Use of Exercises, Ultrasound and Phonophoresis in Treatment of Patients with Tennis Elbow

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ABSTRACT

Purpose: *This study compared between the combined effect of ultrasound and exercises versus that of phonophoresis and exercises in treatment of patients with tennis elbow.* ***Subjects:*** *Thirty patients suffering from unilateral tennis elbow participated in this study;* ***Methods:*** *Patients were divided randomly into two groups: the first group (A) consisted of 15 patients with a mean age 38.3(±5.74) years treated with ultrasound and program of therapeutic exercises, the second group (B) consisted of 15 patients with a mean age 38.2(±4.65) years treated with phonophoresis and the same program of exercises. Patients in both groups treated with the continuous mode of ultrasound with a frequency of 1MHz, an intensity of 1.5W/Cm^2 for 5 minutes/session, 3 sessions per week for a total period of 4 weeks. Patients were evaluated before and after treatment.* ***Results:*** *Patients who were treated by ultrasound and exercises showed significant improvement in all the measured variables. Similarly, patients who were treated by phonophoresis and exercises showed significant improvement in all the measured variables. Between groups comparison after treatment showed no significant difference between groups.* ***Conclusion:*** *Ultrasound combined with exercises and phonophoresis combined with exercises are equally effective in treatment of patients with tennis elbow. Both of these programs relieved pain, improved function, strength and elbow range of motion in patients with tennis elbow.*

Key words: *Tennis elbow, physical therapy, therapeutic exercises, ultrasound, phonophoresis.*

INTRODUCTION

Tennis elbow (lateral epicondylitis) is a soft-tissue lesion of the tendinous origin of the wrist extensor muscles at their origin on the lateral humeral epicondyle[1,20]. The extensor carpi radialis brevis is the area of most pathologic changes[19]**.** It begins as a microtear of the tendinous origin of the wrist extensor muscles and results in degeneration and reactive granulation tissue formation. Activities involving prolonged or repeated gripping, wrist extension, forearm supination, and pronation cause eventual failure of the affected portion of the tendon. The mechanical failure of the tendon results in an ensuring tendinitis and symptoms of lateral epicondylitis[10,12]**.** It is aggrevated with movements of the wrist, by palpation of the lateral side of elbow, or by contraction of extensor muscles of the wrist[22,27]**.**

The incidence of lateral epicondylitis is estimated at 4–7 per 1000 patients per year in general practice, and between 1% and 3% of adults in the general population are affected per year[8,25]**.** Although 50% of all recreational tennis players can expect to experience this condition at some point in their playing lifetime, tennis players account for only 5% of all lateral epicondylitis patients seen in clinical practice. Most cases are associated with work-related activities or have no precipitating factors. It is a common cause of chronic elbow pain and wrist dysfunction in adults especially between the ages of 40 and 60 years, it is

equally distributed between men and women, and typically affects the dominant arm[18,30].

There are different treatment methods for lateral epicondylitis. Initially, lateral epicondylitis has been treated with ice, rest, counterforce tennis brace and/or non steroidal anti-inflammatory drugs. But when the condition is not responding to initial treatment physical therapy is initiated.

Many physical therapy modalities are utilized such as electrical stimulation, stretching and strengthening exercises[16,17]. Other new modalities as laser and acupuncture are used as a last choice for resistant cases. Scientific researches have found that all of these methods have been inconsistently effective in treating lateral epicondylitis[23]. Non-steroidal anti-inflammatory drugs are commonly used but their value has been questioned because their efficacy is unpredictable. There is wide individual variation in response; gastrointestinal side effects remain a serious possibility, and may cause intraarticular haemorrhage[14]. The injection of corticosteroid is also a form of treatment that can be used to decrease pain at the site of tendinosis at least temporarily but many investigators found that intratendinous injections of corticosteroids were associated with deterious effects including tendon rupture[21].

