IMPACT OF AQUATIC REHABILITATION AND ELASTIC BANDS FOR A PARTIAL TEAR OF KNEE MEDIAL COLLATERAL LIGAMENT OF MARTIAL ARTS PLAYERS IN KHANAQIN CLUBS

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ABSTRACT

Background. Players are prone to various sports injuries that prevent them from achieving their highest performance. The likelihood of injury increases with increased training load, as this load is not in line with the athlete's ability and training intensity. **Objectives.** The research aims to study the effectiveness of a program based on in-water rehabilitation. And use tapes Rubber in processing Injury partial ligament tear of the knee joint For players Arts combat in Clubs Khanaqin. **Method.** The researcher used the experimental method for two experimental groups with pre- and post-measurement. The first group was subjected to treatment in an aquatic environment and the second was subjected to treatment with elastic bands. The research sample was deliberately selected and amounted to (8) male players and they were divided into two experimental groups, each group had (4) players. After collecting and statistically processing the data, the results showed that both programs had a positive impact on the rehabilitation of those injured with a partial tear in the internal ligament of the knee. **Results.** The results demonstrated statistically significant improvements, the rehabilitation program also contributed to improving the thigh circumference, increasing muscle strength, expanding the range of motion, and reducing pain levels. This was reflected through the clear statistical differences in the results of the post-measurements of the two groups. **Conclusion.** The rehabilitation approach using elastic bands and aquatic medium has a positive effect on rehabilitation of a tear. The method prepared using elastic bands has a better effect in developing muscular strength of thigh muscles. Effectiveness of rehabilitation approach in developing (thigh circumference, muscle strength, movement angles, and reducingdegree of pain), through clear difference in results of post-measurements of two experimental groups.

Keywords; aquatic rehabilitation, elastic bands, knee tear, martial arts.

A. INTRODUCTION

Players are exposed to many sports injuries that hinder them from reaching the highest levels of achievement. The probability of injury increases with the increase in training loads, as these loads are not compatible with the athlete's ability and the intensity of the training load. Injury is a major obstacle that leads to a decline in the player's physical and skill level, prevents him from continuing and reduces his performance unless he is treated and healed quickly. It has become necessary to undergo rehabilitation and treatment before the player returns to practicing his sports activity to avoid doubling the injury and its recurrence (Johansson, 2021; Dewantara, Yuniana, Graha, et al., 2024; Dewantara, Yuniana, Stefańska, et al., 2024).

Rehabilitation specialists consider the aquatic environment a unique means of rehabilitating injuries, taking advantage of the nature of water and its significant role in providing a set of high resistances due to the density of water that can be utilized. In treatment, the use of more than one method in treatment gives more positive results in rehabilitation of injuries. Therefore , therapists advise using elastic bands because they are inexpensive , easy to use , easy to carry and store, and offer a variety of exercises. Among their characteristics is also providing several resistances with speed of movement with resistance and determination for strength compared to other methods for developing strength and rehabilitation (Irawan et al., 2024; Mahesvi et al., 2023, 2024).

The knee joint is one of the most complex joints in the body and the most susceptible to injury in athletes due to the anatomical nature of the joint . The weak constitution , compared to the amount of body weight , makes it vulnerable to several injuries (Van der Woude et al., 2022). A torn medial collateral ligament is common, particularly in sports that require quick reflexes or sudden changes in direction, such as martial arts in general and karate in particular. This is because the function of these ligaments is to provide stability during flexion and extension of the knee. This condition is treated after consulting a doctor if surgical intervention is not necessary (Poole et al., 2012; Liza et al., 2023; Liza, Bafirman, Masrun, Samodra, et al., 2024; Liza, Bafirman, Masrun, Suganda, et al., 2024).

The scientific and applied importance of the research lies in highlighting the effect of water therapy in the pool with the use of rubber bands for injury. ligament tear Partial For

the knee For players Martial arts that help athletes recover from injury-related disabilities that negatively impact their performance, while also highlighting the importance of using tools that are easy to use and do not cause pain or risks during use (Jabbar et al., 2025).

The research problem lies in the researcher's work in the field of training in the martial arts of Kyokushin-kai/karate, and his observation of the recurrence of injuries to the internal ligament of the knee due to direct friction between players and kicking with the feet on this area, and through the researcher's experience in the field of rehabilitation and treatment. The problem was studied and a rehabilitation program was developed based on scientific principles to rehabilitate this type of injury, increasing the strength of the muscles working on the joint and supporting it, using these methods due to their effectiveness in rehabilitation. The researcher sought to achieve the research objective by identifying the impact of Rehabilitation In the middle Watery And use tapes rubber to injure rupture The strap internal partial For the knee For players Arts combat in Clubs Khanaqin.

