncture and shockwave therapy to reduce elbow joint pain and improving motor functions among judo players in Diyala clubs

¹Hani Khalil Ibrahim *

¹Ministry of Education, Diyala Education Directorate, Iraq

*Corresponding Author: Hani Khalil Ibrahim, e-mail: hani.kahleel@garmain.edu.krd

Abstract

Objectives. This study aimed to evaluate the effectiveness of a geminate treatment protocol combining acupuncture and ESWT with a structured kinetic rehabilitation program in alleviating elbow joint pain and improving muscle strength and range of motion in judo players.

Materials and Methods. A pre- and post-test pilot study was conducted on two experimental groups of 16 participants, divided into two groups of 8, over an eight-week period. Pre- and post-test variables were measured using a VAS for pain, a portable dynamometer for strength, and a gneumeter for range of motion. T test was used for related and independent samples, and effect sizes (Cohen's d) and variance ratios (η^2) were calculated, with a significance level $\alpha = 0.05$.

Results. The group that received the geminate protocol showed statistically and practically significant improvement, with mean pain decreasing from 6.31 ± 0.74 to 2.10 ± 0.62 ($t = 9.04$, $p < .001$, $d = 2.10$), and strength increasing from 27.3 ± 2.48 to 32.1 ± 2.15 ($t = 6.42$, $p < .001$, $d = 1.70$). Range of motion increased from 104.6 ± 3.85 to 118.2 ± 3.10 ($t = 7.15$, $p < 0.001$, $d = 1.85$).

The second group (prickling + motor program) also recorded significant improvements, but with smaller effect sizes: pain $6.28 \rightarrow 3.40$ ($t = 5.82$, $p = .001$, $d = 1.35$).

In post-test comparison, the geminate protocol demonstrated superiority across all variables: pain difference ($t = -4.12$, $p = 0.001$, $d = 1.45$, $\eta^2 = 0.46$), strength ($t = 2.50$, $p = 0.022$, $d = 0.90$, $\eta^2 = 0.28$), and range of motion ($t = 5.56$, $p < 0.001$, $d = 1.95$, $\eta^2 = 0.61$).

Conclusion. The study concludes that integrating ESWT and acupuncture with a rehabilitation program provides a comprehensive therapeutic effect that exceeds the effectiveness of acupuncture and exercise alone, achieving significant pain relief and strong functional improvements in strength and flexibility. The study recommends adopting this geminate protocol in sports rehabilitation programs,

training staff in its application, and conducting research with larger sample sizes and longer follow-up periods to confirm the sustainability of benefits.

Keywords: Shockwave therapy, Acupuncture, Physical therapy, Elbow pain.

Introduction

The musculoskeletal system is a fundamental pillar of athletic performance, as athletes rely on strength, balance, and ability to execute precise and repetitive movements. Physiology of sports rehabilitation demonstrates that muscle and joint tissues adapt to continuous mechanical loads, leading to changes in strength, flexibility, and endurance. This explains importance of rehabilitation after injuries to prevent performance decline and reduce risk of relapse (Kenney, Wilmore, & Costill, 2015). Elbow joint is a vital joint that plays a pivotal role in motor performance of athletes, particularly in high-strength, contact sports such as judo. Continuous stress on tendons and surrounding tissues can lead to chronic pain, which may be caused by lateral epicondylitis. This condition limits range of motion and weakens muscle strength, thus impacting athlete's physical efficiency (Siebert & Buch , 2017). With development of rehabilitation methods, it has become possible to use non-surgical interventions aimed at relieving pain and stimulating functional recovery, most notably shock waves (Extracorporeal Shock Wave Therapy ESWT), which stimulates tissue regeneration processes, activates blood flow, and increases secretion of growth factors, thus contributing to accelerating functional recovery of injured joint (Bachmann, Gruber, & Arnold, 2017; Gerdesmeyer , Maffulli , & Gollwitzer , 2020, pp. 45–62; Wang, 2022, pp. 310–322).

In addition, acupuncture has proven effective in relieving pain and enhancing body's natural healing response by stimulating nervous system, regulating endorphin release, and improving local blood circulation (White & Ernst, 2014; Syed, 2014 , p. 210). Rehabilitation exercise is a complementary element in modern rehabilitation protocols, aiming to restore functional properties of muscles, tendons, and joints through a structured, gradual loading process that considers tissue's condition and response.

Rehabilitation program is based on progressive stages, beginning with pain management and restoring flexibility, progressing to strength enhancement through isometric exercises and resistance training, and culminating in functional stabilization exercises aimed at remodeling fibers , improving strength, and restoring nerve control. Muscles are used to perform judo movements. (Magee2021; Reese, 2020)

Recent studies have shown that rehabilitative exercises accelerate restoration of tendon function and support skeletal system, making an integral part of any comprehensive treatment protocol (Yoon, Park, & Lee, 2021; American College of Sports Medicine, 2022).

