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Iontophoresis Versus Cyriax-Type exercises in Chronic Tennis Elbow among industrial workers

Abdelhamid Akram Fathy[1]

[1] Ph.D., Department of Orthopedic Physical Therapy, Faculty of Physical Therapy, Cairo University, Cairo, Egypt

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Abstract

Introduction: Tennis elbow (TE) is one of the most commonly encountered upper limb conditions. It mainly affects people who use the hand grip against resistance frequently, resulting in microtrauma to the wrist extensors tendon, causing pain. This study was conducted to compare the application of iontophoresis of 0.4% dexamethasone and Cyriax-type exercises in the treatment of chronic tennis elbow (CTE).

Methods: Twenty-two industrial worker diagnosed as having CTE participated in this study, and their ages ranged from 25 to 52. They were assigned randomly to two groups, i.e., "group A" in which the workers were treated by iontophoresis of 0.4% Dexamethasone and "group B" in which the workers were treated by conducting Cyriax-type exercises on the affected tendon. Both groups received stretching exercises for the common extensors tendon for 10 minutes in addition to five minutes of pulsed US 1.1 W/cm2 six times over two weeks. The outcome of the treatment was assessed one week after the last session by the visual analog scale (VAS) to assess pain, by the Oxford elbow score (OES) to measure the patient's satisfaction, and by a handgrip dynamometer to measure the strength of the handgrip.

Results: The application of 0.4% dexamethasone iontophoresis and the use of Cyriax-type exercises both provided significant improvement in the pain, patient's satisfaction, and the power of the handgrip, and there were no significant difference ($p > 0.001$) in any of the three measures after the first week's treatment.

Conclusions: Both iontophoresis of 0.4% dexamethasone and Cyriax-type exercises were successful as treatment modalities for patients with CTE, and there were no significant differences between both of them in the treatment of those cases.

Keywords: Iontophoresis, dexamethasone, Cyriax exercises, tennis elbow

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1. Introduction

When people have a condition that is referred to as lateral epicondylitis or 'tennis elbow' (TE), they usually have pain in the lateral epicondyle (or outside of the elbow), and this pain is intensified by any activities that involve using the hand to grip items, such as tools (1). Lateral epicondylitis is a debilitating musculoskeletal condition that poses significant challenges to the healthcare industry. This condition is reported to be one of the most common disorders of the upper extremities, and it has a well-defined clinical presentation that begins as pain and decreased gripstrength, both of which may cause dysfunction in the arm, decrease the patient's work capacity and quality of life, and increase medical costs (2-4). Unfortunately, the symptoms of this condition can last for quite a while after treatment is initiated, and the occurrence of this condition is followed by an increased likelihood of recurrence (2). The etiology of tennis elbow is poorly understood (3). Microscopic studies have shown the presence of fibroblastic tissue and vascular invasion of the common extensor tendon, which is referred to as angiofibroblastic tendonosis, implying a degenerative tendonopathy. However, recent studies have demonstrated the presence of neuropeptides, substance P, and calcitonin-related gene peptide (CRGP) in the sensory nerve fibers that supply the extensor carpi redialis brevis, which could imply the possibility of neurogenic sensitization as an additional source of pain (2). The average duration of a typical episode of tennis elbow is between six months and two years (2, 3).

Corresponding author:
Dr. Abdelhamid Akram Fathy, Department of Orthopedic Physical Therapy, Faculty of Physical Therapy, Cairo University, Cairo, Egypt. Tel: +20.1110093974, E-mail: drbakram4@gmail.com
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Conservative treatment of tennis elbow involves different theoretical mechanisms of action, all of which have the same aims, i.e., to reduce pain and improve function. Such a variety of treatment options suggests no optimal treatment strategy has been identified, and more research is required to determine the most effective treatment for patients with tennis elbow (5-7). Iontophoresis, which is a therapeutic technique that involves the introduction of ions into the body's tissue by means of a direct electrical current (8), has attracted much interest in the last 20-25 years since it has been used for common musculoskeletal conditions, such as tennis elbow. Iontophoresis for such use involves a dexamethasone sodium phosphate iontophoresis solution is a preservative-free aqueous solution. The preservative-free solution produces better outcomes than preservative solutions, which may contain positively-charged ions that compete with the negatively-charged dexamethasone (8-10). Recent studies have suggested that tennis elbow might be a degenerative process rather than an inflammatory process, which which would enhance the role of steroids for pain relief rather than using the anti-inflammatory approach (9, 10). Although steroids provide short-term benefits, inherent risks are associated with introducing an anti-vulnerary agent directly into the site of the degenerative changes. Steroids can block the release of pro-healing cytokines, thereby having a negative impact on the tissue's reparative ability (11-13). Manipulating the elbow can relieve symptoms in patients who have lateral epicondylitis. Cyriax and Cyriax suggested the use of deep massage with transverse friction in combination with Mill's manipulation for the treatment of tennis elbow (14, 15). The aim of this technique is to elongate the scar tissue by rupturing adhesions within the teno-osseou junction, making the area mobile and pain free (7, 16). The purpoe of this study was to compare the effect of iontophoresis of 0.4% dexamethasone application and Cyriax-type exercises for the treatment of the patients with tennis elbow.