Ultrasound therapy is commonly used in the rehabilitative setting to elicit thermal or nonthermal physiologic effects[5]. It has been used as an agent for more than 50 years for the treatment of a diversity of injuries to tendons, ligaments, muscles, joint capsule inflammation, bursitis and skeletal muscle soreness[7]**.** It has shown also effectiveness in chronic overuse syndromes, such as lateral epicondylitis. Phonophoresis by ultrasound has several advantages. It has been used in the treatment of various dermatological and musculoskeletal disorders[**11**]. It has a low risk of burning the skin, it is not necessary to ionize the drugs, and its permeability is approximately 5 cm and its treatment time is short[29]. One of the most common physiotherapy treatments for lateral epicondylitis is therapeutic exercises[26]. Progressive stretching and strengthening were identified as popular treatments for chronic lateral epicondylitis patients[4]. The literature on this subject suggests that strengthening and stretching exercises are the main components of exercise programs because tendons must not only be strong but also flexible[26]. There is conflicting evidence regarding the effectiveness of phonophoresis or ultrasound with exercises. It is clear that both ultrasound and exercise are common modalities for the management of skeletal muscle injury and are often used in an attempt to augment repair and regeneration of muscle tissue[21]. It has been concluded that ultrasound results in decreased pain and increased pressure tolerance in selected cases with soft tissue injuries (tennis elbow) and it was also found that the using of phonophoresis with fluocinonide did not augment the benefits of ultrasound used[9]. Based on the current literature on ultrasound therapy for lateral epicondylitis there is weak evidence for its effectiveness[**4**]. It was also shown that progressive strengthening and stretching exercise treatment is more effective than pulsed ultrasound in treating chronic lateral epicondylitis; it reduced chronic pain and improved upper limb function and ability to work of patients[19]. Although exercise programs are commonly used in the treatment of lateral epicondylitis, more research is needed to assess, firstly, their effectiveness and, secondly, the mechanism of action of their components[26].

Therefore this current study was conducted to compare between the combined

effect of ultrasound and exercises versus that of phonophoresis and exercises in treatment of patients with lateral epicondylitis (tennis elbow).

SUBJECTS AND METHODS

Subjects

Thirty male and female patients ranged in age from 30 to 50 years diagnosed as tennis elbow participated in this study. The duration of illness ranged from 4 to 12 weeks. They were randomly divided into two groups, the first group (A) consisted of 15 patients with a mean age 38.33(±5.74) years treated with ultrasound and program of therapeutic exercises, the second group (B) consisted of 15 patients with a mean age 38.20(±4.65) years treated with phonophoresis and the same program of exercises.

Patients were treated for 3 sessions per week for a total period of 4 weeks. This study was conducted in the outpatient clinic of rheumatology and rehabilitation department, Zagazig University.

Assessment procedure

Patients were evaluated before and after the end of the study. A 100-point scoring system (Table 1) was used for the evaluation[28], with 40 points for pain, 30 points for function, 20 points for strength, and 10 points for range of elbow motions (5 points for flexion and 5 for extension).Chair test pain was elbow pain elicited by lifting a 3.5 Kg stool with the elbow in extension. The clench test was performed by a powerful grip of the hands with the elbows extended. The Thomsen test was performed by active dorsiflexion of the wrist of the affected arm against resistance with the elbows extended. In both of these tests, the intensity of pain in the affected elbow was compared with that in the opposite elbow. The intensity of pain for all evaluations was measured with the visual analogue scale from 0 to 10, with 10 indicating no pain, and 0 indicating sever pain. The visual analogue scale was reversed for the purpose of keeping a consistent scoring system. These changes did not alter or affect the statistical significance[28]. The patient was instructed to make a single mark across the line corresponding to the severity of pain. The scale was scored by measuring the distance by using a ruler[28].

Table (1): A 100 point scoring system used in clinical evaluation.

Pain score	**40 points**
Pain at rest	10 points
Pain on stretching	10 points
Pressure pain	10 points
Chair test pain	10 points
Function score	**30 points**
Pain at work	10 points
Pain during free time	10 points
Pain at night	10 points
Strength score	**20 points**
Clench test	10 points
Thomsen test	10 points
Range of elbow motions score	**10 points**
Flexion	5 points
Extension	5 points

Treatment procedure

1- Ultrasound group (group A): The patients of this group received continuous mode of ultrasound with a frequency of 1 MHz and an intensity of 1.5 W/Cm^2 for 5 minutes. The site of application was on the lateral epicondyle with elbow slightly flexed while the patient was in relaxed sitting position.

2- Phonophoresis group (group B): The patients of this group were treated by the same parameters of ultrasound given to group (A) in addition to the use of topical application of mobilat gel (salicylic acid 0.4g and mucopolysaccharide 0.04g).