Research hypotheses were based on the existence of a statistically significant relationship between the pre- and post-measurement in the variables (muscle strength - thigh circumference - angles of movement - degree of pain) in favor of measurement distant for the first experimental group, there was a statistically significant relationship between the pre- and post-measurement in the variables (muscle strength - thigh circumference - movement angles - degree of pain) in favor of measurement distant for the second experimental group, there are statistically significant differences between the post-measurement of the first experiment and the post-measurement of the second experiment in the variables (muscle strength - thigh circumference - angles of movement - degree of pain) in favor of the post-measurement of the first experiment.

B. METHOD

Participant

The research sample was deliberately selected from martial arts players (Kyokushin-Kai - Karate) of Khanaqin clubs and training centers who suffered from partial tear of internal ligament and who visited treatment centers in Khanaqin district and were diagnosed by a specialist doctor and did not undergo any surgical intervention. Their ages ranged between (18 - 22) years, where their number reached (8 athletes) and they were divided into two

experimental groups with 4 players in each group. The main experiment of the research was implemented from 1/7/2022 to 3/10/2022.

Table 1. Homogeneity of sample individuals in (height - mass - age - training age)

Variables	Mean	Standard deviation	Mode	Coefficient of skewness
Height (cm)	171.67	5.13	169	0.729
Player mass	66	4.02	64	0.482
Player's age	20	1.30	19	0.758
Training age (month)	33	3.17	35	-0.150

It is clear from Table No. (1) that the skewness coefficient for all variables is less than zero, which indicates that the research sample is free of the negatives of the frequency distribution, which indicates the homogeneity of the sample individuals in these variables.

Table 2. Equivalence of two research groups in research variables in pre-test

Variables	First experimental (rubber bands)		The second experiment (aquatic)		Calculated (t) value	Tabular (t) value
	M.	St.d	M.	St.d		
Thigh circumference	40.69	7.93	41.09	2.18	0.09	1.94
Muscle strength	19.77	1.59	20.31	0.89	1.12	
Angle of movement	109	4.22	113	9.24	1.00	
degree of pain	11	0.40	11.17	0.97	1.00	

It is clear from Table (2) that the value of the tabular t at a degree of freedom = 6 and a significance level of 0.05 indicates the homogeneity of the sample individuals in the research variables in the pre-measurement.

Research Design

The researcher used experimental method for two experimental groups with pre- and post-measurement to suit nature of research.

1. *Thigh circumference measurement*: To determine transverse circumference of thigh muscles of affected limb.

Measurement procedures : The measurement is done using a measuring tape. The method is to fix a point on the lower third of the upper edge of the patella bone , 15 cm upwards. The muscle circumference is then measured.

Recording: The patient records the thigh circumference in centimeters (de Oliveira et al., 2024).

2. *Measurement of lower limb muscle strength*: To measure the strength of the thigh muscles.

Measurement procedures : Using a dynamometer, the tester grasps the tension bar with both hands , with the palm facing down in front of the point where the femur and pelvis meet. The tester then stands on the base of the device, bends the knees, and creates the greatest possible tension by straightening or extending the knees, taking into account the length of the chain with the player's height.

Recording: The injured person records the amount of force in kilograms (Sonchan et al., 2017).

3. *Measure the angle of movement*: to measure the angle of the joint.

Measurement procedures: The patient lies on the ground , The goniometer is fixed on the lateral side of the knee , with the two ends of the device attached to the joint. The patient raises the injured leg and brings it closer to the thigh .

Recording: The injured player is recorded as reading the closest degree that the injured player can reach in the angle (Lloyd et al., 2015).

Pain score measurement

Measurement procedures: Using the visual analogue scale (Analogue) through the (McGill) pain questionnaire, the measurement was done using the pain sensation degree form , which is a form containing numbers (0-10) divided into ratings to describe the pain, the first rating was simple, which was (1-3), a medium rating of (4-6), a severe rating of (7-9), and a severe rating of (10). The researcher presented this form and explained it to the sample members, then recorded the rating that was described by the research sample members (Brígido-Fernández et al., 2022).