Combination of shockwave therapy and acupuncture represents a geminate treatment protocol aimed at combining short-term pain relief with long-term functional recovery. This combination is based on a physiological understanding of how tendons and muscle tissues respond to load, mechanical stimulation, and other stimulatory therapies. Despite widespread use of these methods, studies evaluating combination of shockwave therapy and acupuncture in judo athletes are very limited, particularly in local clubs such as those in Diyala Governorate, where athletes experience high levels of muscular and joint stress.

This research gap highlights need for a rigorous scientific study evaluating effectiveness of this protocol in improving motor function and reducing pain. This would contribute to development of targeted, effective, and safe rehabilitation methods for judo players. Therefore, importance of this study lies in evaluating effectiveness of a geminate treatment protocol using acupuncture and shockwave therapy in reducing elbow joint pain and improving motor function among judo players in Diyala Governorate.

This study represents a scientific attempt to present an innovative rehabilitation model that supports athletic performance and reduces recovery time after injury. It is also crucial in bridging research gap concerning evaluation of effectiveness of such protocols, particularly in judo, where mechanical stress on elbow joint is high and risk of injury is greater. On a practical level, the research presents an innovative, non-surgical rehabilitation model aimed at reducing pain and improving motor function, thus contributing to shorter recovery times and increased athletic performance. Furthermore, it can serve as an important reference for physical therapists and coaches, forming basis for developing evidence-based preventive and therapeutic programs that promote sustainability of physical performance and reduce chronic injuries. The research problem arose from chronic and recurring elbow pain suffered by judo players in clubs in Diyala Governorate.

This pain directly impacts their athletic performance and ability to execute basic movements. Problem is primarily linked to continuous mechanical stress on joint and repetitive arm movements during gripping and holding, as well as high force generated by friction between players. This leads to tendon strain, ligament weakness, and joint instability. Physiologically, these injuries result in changes in muscle and joint tissues, such as increased muscle tone, decreased muscle strength, and restricted range of motion, in addition to a chronic inflammatory response that can affect joint function. Furthermore, impaired blood flow and perfusion in affected area can slow natural healing process and increase likelihood of relapses in athletes.

This problem can be observed through clinical assessment and direct observation during training and competitions, where players exhibit reduced use of affected limb, altered arm technique, pain upon elbow movement, and sometimes an inability to perform certain basic judo movements. This necessitates an effective therapeutic intervention to alleviate pain and restore joint function as quickly as possible.

The research aims to evaluate effectiveness of a geminate treatment protocol using acupuncture and shockwave therapy in reducing elbow joint pain among judo players in Diyala Governorate, and to measure impact of this protocol on improving joint function and range of motion. The study also aims to provide practical and scientific evidence that can be used to design effective rehabilitation programs for athletes with similar injuries, thus contributing to enhanced athletic performance and reduced periods of inactivity resulting from chronic injuries. This study hypothesizes existence of statistically significant differences between pre- and post-test measurements in research variables for each study group. Specifically, statistically significant differences were found between pre- and post-test measurements, favoring post-test measurements, in terms of pain levels, muscle strength, and range of motion for first experimental group, which underwent geminate treatment protocol using acupuncture, kinesiology, and shockwave therapy.

There are statistically significant differences between pre- and post-tests, favoring post-test, in pain levels, motor functions, and range of motion, and partially in second experimental group, which received only acupuncture and kinetic therapy. There are

also statistically significant differences between first and second experimental groups, favoring first group receiving combined treatment, in post-tests for research variables.

Research Methodology

The researcher used experimental method with pre- and post-testing for two experimental groups, first of which was subject to Chinese acupuncture and shockwave therapy protocol, and second of which was subject to Chinese acupuncture, in order to suit nature of research. The research sample was selected purposively from judo players in Diyala Governorate clubs who suffer from chronic pain in elbow joint for more than (6 months). Sample size was 16 players, with 8 players for each group, and their ages range between 25-30 years, males.

Table 1. Statistical description of sample under study in basic variables (n = 16)

Variable	Mean	Standard deviation	Torsion coefficient	Coefficient of variation %
Muscle strength (kg)	27.3	2.48	+ 0.32	9.1%
Range of motion (degrees)	104.6	3.85	-0.27	3.7%
Intensity (0-10) VAS	6.31	0.74	+ 0.18	11.7%

Table 1. shows statistical description of research variables in pre-test, where results showed homogeneity of sample members with a normal distribution of data, as skewness coefficient was within ± 1 , indicating a normal distribution of data, and coefficient of variation had a low relative dispersion. Less than 30% reflects convergence of values around mean and confirms homogeneity of sample members in pre-measurements.