3- Exercise program: A selected exercise program[19] was given to both groups of ultrasound and phonophoresis. This program consisted of 4 different steps; each step was given for one week for a total period of 4 weeks. Each exercise was repeated 10 times per session with 2-3 minutes rest between exercises. At the end of each session gentle passive stretching exercises of wrist flexors and extensors were given. Each of them was for 10 times with a 30 seconds hold.

The first step consisted of the following exercises

1- Slow first clenching with elbow extended and forearm pronated.
2- Manual resisted wrist extension with elbow extended and forearm pronated.
3- Manual resisted wrist flexion with elbow extended and forearm pronated.
4- Forearm supination and pronation using a stick.

The second step consisted of the following exercises by using Thera elastic band for

1- Wrist flexion with elbow extended and forearm pronated.
2- Wrist extension with elbow extended and forearm pronated.
3- Radial deviation with elbow extended and forearm in midposition.
4- Ulnar deviation with elbow extended and forearm in mid position.

The third step consisted mainly of the combined wrist rotatory movements with a manual resistance given in the opposite direction. These movements were extension with ulnar deviation, extension with radial deviation, flexion with ulnar deviation and flexion with radial deviation. In addition to autopassive stretching of wrist flexors by pressing hands against the wall.

The fourth step consisted mainly of an occupational training program which included soft ball compressing exercises, transferring buttons from cup into another and twisting a towel into a roll. Forearm supination and pronation exercises on a table were also practiced.

RESULTS

1. General characteristics of subjects

There was no significant difference between the two treatment groups regarding age and duration of illness. In Group (A) treated by ultrasound with exercises the mean age was 38.33(±5.74) years, and the mean duration of illness was 7.46(±2.85) weeks. In Group (B) treated by phonophoresis with exercises the mean age was 38.20(±40.65) years, and the mean duration of illness was 7.20(±2.56) weeks (Table 2).

Table (2): Demographic data of patients.

Variable	Group A	Group B	t-value	P-value
Age	38.33(±5.74)	38.20(±4.65)	0.03	0.97 (N.S)
Duration of illness	7.46(±2.85)	7.20(±2.56)	0.26	0.79 (N.S)

In addition to that there was no significant difference between groups before treatment regarding pain score, function score, strength score, range of elbow motions score and the total score as shown in table (3).

Table (3): Comparison between groups before treatment.

Variable	Group A	Group B	t-value	P- value
Pain score	19.14(±7.41)	18.97(±7.31)	0.64	0.94 (N.S)
Function score	15.90(±5.73)	16.05(±5.13)	0.07	0.94 (N.S)
Strength score	9.27(±3.43)	9.33(±3.07)	0.05	0.96 (N.S)
Elbow motions score	9.22(±0.85)	9.42(±0.67)	0.67	0.50 (N.S)
Total score	53.55(±17.04)	53.78(±15.69)	0.03	0.97 (N.S)

2. Within the ultrasound group differences

In this group there was significant improvement of pain score from 19.14 (±7.41) pretreatment to 34.15 (±3.55) posttreatment. Function score was also improved from 15.90 (±5.73) pretreatment to 27.26 (±1.90) posttreatment. Strength score was improved from 9.27 (±3.43) pretreatment to 17.67 (±1.82) posttreatment. The range of elbow motions score was improved from 9.22 (±0.85) before treatment to 9.99 (±0.02) after treatment. In addition to that there was also a significant improvement of the total score which increased from 53.55 (±17.04) before treatment to 89.08 (±6.93) after treatment (Table 4 & Figure 1).

Table (4): Within the ultrasound group differences.

Variable	Mean	t-value	P-value
Pretreatment pain score Posttreatment pain score	19.14(±7.41) 34.15(±3.55)	10.18	P<0.001(Sig)
Pretreatment function score Posttreatment function score	15.90(±5.73) 27.26(±1.90)	9.59	P<0.001(Sig)
Pretreatment strength score Posttreatment strength score	9.27(±3.43) 17.67(±1.82)	13.03	P<0.001(Sig)
Pretreatment elbow motions score Posttreatment elbow motions score	9.22(±0.85) 9.99(±0.02)	3.51	P<0.05(Sig)
Pretreatment total score Posttreatment total score	53.55(±17.04) 89.08(±6.93)	10.76	P<0.001(Sig)