Appreciation	Without pain	Simple pain			Average pain			severe pain			sharp pain
The number	zero	1	2	3	4	5	6	7	8	9	10
1											
2											

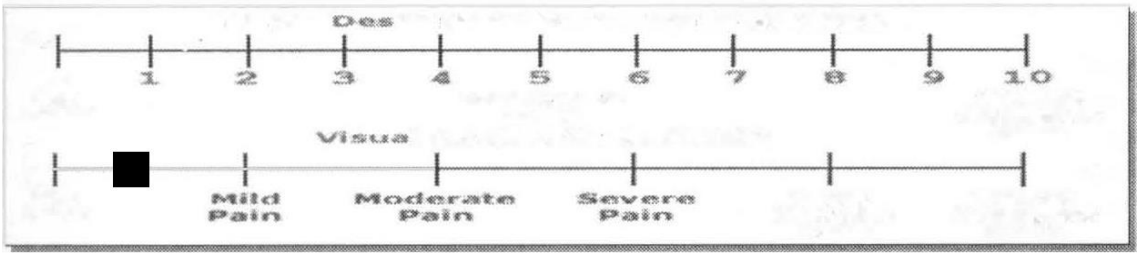

Figure 1. Sense Level Measurement Form

Pre-measurements

Pre-measurements were conducted on 7-8/1/2022 (at the Gold Center for Martial Arts and Bodybuilding). The pre-measurements included measuring (thigh circumference - degree of pain - muscle strength - angles of movement) for the knee joint, along with body measurements (height - weight), with recording the training age and the player's age.

Rehabilitation curriculum

By reviewing the scientific references and previous studies, the researcher divided the rehabilitation curriculum into two rehabilitation programs represented by the aquatic environment program (hydrotherapy) in the swimming pool and the rubber bands program. The rubber bands therapy was applied to the first experimental group, and the hydrotherapy program was applied only to the second experimental group. The program continued for two months, divided into two stages, each stage being one month, with three treatment sessions per week, for a total of (24) sessions for the entire program. The aquatic environment therapy program inside the swimming pool included several exercises (Appendix 2), and rubber bands exercises (Appendix 3) at (Gold Center for Martial Arts and Bodybuilding) .

The first stage: for a period of one month, at a rate of (4) weeks and three weekly sessions. It is a moderate preventative therapeutic stage for the first and second experimental groups, taking into consideration the gradual progression of therapeutic sessions to maintain the efficiency of neuromuscular work and eliminate the feeling of fear

of using the injured limb and work to prevent muscle atrophy as well as restore the strength and flexibility of the joint.

The second stage: Its duration is one month, (4) weeks, and three sessions per week. It is a functional stage, the goal of which is to increase the painless range of motion of the joint, develop muscle endurance, eliminate pain, increase muscle strength, and gradually return to sports activity. The duration of the therapeutic session for treatment with aquatic media ranges from (15-30) minutes, and from (15-30) minutes for treatment with elastic bands.

Table 3. Aquatic rehabilitation curriculum

Weeks	Day	Session	Repetitions	Rest	Groups	Exercises
First week	Saturday	1	10	30 seconds	3	4 - 2 - 3 - 1 - 5
	Monday	2				
	Wednesday	3				
Second week	Saturday	4	10	30 seconds	4	7 – 8 – 10 – 12 – 13
	Monday	5				
	Wednesday	6				
Third week	Saturday	7	12	30 seconds	4	14 – 15 – 4 – 12 – 10
	Monday	8				
	Wednesday	9				
Week 4	Saturday	10	12	30 seconds	5	1 – 5 – 7 – 3 – 2 – 10
	Monday	11				
	Wednesday	12				
Week 5	Saturday	13	14	30 seconds	5	8-13-14-7-9-12-15
	Monday	14				
	Wednesday	15				
Week 6	Saturday	16	14	30 seconds	6	14-15-12-7-3-5-1
	Monday	17				
	Wednesday	18				
Week 7	Saturday	19	14	30 seconds	7	2-4-10-13-8-9-7-3
	Monday	20				

	Wednesday	21				
Week 8	Saturday	22	14	30 seconds	8	12-15-14-5-11-2-4-9
	Monday	23				
	Wednesday	24				

Table 4. Elastic band rehabilitation curriculum

Weeks	Day	Session	Repetitions	Rest	Groups	Exercises
First week	Saturday	1	10-12	20 seconds	3	1-2-3-4-5
	Monday	2				
	Wednesday	3				
Second week	Saturday	4	10-12	20 seconds	4	7-8-6-9-10
	Monday	5				
	Wednesday	6				
The third week	Saturday	7	12-14	30 seconds	4	1-3-12-14-13-11
	Monday	8				
	Wednesday	9				
Week 4	Saturday	10	12-14	30 seconds	5	4-5-8-6-15-16
	Monday	11				
	Wednesday	12				
Week 5	Saturday	13	14-15	30 seconds	5	17-20-18-9-7-1-2
	Monday	14				
	Wednesday	15				
Week 6	Saturday	16	14-15	30 seconds	6	12-14-13-3-11-10-16
	Monday	17				
	Wednesday	18				
Week 7	Saturday	19	15	30 seconds	7	20-18-19-8-15-4-2-9
	Monday	20				
	Wednesday	21				
Week 8	Saturday	22	15	30 seconds	8	19-16-15-14-12-9-7-2
	Monday	23				
	Wednesday	24				