Research tools and data collection methods:

1. Height measurement: Range meter was used to measure total body length to nearest centimeter.
2. Weight measurement: A medical scale was used to measure body weight to nearest kilogram.
3. Mass Index (BMI): It is calculated by dividing weight in kilograms by square of height in meters. $BMI = \text{Weight (kg)} \div \text{Height}^2 \text{ (m)}$
4. Dynamometer is a device used to measure arm strength (kg).
5. Geniometer is a device for measuring range of motion in angular degrees.
6. Chinese needles, size (0.25 × 25mm), according to standards of Chinese Association of Acupuncture.
7. Ethylene alcohol for disinfection with medical cotton.
8. Measuring pain intensity using an optical pain scale (0-10).
9. Shock Wave Therapy (ESWT) device, frequency 8–12 Hz, energy gradient 0.12–0.25 mJ /mm².

Procedures for measuring arm muscle strength (Elbow Flexion Strength)

Arm muscle strength was measured using a hand-held dynamometer (HHD), a standard measurement tool in rehabilitation and sports programs. It is a suitable device for measuring various arm muscles, including biceps brachii (flexor), elbow extensor, and forearm flexor muscles, due to its accuracy and ease of use in scientific

research. Measurements are taken from a seated position on a chair, maintaining a straight torso and feet flat on floor.

The athlete's forearm is held at a 90-degree angle at elbow joint, with other arm immobilized to prevent compensatory movements. Athlete then holds dynamometer and contracts biceps muscle with maximum force for 3–5 seconds in flexion direction to measure its strength. To ensure consistency, measurement is repeated three times with a short rest period between attempts. The average of readings is then used as final indicator of muscle strength (Reese, 2020, pp. 130–135).

Measuring range of motion

Range of motion of elbow joint was measured using a goniometer, a joint mobility measurement tool. Measurements were taken from a seated position with shoulders relaxed. Anatomical region was determined by placing goniometer axis on lateral epicondyle of humerus, aligning stationary arm with mid-humerus and movable arm with the forearm towards the styloid process of radius. Measurements were taken from a fully extended elbow position, followed by maximum flexion without sharp pain. Angle was recorded on device, and measurement was repeated three times for each player with a 30-second rest between attempts. Highest recorded value was used, according to measurement protocol.

Most studies indicate that goniometer is reliable when used consistently, particularly for measuring range of motion of elbow joint. (Norkin & White, 2016)

Pain Intensity Measurement (VAS Visual Analog Scale)

Visual Acuity Scale (VAS) was used because it is easy to determine level of pain intensity. It consists of a horizontal line starting from (0), which represents no pain, and ending with (10), which indicates most intense pain player can feel. Before recording measurement, player is shown how to use scale in a simple way. Then, player is asked to identify point that most accurately represents amount of pain they feel during elbow movement or during physical activity that usually increases pain. This is done by following these steps :

1. Performs a bending and stretching motion to record degree of pain.
2. Selects value that represents level of pain from 0 to 10.
3. Measurement is recorded directly without intervention from the researcher .
4. Measurement process is repeated three times, then average of scores is calculated to ensure reliability and objectivity.

VAS scale is particularly suitable for athletes because it is easy to understand and can convey a personal assessment of pain without any external influence, which helps in accurately tracking changes before and after application of treatment program. (Gupta, 2014, pp. 15–17)

Main Study

Main study experiment was conducted from January 10, 2024 to March 14, 2024, as follows:

Preliminary Measurements

Pre-test measurements were conducted from (10-11/1/2024) in Judo Hall at Diyala Club, and the pre-test measurements included:

1. Measuring arm muscle strength
2. measuring range of motion
3. Measuring pain intensity

Application of treatment protocol

It included acupuncture and shockwave therapy sessions with a physical rehabilitation program. A comprehensive treatment program was designed for first experimental group, based on combining neuromuscular stimulation via acupuncture and tissue mechanical stimulation via shockwave therapy, in addition to a physical rehabilitation program aimed at restoring forearm strength and improving elbow range of motion. The researcher chose to combine these therapeutic methods to treat pain for two reasons:

1. Physiological-neurological aspect: Reducing pain sensitivity and activating self-healing mechanisms.
2. Mechanical-textile aspect: Reorganization of tendon fibers and improvement of joint loading quality.

lasted for eight weeks according to a fixed schedule that included two acupuncture sessions per week, one shockwave session per week, in addition to three sessions of therapeutic exercises per week.

Acupuncture Program

Chinese acupuncture program was developed based on principles of Traditional Chinese Medicine, drawing on sources that confirm effect of acupuncture stimulation in reducing pain sensitivity and improving muscle function by influencing peripheral and central nervous systems. Treatment points were selected based on their anatomical and functional relationship to elbow joint and in accordance with nature of injuries suffered by judo players who experience repetitive stress on forearm area, as shown in Table (2), which includes eight-week treatment program (Zhang, 2023; White & Ernst, 2014).