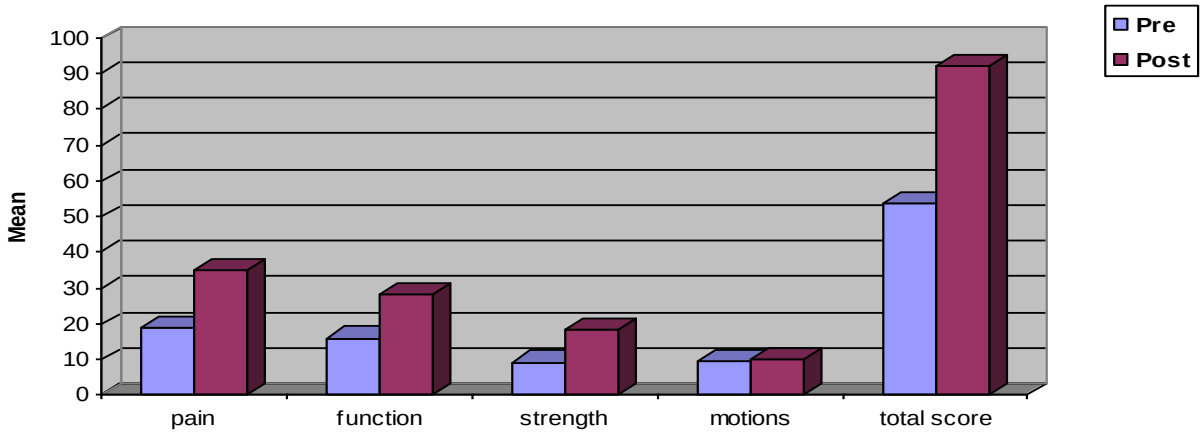

Fig. (1) Within the ultrasound group differences.

3. Within the phonophoresis group differences

In this group there was significant improvement of pain score from 18.97 (±7.31) pretreatment to 35.15 (±3.43) posttreatment. Function score was also improved from 16.05 (±5.13) pretreatment to 28.23 (±1.41) posttreatment. Strength score was improved from 9.33 (±3.07) pretreatment to 18.44 (±1.07) posttreatment. The range of elbow motions score was improved from 9.42 (±0.70) pretreatment to 10 (±0.00) posttreatment. Furthermore there was also a significant improvement of the total score which increased from 53.78 (±15.69) before treatment to 91.83 (±5.62) after treatment (Table 5 & Figure 2).

Table (5): Within the phonophoresis group differences

Variable	Mean	t-value	P-value
Pretreatment pain score Posttreatment pain score	18.97 (±7.31) 35.15 (±3.43)	10.468	P<0.001(Sig)
Pretreatment function score Posttreatment function score	16.05 (±5.13) 28.23 (±1.41)	10.620	P<0.001(Sig)
Pretreatment strength score Posttreatment strength score	9.33(±3.07) 18.44 (±1.07)	13.781	P<0.001(Sig)
Pretreatment elbow motions score Posttreatment elbow motions score	9.42 (±0.70) 10.00 (±0.00)	3.190	P<0.05(Sig)
Pretreatment total score Posttreatment total score	53.78 (±15.69) 91.83(±5.62)	11.357	P<0.001(Sig)