Post-measurements

Post-measurements were conducted on the research sample after completing the rehabilitation program on March 9-10/2022 at (Gold Center for Martial Arts and Bodybuilding) under the same conditions as those used in the pre-measurements.

Statistical methods

The researcher relied on analyzing the research data The study was conducted using the statistical program (SPSS) used in mathematical research. A set of statistical methods were selected to serve the nature of the study, including (mean and mode to determine central values - standard deviation to measure the extent of data dispersion - skewness coefficient to indicate the direction of distribution - (T) test for related samples to measure the differences between pre- and post-measurements within one group - as well as (T) test for independent samples to compare the results of the two experimental groups).

C. RESULTS AND DISCUSSION

Results

Table (5) shows statistical description of measurement results of research (thigh circumference, muscle strength, angle of movement, degree of pain) for the experimental group (elastic bands) before and after, where the arithmetic averages were all greater than (2.35) at the degree of freedom (3), and at a significance level of (0.05), and this confirms the existence of significant differences in favor of the results of the post -measurements.

Table 5. Means, standard deviations, calculated (t) value, tabular (t) value, and significance level in the pre- and post-measurements of the first experimental group (rubber bands)

Variables	Pre-measurement		Post-measurement		Calculated (t) value	Tabular (t) value	Significance level
	M.	St.d	M.	St.d			
Thigh circumference	40.69	7.93	45.39	6.73	8.79	2.35	Sig.
Muscle strength	19.77	1.59	43.12	2.88	12.32		Sig.
Angle of movement	109	4.22	44.91	4.08	22.51		Sig.
Degree and severity of pain	11	0.40	4.3	0.39	22.51		Sig.

Value of (t) at degree of freedom = 3 and significance level = 0.05

Table 6. Means, standard deviations, calculated t -value, tabular t -value, and significance level in the pre- and post-measurements of the second experimental group (aquatic medium)

Variables	Pre-measurement		Post-measurement		Calculated (t) value	Tabular (t) value	Significance level
	M.	St.d	M.	St.d			
Thigh circumference	41.09	2.18	45.58	1.93	6.09	2.35	Sig.

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Muscle strength	20.31	0.89	39.33	2.30	20.78		Sig.
Angle of movement	113	9.24	42.47	2.77	22.46		Sig.
Degree and severity of pain	11.17	0.97	4.62	0.23	22.46		Sig.

Value of (t) at degree of freedom = 3 and significance level = 0.05

Table (6) shows the statistical description of the measurement results . research (thigh circumference, muscle strength, angle of movement, degree of pain) For the second trial (Aquatic) pre- and post-measurement, the values of their arithmetic means in the pre-measurement came respectively (41.09, 20.31, 113, 11.17) and standard deviations (2.18, 0.89, 9.24, 0.97), while their means in the post- measurement came (45.58, 39.33, 42.47, 4.62). With standard deviations (1.93, 2.30, 2.77, 0.23) and for the purpose of knowing the differences between the pre- and post- measurements of the experimental group (aquatic medium), the researcher used the (T-Test) for the related samples.

The calculated values of this test came, respectively, (6.09, 20.78, 22.46, 22.46) and all of them are greater than the table value (2.35) at a degree of freedom (3), and at a level of (0.05). This confirms the significance of the differences and in favor of the results of the post -measurements.

Table 7. Mean, standard deviation, calculated (t) value, tabular (t) value, and significance level in the dimensional measurements of the first and second experimental groups.

Variables	First experimental (rubber bands)		The second experiment (aquatic)		Calculated (t) value	Tabular (t) value	Significance level
	M.	St.d	M.	St.d			
thigh circumference	45.39	6.73	45.58	1.93	0.03	1.94	Insig.
Muscle strength	43.12	2.88	39.33	2.30	2.71		Sig.
Angle of movement	44.91	4.08	42.47	2.77	1.10		Insig.
Degree and severity of pain	4.3	0.39	4.62	0.23	1.10		Insig.