2. Material and Methods

2.1. Subjects

Twenty-two subjects (11 men and 11 women) with confirmed diagnosis of chronic tennis elbow participated in this study. They were recruited from the out clinics of different industry area named EL 10th of Ramadan. The patients included in this study had suffered from tennis elbow for more than six months but less than two years. This limit was set because, after two years, the tendon becomes almost fibrosed and requires surgery as supported by (7). Patients with bilateral tennis elbow were included, and the study only considered the more affected elbow. Patients were excluded if they were pregnant, had limited extension of the passive range of motion, or had a history of fibromyalgia or elbow surgery. We also excluded patients with bony abnormalities around the elbow or restricted elbow function.

2.2. Instrumentation

All of the patients who were selected to participate in this study were evaluated before and after treatment for hand grip strength using a CAiRY-100 handgrip Dynamometer. Visual analogue scale (VAS) had been used for pain measurement. Patients ranked pain from 0 to 10 (10 is the maximum pain and 0 represents no pain). Patients' satisfaction had been measured by asking the patient to answer the question on the Oxford elbow score that represents his functional abilities. The Oxford elbow score has 12 items (questions) with five response options, i.e., 0 to 5, with 5 representing the greatest severity. Underlying the 12 items are three domains (sub-scales), i.e., elbow pain during activities, elbow function, and social domain. The score after that was converted to a metric score to make the grades from 0 to 10, with 10 representing the greatest severity. For treatment, ultrasonic treatment was applied by using a COMBI-500 electrotherapy unit (produced by Gymna uniphy-Belgium), and the same machine also was used in the application of iontophoresis with dexamethasone. The outcomes of the treatments were measured after one week from the last session and at three months after the treatment as a follow-up.

2.3. Procedures

2.3.1. For Evaluation

All of the patients who participated in this study were screened to ensure that they followed the inclusive and exclusive criteria of the study. In the first session, each patient was asked to localize the area of pain and to indicate the level of pain using the VAS. A CAiry-100 handgrip dynamometer was used to determine the strength of the handgrip, as follows. The subject held the dynamometer in the hand to be tested, with the arm at a right angle, the wrist joint in 15° of dorsiflexion (17), and the elbow by the side of the body. The handle of the dynamometer was adjusted, if required, and its base rested on the first metacarpal, while the handle rested on the middle finger. When ready, the subject squeezed the dynamometer with her or his maximum isometric effort and maintained it for about five seconds. The subjects were asked to perform the previous procedure three times with 30 seconds between each trial, and the mean of the three trials was recorded. After that, the patient determined her or his elbow's functional

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ability by using the Oxford elbow score, which is valid and reliable for measuring the functional ability of the patients with tennis elbow.

2.3.2. For Treatment

All the patients who participated in this study were distributed randomly into two groups (Group A and Group B). All patients were treated by application of stretching exercises for extensors muscles of the wrist with holding 20 seconds at maximum range of stretching according to the patient's tolerance. Followed by application of deep pulsed US 1.1 W/cm2 for 5 min on the most painful area of the elbow (lateral humeral epicondyle), this procedure was repeated six times over two weeks using Gymna 500 Ultrasonic machine. “Group A” patients were treated by iontophoresis of 0.4% dexamethasone six times over the two weeks using Gymna 500 iontophoresis current placed on the affected area for 20 min. Dexamethasone 0.4%,which is a negative ionized drug, was added at the negative electrode. Negative electrode (active electrode) was placed just distal to the lateral humeral epicodyle and the positive electrode (reference electrode) was placed away from the negative electrode by 5 cm passing the lateral humeral epicondyle. This application was suggested by (8). The patients in “group B” were treated by 10 min application of Cyrix-type exercises of the affected tendon. The application of the Cyriax-type manipulation divided into the following two stages: In the first stage, the patients sat with elbows bent at a right angle and full supinated. Examiner was using the pad of his thumb to move patient's skin over the site of the lesion back and forth with light pressure for 10 min in the direction perpendicular to the normal orientation of tendon fibers. The second stage, manipulation, followed the massage immediately, while the patient sat upright with her or his arm abducted to the horizontal and so far medially rotated, with the therapist standing behind the patient while the patient's forearm was fully pronated and her or his hand was flexed. Then, while the tension was strongly maintained, we used a sudden, small jerk of the patient’s hand to force the full extension of the elbow.