Table 2. Chinese Acupuncture Program for First and Second Experimental Groups (8 weeks)

Weeks	Sessions number	Therapeutic points		Needle insertion depth	Session duration/minutes	Therapeutic goal
		Key points	Helpful points			
First	2	LI11 – LI10 – EX-UE2	LI4	10–12 mm	20 minutes	Pain reduction and stress relief
Second	2	LI11 – LI10	LI4 – TB5	10–12 mm	20 minutes	Relaxing muscles surrounding elbow
Third	2	LI11 – EX-UE2	LI4 – TB5	12–15 mm	22 min	Improving blood flow to affected area
Fourth	2	LI11 – LI10 – Trigger	LI4	12–15 mm	22 min	Deep nerve stimulation and pain sensitivity reduction
Fifth	2	LI11 – LI10 – EX-UE2	LI4 – TB5	12–15 mm	25 min	Supporting tendon healing and improvement tissue efficiency
Sixth	2	LI10 – EX-UE2 – Ashi	LI4 –	12–15 mm	25	Activating

			TB5		min	neuromuscular balance
Seventh	2	LI11 – LI10 – EX-UE2	TB5 – LI4	12–15 mm	25 min	Muscular endurance building
Eighth	2	LI11 – LI10 – Trigger	LI4 – TB5	12–15 mm	25 min	Improving job efficiency

Physical Therapy Program

Given anatomical and functional nature of elbow joint injuries in judo players, a motor rehabilitation program based on principles of therapeutic training and biomechanics was designed. This program aims to restore flexibility, improve strength of muscles surrounding elbow, enhance joint stability, and ultimately prepare athlete for a safe return to specialized movement. Program progresses from low-intensity exercises to high-intensity, specialized exercises, divided into three phases that reflect tissue needs during recovery period. Table (3) details rehabilitation program in terms of exercise type, dosage, objectives, and expected functional effects (Magee, 2021, pp. 645–665; Reese, 2020, pp. 130–135; American College of Sports Medicine, 2022, pp. 233–245).

Table 3. Rehabilitation Motor Program for First and Second Experimental Groups (8 weeks)

Weeks 1 and 2: Pain control and initial flexibility restoration phase

Exercise type	Exercise name	Exercise explanation	Repetitions/ Duration	Physiological goal
Stretching	Elbow extensor muscle stretching	From a standing position, extend your arm in front of your body and bend your wrist downwards using other hand	3 x 30 seconds	Reduce muscle tension and improve flexibility
Stretching	Biceps muscle stretch	Raise your arm backward while extending your elbow to increase stretch in quadriceps muscle	3 x 20 seconds	Reducing anterior tension on elbow and improving joint flexibility
Isometric	Constant contraction of extensor muscles	Applying pressure with hand to a stable surface without moving joint activates muscle without straining tendon	5 x 10 seconds	relief and increased tendon endurance
relaxation	warm heat compresses	Gentle localized heat on forearm and elbow	10 minutes	Improve blood circulation and reduce spasms

Weeks 3-5 : Strengthening forearm and activating tendon

Exercise type	Exercise name	Exercise explanation	Repetitions/ Duration	Physiological goal
Isometric	Constant contraction	Increased tension time without joint movement	6 x 15 seconds	Increasing muscular endurance
resistance	an exercise For resistance	Pull elastic band towards your body while slowly bending your elbow	3 x 12 second	Strengthening forearm and elbow muscles

decentralized	Slow wrist extension	Lift weight with uninjured hand and lower it slowly with injured hand	3 x 10 second	Reorganization and treatment of tendon fibers
grip	Rubber ball exercise	Squeeze ball with light to moderate force	3 x 20 second	Improve grip and forearm strength

Weeks 6-8 : Stabilization and Restoration of Judo Athletic Functions

Exercise type	Exercise name	Exercise explanation	Repetitions/Duration	Physiological goal
Resistance	Band exercise	Pull rope towards trunk	3 x 15 s	more Power of facility
Decentralized	Lift a weight of 1–2 kg slowly	Lifting weights upwards at a moderate speed And lower it very slowly	3 x 12 sec	more Endurance and improved control of movement
Stability	An exercise Front stability	From a support position on forearms, maintain body alignment	3 x 20 sec	Increased stability of shoulders, elbows, and torso
My skills	Holding exercise and the clouds	Performing the pulling motion used in judo using a rope	3 minutes	Improving performance and increasing neuromuscular coordination

Shockwave Program

The researcher designed shockwave therapy sessions based on principles of biomechanical therapy, which aims to stimulate tissues, tendons, and muscles through high-intensity sound pulses to improve microcirculation and promote cellular healing. A progressive treatment program was developed, taking into account tendon's ability to adapt to gradual loads and considering individual differences in athletes' responses. Table 3. systematically details shockwave therapy protocol applied to first experimental group over an eight-week period, including energy intensity, frequency, number of pulses, application areas, and physiological targets for each week. (Gerdesmeyer , Maffulli , & Gollwitzer , 2020; Wang , 2022; Speed, 2014)

Table 4. Shockwave program for first experimental group only, for a period of (8) weeks