Value of (t) at degree of freedom = 6 and significance level = 0.05

Table (7) Statistical description of the results of the dimensional measurements for the two experimental groups (rubber bands - aqueous medium). The means for the rubber bands group in the dimensional measurement of the research variables (thigh circumference, muscle strength, angle of movement, degree of pain) came, respectively: (45.39, 43.12, 44.91, 4.3), with standard deviations (6.73, 2.88, 4.08, 0.39), While the means

values of the aquatic medium group in the dimensional measurement of the research variables (thigh circumference, muscle strength, movement angle, degree of pain) came respectively (45.58, 39.33, 42.47, 4.62), with standard deviations (1.93, 2.30, 2.77, 0.23), and to know the differences between the results of the dimensional measurements of the two experimental groups in the research variables, the (T-Test) test for independent samples was used.

The calculated value of this test in measuring (muscle strength) came to (2.71), which is greater than (1.94) at a degree of freedom (6) and a significance level of (0.05), which confirms the significance of the differences between the two groups in muscle strength in favor of the rubber bands group. As for the results of the (T-Test) test for the measurements (thigh circumference, movement angle, degree of pain), the value of this test came to (2.71). The test is respectively (0.03, 2.71, 1.10, 1.10), and they are all smaller than the corresponding table value of (1.94) at a degree of freedom (6) and a significance level of (0.05), and this confirms the insignificance of the differences between the two groups in these variables.

Discussion

First hypothesis

Discussing the results of the first hypothesis, which states that there is a statistically significant relationship between the pre- and post-measurement in the variables (muscle strength - thigh circumference - movement angles - degree of pain) in favor of Measurement The distant For the first experimental group, Table (5) shows the results of the pre- and post-measurements of the research variables (thigh circumference, muscle strength, angle of movement, degree of pain), for the first experimental group (rubber bands). The mean values in the pre-test were 40.69, 19.77, 109, and 11, respectively, with standard deviations of 7.93, 1.59, 4.22, and 0.40. In the post-test, the arithmetic means were 45.39, 43.12, 44.91, and 4.3, with standard deviations of 6.73, 2.88, 4.08, and 0.39. All values exceeded the corresponding table value of 2.35 at a degrees of freedom of 3 and a significance level of 0.05, confirming the significance of the differences and supporting the favorable results in the dimensional measurements.

The researcher attributes these significant differences to the type of exercises involving the use of rubber bands, which were found to be highly effective in improving muscle strength, thigh circumference, angle of movement, and degree of pain. This effectiveness is due to the rubber bands providing gradual resistance throughout the range of motion, which leads to an increase in strength in two ways: first, through the muscular aspect, by enhancing muscle cross-sectional area, and second, through the neurological aspect, by activating more motor units and increasing exercise intensity. The resistance also helps in providing the necessary nerve fluids, thereby supporting higher-intensity exercise loads (Wirth et al., 2022).

In addition to strengthening joint ligaments through band exercises, elastic bands have a positive effect on muscle strength because they add resistance in all directions, which is reflected positively in improving muscle performance and strengthening joint ligaments . They also play a role in developing muscle strength and improving muscle balance (Guo, 2022).

One study indicated that exercises with elastic bands for (6) weeks improved muscle strength and size, and also worked to achieve motor balance and fluidity for the muscles of the lower limb. Thus, the validity of the first hypothesis is confirmed.(Wirth et al., 2022)

Second hypothesis

Discussing the results of the second hypothesis, which states: (There is a statistically significant relationship between the pre- and post-measurement in the variables of muscle strength - thigh circumference - movement angles - degree of pain, in favor of Measurement The distant For the second experimental group) Table (6) shows the results of the pre- and post-measurements of the research variables (thigh circumference, muscle strength, angle of movement, degree of pain) for the second experimental group (aqueous medium) . The emergence of significant differences between them in favor of the dimensional measurement.

The researcher attributes the significant differences to the effect of the aquatic environment and the various standardized exercises used by the researcher in rehabilitating and developing the research variables (thigh circumference, muscle strength, movement angles, degree of pain) because the properties of water are considered ideal for achieving treatment in an effective and safe environment or medium because the aquatic environment

is much better for rehabilitation and treatment due to the distinctive properties of water, including the lack of gravity (Abreu et al., 2024).

Rehabilitation exercises can be easily performed in the water due to the laws of buoyancy and water density, which reduce weight according to the laws that govern the body in the water. This helps in performing rehabilitation treatments with less effort, reducing pressure on the joints and making them easier to perform. These programs also contribute to facilitating the performance of injured joints, activating weak muscles and providing relaxation for the player during the session, which reduces the occurrence of another injury (Zemková, 2022).