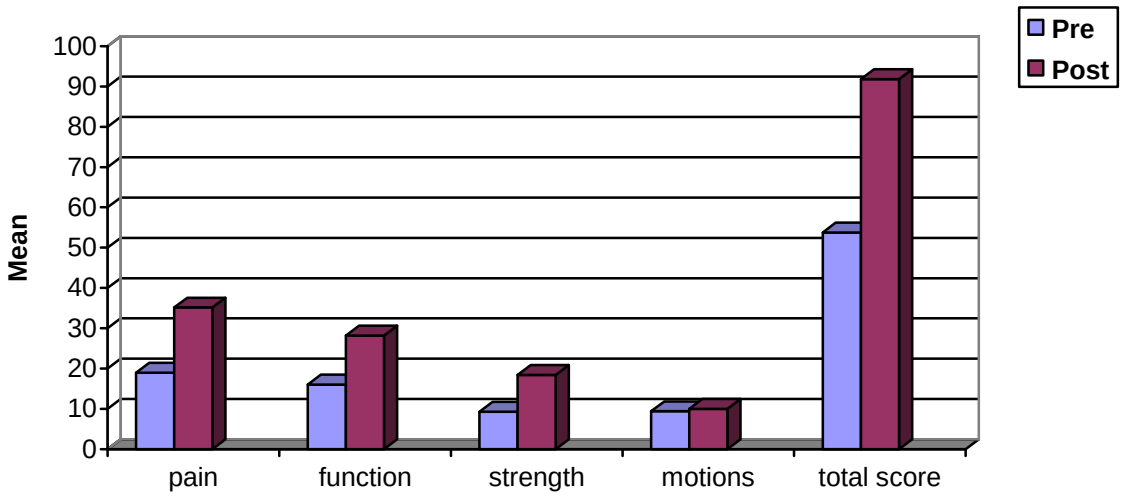

Fig. (2): Within the phonophoresis group differences.

4. Comparison between groups after treatment

Comparison between the ultrasound group (A) and the phonophoresis group (B) after treatment showed that there was no significant difference between them in all the measured variables of the study as illustrated in table (6) & figure (3)

Table (6): Comparison between groups after treatment..

Variable	Group (A)	Group (B)	t-value	P- value
Posttreatment pain score	34.15(±3.55)	35.15(±3.43)	0.78	P>0.05(N.S)
Posttreatment function score	27.26(±1.90)	28.23(±1.41)	1.57	P>0.05(N.S)
Posttreatment strength score	17.67(±1.82)	18.44(±1.07)	1.41	P>0.05(N.S)
Posttreatment elbow motions score	9.99 (±0.02)	10.00(±0.00)	1.00	P>0.05(N.S)
Posttreatment total score	89.08(±6.93)	91.83(±5.62)	1.19	P>0.05(N.S)

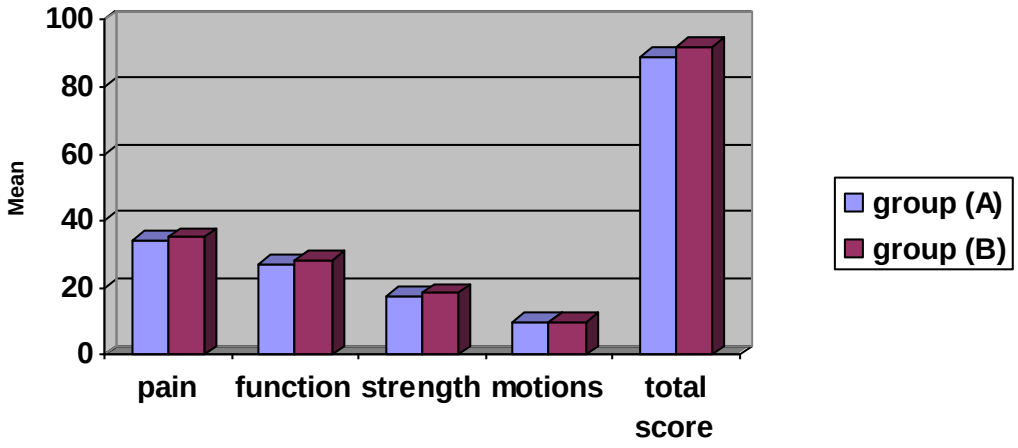

Fig. (3): Comparison between groups after treatment post treatment.

DISCUSSION

In our current study the ultrasound combined with exercises and phonophoresis combined with exercises were equally effective in treatment of patients with tennis elbow. There was no significant difference between both treatments on pain reduction. This does not necessarily mean that either ultrasound or phonophoresis is of no help in treating these patients, but it indicates that exercise therapy is the key element in treatment of such kind of patients.

Furthermore, it means that the pain response after phonophoresis does not differ from pain response after treatment by ultrasound. This is supported by the previous work of Klaiman et al.[9] who reported that ultrasound resulted in decreased pain severity of patients with tennis elbow and the addition of phonophoresis with fluocinonide did not augment the benefits of ultrasound. Binder et al.[3] compared between placebo ultrasound and pulsed ultrasound in treatment of patients with tennis elbow and found that inflammation and pain were lowered significantly in those who were treated by the real ultrasound compared to the placebo group. They concluded that ultrasound enhanced recovery in patients with tennis elbow through significant improvement in pain scores.