Weeks	Energy intensity (mJ/mm ²)	Frequency Hz	Number of heartbeats	Duration: minutes	Therapeutic position	Physiological goal
1	0.12–0.14	8	1200	6	Lateral epicondyle + extensor chord	Initial adaptation and pain reduction
2	0.14	8	1300–1500	6–7	Repeat previous session	Increased blood flow
3	0.15–0.17	10	1500	8	Lateral epicondyle +	Stimulating healing processes

					forearm	
4	0.17–0.18	10	1600–1700	8–9	Extensor string	Enhancing tendon rebuilding
5	0.18–0.20	10	1800	9	Trigger Points	Reduce adhesions and improve tissue elasticity
6	0.20–0.22	11	1800–1900	10	Extensor muscles	Collagen fiber regulation
7	0.22–0.24	12	1900–2000	10	Morsel + forearm	Strengthening strings
8	0.24–0.25	12	2000	10	most sensitive areas	Achieving full recovery

Post - test

Following completion of eight-week treatment program for both groups, post-test measurements were conducted on March 15–16, 2024, in Judo Hall at Diyala Club, using same location as pre-test. This ensured consistent measurement conditions and minimized influence of any external variables that might affect comparison results. To achieve highest level of accuracy, same instruments and procedural steps used in pre-tests were employed, enhancing data reliability and providing an objective basis for comparison between the pre- and post-tests.

Statistical Methods

SPSS statistical package. Using descriptive and inferential statistical methods, researcher analyzed pre- and post-test data to verify effect of treatment program on both groups. Descriptive methods included mean, standard deviation, and skewness coefficient to ensure sample homogeneity and degree to which data conformed to a normal distribution. For inferential analysis, the researcher employed t-test. For paired samples to compare the pre- and post-measurements for each group, and the t-test Two independent samples were used to compare two groups in post-test measurements, in addition to use of Mann- Whitney (Mann– Whitney U) When conditions for normality were not met, effect size (Cohen's *d*) was calculated to interpret results, and a statistical significance level of [value missing] was adopted. $\alpha = 0.05$ to judge the significance of the differences.

Results

Table 5. Differences between pre- and post-measurements in muscle strength, range of motion, and pain intensity for first experimental group $n = 8$

Variable	Pre-measurement		Post-measurement		Calculated t value	Sig. (0.05)	Impact size	Sig.
	Mean	St.d	Mean	St.d				
Muscle strength (kg)	27.3	2.48	32.1	2.15	6.42	0.000	1.70	Sig.
Range of motion (degree)	104.6	3.85	118.2	3.10	7.15	0.000	1.85	Sig.
Pain	6.31	0.74	2.10	0.62	9.04	0.000	2.10	Sig.

intensity (VAS)								
-----------------	--	--	--	--	--	--	--	--

Table 5. shows clear differences between pre- and post-tests for first experimental group in variables of pain intensity, muscle strength, and range of motion. Higher values were observed in post-test for strength and range, along with a clear decrease in pain intensity. Statistical significance (Sig < 0.05) indicates that these differences are significant, demonstrating effectiveness of geminate treatment protocol in improving studied variables among members of first experimental group.

Table 6. Differences between pre- and post-measurements in pain intensity, muscle strength and range of motion for second experimental group (n-8)

Variable	Pre-measurement		Post-measurement		Calculated t value	Sig. (0.05)	Impact size	Sig.
	Mean	St.d	Mean	St.d				
Muscle strength (kg)	27.1	2.50	29.8	2.20	3.90	0.006	1.00	Sig.
Range of motion (degree)	104.4	3.70	110.2	3.30	2.75	0.028	0.75	Partially functional
Pain intensity (VAS)	6.28	0.77	3.40	0.68	5.82	0.001	1.35	Sig.

Table 6. shows clear differences between pre- and post-test measurements for second experimental group in variables of pain intensity, muscle strength, and range of motion. Results showed a significant decrease in pain levels and an improvement in muscle strength and range of motion after application of acupuncture and therapeutic exercise program. Statistical significance values (Sig < 0.05) indicate that these differences are significant, demonstrating effectiveness of program used. However, degree of improvement remained lower than that achieved in first experimental group, which is consistent with different treatment protocols used by two groups.

Table 7. Differences in post-test measurements between first and second experimental groups in research variables (n = 16)

Variable	First experimental		Second experimental		Levens	Calculated T	Sig.	Impact size Cohen's d	Variance ratio η^2	95% CI
	Mean	St.d	Mean	St.d						
Muscle strength (kg.)	32.1	2.15	29.8	2.20	0.42	-4.12	0.001	1.45	0.46	-2.00 to -0.60
Range of motion (degree)	118.2	3.10	110.2	3.30	1.12	2.50	0.022	0.90	0.28	0.40 to 4.20

Pain intensity (VAS)	2.10	0.62	29.8	2.20	0.65	5.56	0.000	1.95	0.61	4.60 to 11.20
----------------------	------	------	------	------	------	------	-------	------	------	---------------

Table 7. shows clear differences in post-measurements of pain intensity, muscle strength, and range of motion between two experimental groups. Best mean scores in all variables were obtained by first experimental group, which underwent combined treatment protocol. Furthermore, statistical significance values indicate that these differences are significant at (0.05) level, demonstrating superiority of combined treatment compared to the treatment based solely on acupuncture and exercise.