Water pressure increases blood flow back to the heart and regulates blood flow. Movement in the water provides resistance and helps with strength training (Cretu et al., 2021). Water training is an effective means of rehabilitating many sports injuries , as it helps reduce the effects of the injury and eliminate its complications, which helps in gradually restoring health. These exercises also provide an opportunity for the athlete to return to his physical level as quickly as possible.(Lee & Joo, 2024) Thus, the validity of the second hypothesis is confirmed.

Third hypothesis

The third hypothesis posits that statistically significant differences exist between the post-measurements of the first and second experiments in terms of muscle strength, thigh circumference, angles of movement, and pain levels. It is expected that the post-measurements of the first experiment will show better results. As shown in Table (7), the results of the post-measurements for the research variables (thigh circumference, muscle strength, angles of movement, and degree of pain) in both groups revealed no statistically significant differences between the two groups in thigh circumference, angles of movement, and degree of pain. This shows that the two experimental settings had identical effects on these variables, which goes against the expectation that the first experiment would have superior results. But when it came to muscle strength, the results of the first experiment revealed a big improvement after the second measurement, which supports the idea that the first trial would make muscle strength better

The absence of significant differences in thigh circumference, angle of movement, and degree of pain suggests that these variables were not as responsive to the interventions as muscle strength, or that other factors, such as intervention specifics or measurement conditions, influenced the outcomes. In the final analysis, the hypothesis was only partly proven. The first test showed a huge increase in muscle strength, but the other factors didn't indicate any big changes. These results show that more research is needed to find out what causes these consequences.

Means of the rubber band group in the dimensional measurement of the research variables (thigh circumference, muscle strength, angle of movement, degree of pain) came, respectively. (45.39, 43.12, 44.91, 4.3), with standard deviations (6.73, 2.88, 4.08, 0.39), While the arithmetic average values for the aquatic medium group in the dimensional measurement of the research variables (thigh circumference, muscle strength, movement angle, degree of pain) came respectively (45.58, 39.33, 42.47, 4.62), with standard deviations (1.93, 2.30, 2.77, 0.23).

To assess the differences between the dimensional measurements of the two experimental groups in the research variables, the researcher applied the independent samples T-Test. Muscle strength measured out at 2.71, which is higher than the crucial value of 1.94 at a significance level of 0.05 and 6 degrees of freedom, confirming the significant difference between the two groups in favor of the rubber bands group. Regarding the results of the T-Test for thigh circumference, angle of movement, and degree of pain, the test values were 0.03, 2.71, 1.10, and 1.10, respectively, all of which are smaller than the critical value of 1.94 at a degree of freedom of 6 and a significance level of 0.05

The researcher attributes this to the fact that both methods for the two experimental groups (rubber bands and aqueous medium) contributed to improving these variables, as they are considered effective rehabilitation methods in developing many physical and motor qualities, body measurements, and reducing the degree of pain. As for the significant differences shown by the statistical function in the variable of muscle strength in favor of the rubber bands group, the researcher believes that the rubber bands have advantages that differ from the aqueous medium in providing a gradation of resistance with the ease of using the bands in their various shapes and resistances. Ease of changing the angles of muscle work and in different directions, in addition to the fact that they have the possibility of increasing

resistance with the variety of their bands, which reaches (18 kg) and more with the increase in the number of bands.(Hortobágyi et al., 2022) Rubber bands have the advantage over other methods in developing strength and rehabilitation, and they also have an advantage over several means due to their ability to stimulate muscles and subsequently develop muscle strength (Emirzeoğlu M., 2021).

Elastic bands are a good choice because they are cheap, easy to use, convenient to transport and store, and can be used for many different activities. In addition, they provide a variety of resistances, including speed of movement, resistance, and force-torque, which compares favorably to other methods for developing strength and rehabilitation. Thus, the third hypothesis is partially valid (Khazaal, 2025).

D. CONCLUSION

The rehabilitation approaches using elastic bands and an aquatic medium have shown significant positive effects on the recovery of partial tears of the internal ligament of the knee in martial arts athletes. Specifically, the elastic band method proved more effective in enhancing the muscular strength of the thigh muscles. The rehabilitation programs also contributed to improvements in thigh circumference, muscle strength, joint mobility (movement angles), and a reduction in pain levels, as evidenced by notable differences in post-treatment measurements between the experimental groups. Based on these findings, the researcher recommends the use of elastic bands in rehabilitation programs for their effectiveness in addressing internal ligament tears of the knee, particularly in increasing muscle strength and improving overall functional recovery. Additionally, the researcher advises incorporating aquatic therapy, which not only aids physical recovery but also promotes relaxation and psychological comfort during rehabilitation for martial arts athletes.