On the other hand Pienimaki et al.[19] compared between ultrasound and progressive strengthening and stretching exercises in patients suffering from chronic tennis elbow and found that progressive strengthening and stretching exercises therapy was more effective than ultrasound in reduction of pain. Pienimaki et al.[19] findings support to some extent our results that showed the importance of exercise therapy in treatment of tennis elbow. Our findings are also supported by the work of Manias and Stasinopoulos[15] as well as by Stasinopoulos et al.[26] who found that the supervised exercise program was superior for pain reduction and functional improvement in the management of patients with tennis elbow.

The findings of our study showed that there was a significant functional improvement within the ultrasound and phonophoresis groups and there was no significant difference between both group after treatment. These findings are supported by the research work of Binder et al.[3] and Pienimaki et al.[19] who also found functional improvement of patients with tennis elbow after treatment by a combination of ultrasonic and therapeutic exercises. They are also supported by Smidt et al.[24] and Struijs et al.[27]

Regarding strength score, there was a significant improvement within the ultrasound and the phonophoresis groups with no significant difference between them after treatment. This particular finding coincides with the results of many previous studies[2,3,8,19,24] who found a significant improvement of pain-free grip strength, maximum grip strength and wrist extensors power.

Concerning the range of elbow motions score there was also significant improvement within both treatment groups with no significant difference between them after treatment. This result is similar to that of Holdworth and Anderson[8] and Pienimaki et al.[19]. It has to be mentioned that in our current study the elbow range of motion was much less affected than pain and function before treatment.

In our study we combined ultrasound and phonophoresis with progressive exercise treatment which consisted of slow, repetitive wrist and forearm stretching, strengthening and occupational exercises intensified in four steps as used and recommended by Smidt et al.[24] to obtain maximal results. None of the

previous studies[6,13,30] reported statistically significant or clinically important effects of ultrasound added to exercises, when compared to exercises without the addition of ultrasound therapy.

Based on the systematic review of the randomized clinical trials made by Gam and Johannsen[6] on the effectiveness of ultrasound therapy for musculo-skeletal conditions, they concluded that there was little evidence for the effectiveness of ultrasound therapy from well-designed trials, yet they hypothesized that ultrasound therapy might augment the effect of exercise therapy.

As the patients with tennis elbow usually fail to comply with the regimen of home exercise programs[15,26] we solved this common problem by having them exercising on an individual session basis under the direct supervision of the investigators.

All the evaluation scores of this study were dependent on the visual analogue scale, this was based on the research work of Pienimaki et al.[19]; Smidt et al.[24] and Wang and Chen[28]. Visual analogue scale has been proved to be an effective technique for monitoring patients pain levels and it has been shown to be valid and reliable technique for pain evaluation[9]. It was quick and easy to use and clearly demonstrated the pain status of patients as it is related to a self selected functional activity. In the last 10 years it had been used more and more frequently.

In conclusion, that therapeutic exercises combined with ultrasound or combined with phonophoresis are equally effective in treatment of patients with tennis elbow. Both of these programs relieved pain, improved function, strength and elbow range of motion in those patients.

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الملخص العربى

استخدام التمرينات والموجات الفوق صوتية والتأيين بالموجات الفوق صوتية فى علاج مرضى مرفق التنس

الغرض من هذه الدراسة: هو مقارنة التأثير المشترك للموجات الفوق صوتية مع التمرينات العلاجية مقابل التأثير المشترك للتأيين بالموجات الفوق صوتية مع التمرينات العلاجية لمرضى مرفق التنس . أجريت هذه الدراسة على ثلاثين مريضًا تم توزيعهم عشوائيًا على مجموعتين متساويتين. تم علاج المجموعة الأولى بالموجات الفوق صوتية مع التمرينات العلاجية بينما تم علاج المجموعة الثانية بالتأيين بالموجات الفوق صوتية مع نفس برنامج التمرينات العلاجية المستخدم فى المجموعة الأولى . تم علاج كل مريض لمدة 12 جلسة خلال فترة أربعة أسابيع. أثبتت النتائج تحسنًا ملحوظًا فى كلتا المجموعتين بعد انتهاء فترة الدراسة من حيث تخفيف شدة الألم والتحسن الوظيفى والعضلى والحركى مع عدم وجود فرق ملحوظ بين المجموعتين.

الخلاصة: يستخلص من هذا البحث أهمية دور التمرينات العلاجية فى علاج مرضى مرفق التنس كما يتضح أن إضافة الموجات الفوق صوتية أو التأيين بالموجات الفوق صوتية فى العلاج ذوى تأثير محدود.