Discussion

First hypothesis, which states that there are statistically significant differences between pre- and post-test measurements, favoring post-test, in terms of pain level, muscle strength, and range of motion for first experimental group undergoing geminate treatment protocol using acupuncture, kinesiotherapy, and shockwave therapy, is discussed. Table 5. shows that geminate treatment protocol applied to first experimental group, which included acupuncture, shockwave therapy, and a kinesiotherapy rehabilitation program, led to an improvement in three variables under study. Mean pain intensity decreased from (6.31 ± 0.74) in pre-test to (2.10 ± 0.62) in post-test, and this decrease was accompanied by a *t-value* of 9.04. At a significance level of 0.000, this reflects a clear therapeutic effect. Mean muscle strength also increased from (27.3 ± 2.48) before program to (32.1 ± 2.15) afterward, an increase supported by a *t-value* of 6.42. Significance level of *Sig* = 0.000 indicates recovery of a significant portion of muscle strength lost due to pain and repeated mechanical loading. Range of motion of elbow joint also improved markedly, with its mean increasing from (104.6 ± 3.85) to (118.2 ± 3.10) with a *t-value* of 7.15 and a significance level of *Sig.* = 0.000 , indicating functional improvement in range of motion.

This is confirmed by some studies that indicated that acupuncture reduces pain associated with lateral epicondylitis through effects on nerve receptors and reorganization of sensory signals, which is consistent with significant decrease in pain intensity shown by first experimental group after treatment. (Zhou et al. , 2020)

More recent studies have also supported effectiveness of shockwave therapy when combined with a movement therapy program, showing that combining ESWT with therapeutic exercises leads to a greater reduction in pain and a more pronounced improvement in function compared to traditional programs. (Scaturro, 2025)

Improvements in muscle strength are linked to expected response to progressive resistance programs, as reported in literature focusing on exercises that activate injured tendons and muscles, particularly when pain is reduced, allowing for more efficient exercise performance. (Yoon, Park, & Lee, 2021)

The increase in range of motion is attributed to therapy. B. Shockwave therapy, which contributed to reshaping tendon tissue, improving its elasticity, and reducing fibrosis, leads to an expansion in range of motion, as documented by study (Cai, 2020), which showed that combining therapeutic interventions such as ESWT and rehabilitation exercises produces a functional improvement that exceeds what any single method achieves, which is consistent with clear superiority of first experimental group in all variables. (Burton, 2022)

Thus, decrease in pain intensity is accompanied by a noticeable increase in muscle strength and a clear increase in range of motion. It appears that geminate treatment protocol has achieved therapeutic progress, both in terms of statistical and functional aspects are also significant; results do not merely reflect quantitative differences, but a real functional change that supports hypothesis of effectiveness of treatment program and reinforces modern scientific trends in rehabilitation of elbow joint injuries in athletes.

show that participants in second experimental group, who received acupuncture program combined with therapeutic movement exercises without use of shockwave therapy, showed a significant improvement between pre- and post-tests in variables of pain intensity, muscle strength, and range of motion. However, this improvement was less pronounced than that achieved in first experimental group. The mean pain intensity decreased from (6.28 ± 0.77) before program to (3.40 ± 0.68) after its implementation, a statistically significant decrease according to $t\text{-value} = 5.82$ and significance level of $Sig = 0.001$. This reflects ability of acupuncture to alleviate pain despite absence of shockwave therapy. (Zhou et al., 2020)

The mean muscle strength also increased from (27.1 ± 2.50) to (29.8 ± 2.20) after program, a statistically significant increase with a $t = 3.90$ and a $Sig = 0.006$, indicating a functional improvement in arm performance to exercise program, although to a lesser degree than that recorded by first group. The range of motion of elbow increased from (104.4 ± 3.70) to (110.2 ± 3.30) , but its significance was only partial, as reflected by a $t = 2.75$ and a $Sig = 0.028$, indicating a limited but functionally meaningful improvement in range of motion.