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F. AUTHOR CONTRIBUTION STATEMENT

HKI contributed to all aspects of the writing of this paper.

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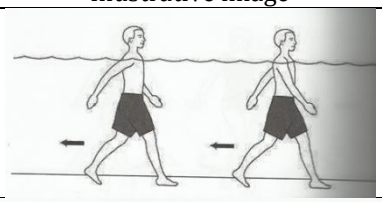
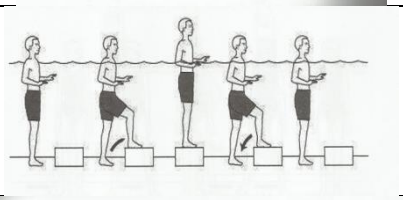
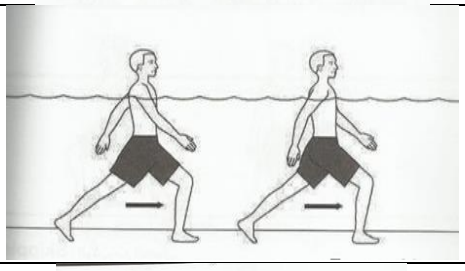
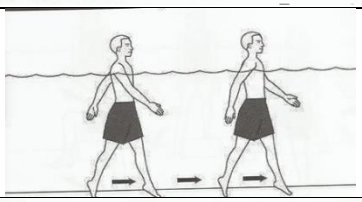
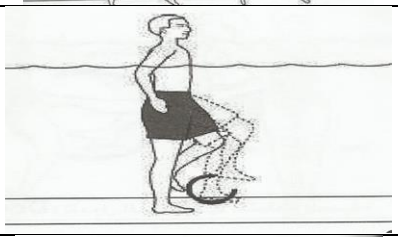
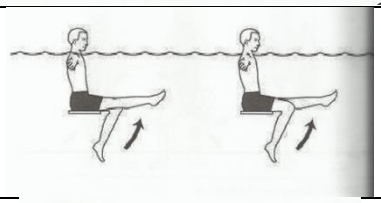
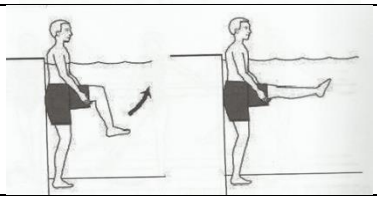
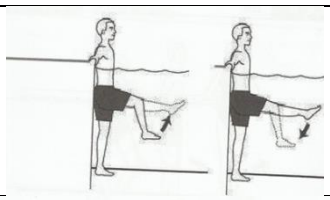
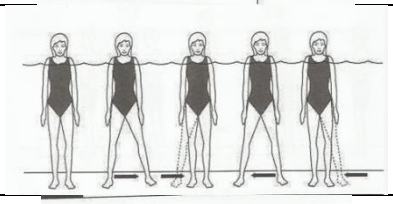
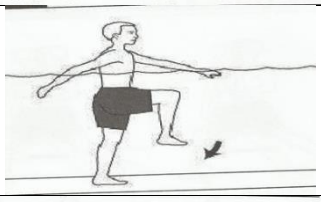
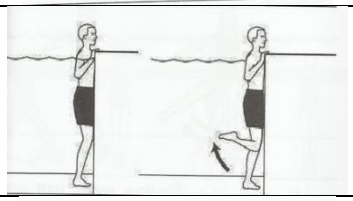
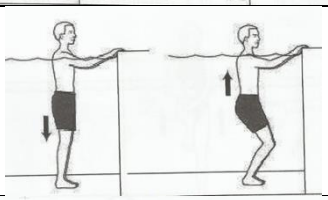
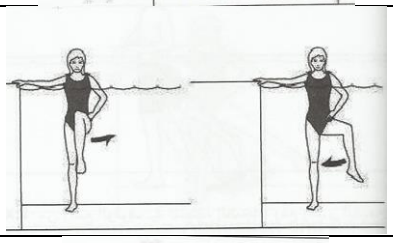
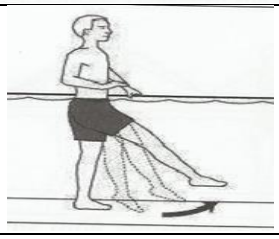
Appendix (2) **Aquatic exercises used in the rehabilitation program**

No.	Exercise explanation	Illustrative image
1	From a standing position in the pool, with the water at chest level, walk forward to the other side and then walk backward to return to the starting point.	
2	Using a wooden piece inside the pool from a standing position: step onto the stepping box and then descend.	
3	From a standing position: Walk forward with a large step (stabbing position), with the leg and thigh at an angle of (90) degrees and the back knee as straight as possible, repeating the steps, taking into account that the heels touch the floor of the pool and not stabbing on the tips of the toes.	
4	From a standing position in the water at chest level: walk on your toes until you reach the other side and repeat the exercise.	
5	From a standing position with hands on waist: Walk in place on one leg while maintaining balance.	
6	From a sitting position on a chair in the pool: Extend your legs upwards alternately, making sure to contract your thigh muscles while extending and relax them while flexing.	
7	From a standing position, extend your arms to the sides of the water at chest level: alternately bring your legs together and apart to the side.	
8	How to stand: Lean on the pool wall and raise the knee high forward, supporting the thigh with the hands, then extend the leg forward.	

9	From a standing position: Lean against the pool wall, then extend and bend your legs at the knee joint.	
10	From a standing position in the water to chest level: walk a step to the side and then repeat to the other side.	
11	From a standing position: raise the knee high and then lower it alternately, taking care to balance with the hands.	
12	From a standing position facing the pool wall: Bend your leg backwards towards the back of your thigh muscle, then extend it back to its original position while repeating with the other leg.	
13	From a standing position and holding the pool wall with your hands: do a half squat, then return to the normal position.	
14	From a standing position on one foot: the knee is at a 90-degree angle, adducting and abducting the knee joint, raising the knee forward and high, then to the side in a semi-circular motion.	
15	From a standing position and leaning on the pool wall to the side: raise the leg up and then return to the starting position, repeating and alternating.	

Appendix (3) **Rubber band exercises used in the rehabilitation program**

No.	Exercise	Illustrative image
1	From a sitting position on the bench, secure one end of the elastic band under the bench and tie the other end around the ankle, then raise the injured leg bent upwards .	
2	From a sitting position on the bench, secure the two ends of the tape below and behind the injured person on the bench, and the other end around the ankle, and extend the injured leg and return to the starting position.	
3	From a sitting position on a chair, attach one end of the strap to the ankle of the injured leg and the other end to the wall from the front. Gradually pull the leg backward.	
4	Sit on the bench with your legs slightly open, place the band around the injured leg and the other end attached to the wall next to the injured leg, and pull the injured leg inwards.	
5	Lying on your back with your legs extended, hold both ends of the tape in your hand and the other end around your foot. Push your foot forward and return to the starting position.	
6	Lie on your back on a bench. Tie your legs at the thigh with a circular elastic band. Keep your legs extended. Try to open your legs outwards.	
7	Side standing with open legs. Tie the injured leg from the ankle to one end of the tape and fix the other end to the wall on the side of the injured leg. Pull the injured leg inwards.	

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8	Lying on your stomach, secure one end of the band around the ankle of the injured leg and the other end fixed to the wall. Pull the leg towards the hamstring muscle.	
9	From the supine position, place the tape around the foot and the ends of the tape with both hands, holding the leg at a right angle. Push the injured leg forward until the leg is extended.	
10	From a standing position facing a wall, place the elastic band around the top of the knee of the affected leg. Keep the affected leg bent and try to fully extend the leg.	
11	Standing position: Elastic band around the ankles, affected leg extended, affected leg pushed forward.	
12	In a standing position, place the strap around the ankle of the injured leg and the other end attached to the wall. Pull the leg backward.	
13	From the side-lying position, with the affected leg up, the elastic band around the ankles, the leg extended, raise the affected leg up.	
14	From a standing position, place the elastic band under the feet, and the ends of the band in the injured person's hand, slightly lowering (half a cubbit).	

15	From a sitting position on the bench, hold the elastic band with both hands and hold the band over the affected foot. Keep the leg bent, extend the leg and then lift it up.	
16	1- From a standing position, fix one end of the tape around the injured leg and the other end attached to the ankle. Place the wall behind the injured person, with the injured leg backwards, and the movement of the leg should be like kicking a ball forward.	
17	From a standing position, place the wall behind the injured person, place the elastic band around the injured leg and secure it around the ankle, and the other end is fixed to the wall. Pull the injured leg forward.	
18	Side standing with open legs. Tie the injured leg from the ankle to one end of the tape and fix the other end to the wall on the side of the healthy leg. Pull the injured leg outwards.	
19	Position: Standing with the injured person facing the wall. Tape around the injured leg that is farthest from the healthy leg. Pull the injured leg backward.	
20	Leaning on the ground on your hands and knees, place the tape around the injured leg and the ends of the tape in both hands of the injured person. Push the leg back and extend it.