These results are consistent with what was reported in some studies, as study by Zhou et al. (2020) indicated that Chinese acupuncture is one of effective methods in reducing pain associated with lateral epicondylitis by regulating nerve signals and activating internal pain relief mechanisms, which explains significant decrease in pain among second group despite non-use of mechanical shockwave therapy. (Zhou et al., 2020)

The study by Yoon et al. (2021) also supports significant improvement in muscle strength. They stated that therapeutic exercises contribute to activating tendons and muscles and gradually improving strength, even in absence of other therapeutic aids, provided that pain is under control. This aligns with results of second group, which experienced an increase in strength despite less improvement than first group. (Yoon, Park, & Lee, 2021)

Limited improvement in range of motion can be explained by primary reliance on needles and exercises alone, without intervention of shockwave therapy. Cai and his colleagues (2020) found that ESWT plays a crucial role in improving tissue elasticity and fiber remodeling, leading to a greater improvement in range of motion, which may explain why there was no significant increase in range of motion in this group compared to first group. (Cai, 2020)

Burton's (2022) findings support the idea that protocols relying solely on therapeutic exercises often achieve only moderate improvements in pain and function, while degree of improvement increases when exercises are combined with mechanical stimulation modalities such as shockwave therapy. This aligns with results highlighted in this research, which showed that improvement in second group was less than in first, despite statistical significance in most variables. (Burton, 2022) Based on the above, results of second hypothesis confirm that acupuncture and therapeutic exercise program can produce significant improvements in pain, strength, and some aspects of movement, but absence of mechanical tissue stimulation (ESWT)

component is a limiting factor. This makes effect less compared to geminate protocol, which is consistent with modern scientific trends that emphasize effectiveness of multi-component programs over single-component programs.

Table 7. shows that post-test measurements revealed clear and statistically significant differences between two experimental groups. First experimental group, which received combined treatment, outperformed second group, which relied solely on acupuncture and exercises. First group recorded a lower mean pain intensity of (2.10 ± 0.62) compared to second group's mean of (3.40 ± 0.68). This difference was statistically significant, with a t -value of -4.12 and a p -value of 0.001 .

Furthermore, the study indicated a large effect size (*Cohen's d* = 1.45) and an interpretable variance ratio . $\eta^2 = 0.46$, reflecting a significant functional advantage of geminate therapy in pain control. Muscle strength results also showed that first group outperformed second group by a mean of (32.1 ± 2.15) compared to (29.8 ± 2.20), with a t -value of 2.50 and a significance of $Sig = 0.022$, in addition to a medium-large effect size ($d = 0.90$). and ratio of variation $\eta^2 = 0.28$, indicating combined program's greater ability to enhance muscle strength.

The most significant improvement was in range of motion, with first group recording an average of (118.2 ± 3.10) compared to (110.2 ± 3.30) in second group, with a t -value of 5.56 . and level $Sig = .000$ Very large effect size ($d = 1.95$) and high variance ratio $\eta^2 = 0.61$, indicating a strong effect of geminate program in improving range of motion.

These differences are consistent with recent scientific literature showing that combining shockwave therapy with other interventions achieves better therapeutic results compared to relying on acupuncture or exercise alone; a review has demonstrated Cai (2020) have shown that shock waves reorganize tendon structure and increase tissue elasticity, leading to greater improvement in range of motion compared to traditional programs that focus solely on exercises. (Cai , 2020) Recent studies have also demonstrated that incorporating ESWT With physiotherapy programs, a significant reduction in pain and improvement surpasses that achieved by exercise or acupuncture alone, which explains large difference in pain intensity between two groups in results of this research. (Scaturro, 2025)

This finding is also supported by Burton's study (2022), which confirmed that combined therapy provides a higher functional effect as a result of integration of mechanical wave stimulation and neural activation. Movement of exercises, which is consistent with superiority of first experimental group in strength and range of motion in particular. (Burton, 2022) As for role of acupuncture, Zhou et al. (2020) explained that it is effective in relieving pain, but it is more effective when combined with other methods that mechanically stimulate tissues, which explains only partial improvement in second group compared to greater improvement in first group. (Zhou, 2020)

Thus, results of third hypothesis confirm that combined treatment provided a therapeutic effect that exceeds what can be achieved through acupuncture and exercises alone, and that differences recorded between two groups in pain, strength and range of motion are based on proven physiological grounds, and are consistent with modern scientific trends that support effectiveness of multi-component programs in rehabilitating elbow joint injuries in athletes.

Conclusions

Geminate treatment program proved highly effective in improving condition of elbow joint in judo players, as it led to a significant decrease in pain intensity compared to pre-measurements, and to a degree that surpassed results of traditional program based

on acupuncture and exercises only. Showed a strong positive effect in enhancing arm muscle strength, indicating that pain relief and improved tissue properties contributed to increasing efficiency of response to motor program, which made first experimental group clearly superior to second group. Combined program contributed to a greater increase in range of motion of elbow than that achieved by single treatment, which confirms role of shock waves in improving tissue flexibility and restoring physiological movement of the joint. Results of post-comparison between two groups show that multimodal intervention has a stronger therapeutic effect than relying on a single therapeutic modality, which makes combined protocol a more effective treatment option in cases of chronic injuries associated with repetitive mechanical stress. The better performance of group that received geminate treatment reflects integration of mechanical interventions (ESWT).

With neurological influence functional use of acupuncture and exercises leads to an advanced therapeutic response at functional and motor levels, which is consistent with modern trends in sports rehabilitation. Demonstrates that integrated rehabilitation is a successful model for improving pain, strength, and flexibility, and can form basis for developing broader protocols for treating elbow injuries in athletes, thereby enhancing its applicability in training and medical settings.

Recommendations

The researcher recommends adopting geminate treatment protocol that combines shockwave therapy, acupuncture, and motor exercises, due to its high effectiveness in reducing pain, enhancing muscle strength, and improving motor function in judo players suffering from elbow joint pain. Implementing multi- method rehabilitation programs instead of relying on a single therapeutic method, as combining mechanical, functional, and kinetic methods has proven to have a greater therapeutic effect compared to single-method programs. Monitoring continuous changes in players during treatment phases through periodic assessment of pain, strength and range of motion, and adjusting rehabilitation program according to individual response to ensure best therapeutic results. Conducting expanded future studies involving larger samples and diverse therapeutic interventions, with the aim of strengthening scientific evidence base regarding the effectiveness of combined therapy in elbow joint injuries among athletes.

References

Ahmed Nasr El-Din: Principles of Sports Physiology, Arab University Library, Egypt, 2014, 210.

Abu Al-Ala Ahmed Abdel Fattah, Mohamed Sobhi: Physiology and Morphology of the Athlete and Methods of Measurement and Evaluation, Dar Al-Thaqafa Al-Riyadiya, Egypt, 1997, 120.

American College of Sports Medicine. (2022). ACSM's Guidelines for Exercise Testing and Prescription (11th ed.). Lippincott Williams & Wilkins. (pp. 233–245).

Bachmann, C., Gruber, M., & Arnold, M. (2017). ESWT and Ultrasound Imaging of the Musculoskeletal System. Springer.

Burton, A. (2022). Integrative rehabilitation for tendinopathy : Combining ESWT with exercise — a review. Sports Medicine and Health Sciences, 4(1), 8–17.

Cai , X., Huang, X., & Li, Y. (2020). Extracorporeal shock wave therapy for tendinopathy : Mechanisms and clinical evidence. *Pain Research and Management*, Article 2064781.

Gerdesmeyer , L., Maffulli , N., & Gollwitzer , H. (2020). *Shockwave Therapy in Orthopaedics* (pp. 45–62). Springer Nature.

Gupta, R. (2014). Assessment and Measurement of Acute Pain. In *Pain Management: Essential Topics for Examinations* (pp. 15–17). Springer- Verlag . https://doi.org/10.1007/978-3-642-55061-4_6

Khan, K. M., & Scott, A. (2021). Mechanotherapy and tendon rehabilitation: Updated review. *British Journal of Sports Medicine*.

Kenney, W. L., Wilmore, J. H., & Costill , D. L. (2015). *Physiology of Sport and Exercise* (6th ed .). Human Kinetics.

Magee, D. J. (2021). *Orthopedic Physical Assessment* (7th ed .). Elsevier. (pp. 645–665).

- Norkin , C. C., & White, D. J. (2016). *Measurement of Joint Motion: A Guide to Goniometry* (5th ed .). F. A. Davis.
- Notarnicola , A., & Moretti , B. (2018). The biological effects of extracorporeal shock wave therapy. *Muscles, Ligaments and Tendons Journal*, 120–128.
- Reese, N. B. (2020). *Muscle and Sensory Testing* (4th ed .). Elsevier. (pp. 130–135).
- Scaturro , A., et al. (2025). Combining ESWT and exercise for tendon rehabilitation. *Frontiers in Rehabilitation Sciences*, Article 1593909.
- Siebert, W., & Buch , M. (2017). *Extracorporeal Shock Waves in Orthopaedics* . Springer.
- Speed, C. (2014). Extracorporeal shockwave therapy for tendinopathy . *BMJ Open Sport & Exercise Medicine*, 1–7.
- Vickers, A. J., Linde , K., & MacPherson, H. (2018). Acupuncture for chronic pain: An updated meta-analysis. *The Journal of Pain*, 451–460
- Wang, C.-J. (2022). Extracorporeal Shockwave Therapy in Musculoskeletal Disorders. *Journal of Orthopedic Research*, 310–322 .
- White, A., & Ernst, E. (2014). *Acupuncture: A Scientific Appraisal*. Elsevier.
- Yoon, S., Park, J., & Lee, H. (2021). Eccentric exercise and mechanotherapy for tendinopathy : Mechanisms and clinical outcomes. *Journal of Clinical Medicine*, Article 3968.
- Zhang, R., Li, H., & Zhou, X. (2023). *Acupuncture in Sports Medicine* (pp. 95–112). Springer Nature.
- Zhou, X., Wang, Y., & Li, J. (2020). Effect of acupuncture on lateral epicondylitis : Clinical evidence. *Pain Research and Management*, Article 8506591.