3. Results

3.1. General findings

The general findings are presented in Table 1. Statistical analyses, including means and standard deviations, were calculated for all measurements. Data analysis was performed with SPSS version 14.0. The mean differences with SD for outcome measures of pain, grip strength, and function were calculated for three time periods, i.e., baseline, one week after treatment, and three months after treatment (Table 2).

Table 1. Demographic characteristics of the 22 participants

Variables	Men (n = 11)		Women (n = 11)	
	Mean	SD	Mean	SD
Age (yr.)	38.2	8.2	34.1	6.9
Weight (kg)	77.8	15.2	73.7	14.2
Height (cm)	168.9	10.7	159.0	9.2

3.2. Pain

The average pre-treatment pain level was 6.8± 0.6; one week after the treatment, the average of pain levels in group (A) and group (B) were 5.2 ± 0.5 and 5.3 ± 0.5, respectively. After three months, the average of pain levels in group (A) and group (B) were 3.2 ± 0.4 and 3.3 ± 0.4, respectively ($p < 0.001$) (Table 3)

3.3. Handgrip Strength

The average pre-treatment handgrip strength level was 86 ± 8 lb; one week after the treatment, the average handgrip strengths in group (A) and group (B) were 106 ±7 and 108 ± 6 lb, respectively. After three months, the average handgrip strengths in group (A) and group (B) were 133 ± 6 and 134 ± 9 lb ($p<0.001$).

3.4. Functional activities

The patients’ satisfaction, based on their ability to do functional activities, were measured using the Oxford elbow score (OES). On average, the pre-treatment total score was 8.5± 0.5, while, one week after treatment, in group (A) and group B the averages were 5.5 ± 0.5 and 5.8 ± 0.4, respectively. After three months, the averages in group (A) and group (B) were 2.9 ± 0.3 and 2.8 ± 0.3, respectively ($p < 0.001$).

3.5. Pain between subjects in Groups (A) and (B)

The mean value ±SD of pain for groups (A) and (B) were 3.2 ± 1.2 and 3.3 ± 0.4, respectively. The mean difference for each of the groups was 0.09. There was a non-significant difference in pain between the two groups after the treatment ($p > 0.001$).

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Table 2. Outcome measures of the visual analog scale (VAS), Oxford elbow score (OES), and handgrip strength before and after treatment

Variables		Group	Mean	SD	n
VAS	Pre-treatment	Exercise	7.45	0.93	11
		Iontophoresis	7.36	1.20	11
		Total	7.40	1.05	22
	One week after treatment	Exercise	4.09	0.53	11
		Iontophoresis	4.18	0.60	11
		Total	4.13	0.56	22
	Three months after treatment	Exercise	1.90	0.30	11
		Iontophoresis	1.63	0.50	11
		Total	1.77	0.42	22
OES	Pre-treatment	Exercise	7.45	1.03	11
		Iontophoresis	7.45	1.03	11
		Total	7.45	1.01	22
	One week after treatment	Exercise	3.63	0.80	11
		Iontophoresis	3.54	0.82	11
		Total	3.59	0.79	22
	Three months after treatment	Exercise	1.27	0.46	11
		Iontophoresis	1.27	0.46	11
		Total	1.27	0.45	22
Hand grip	Pre-treatment	Exercise	76.36	8.09	11
		Iontophoresis	76.36	11.20	11
		Total	76.36	9.53	22
	One week after treatment	Exercise	111.81	8.73	11
		Iontophoresis	113.63	9.24	11
		Total	112.72	8.82	22
	Three months after treatment	Exercise	133.63	6.74	11
		Iontophoresis	135.45	6.87	11
		Total	134.54	6.70	22

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Table 3. Pain, handgrip strength, and Oxford elbow score (OES) before and after treatment

Variable			Range	Mean	SD
Pain	Pre-treatment		6 to 9	6.8	0.6
	After one week	Group A	4 to 7	5.2	0.5
		Group B	4 to 8	5.3	0.5
	After three months	Group A	3 to 5	3.2	0.4
		Group B	3 to 5	3.3	0.4
Handgrip	Pre-treatment		80 to 92	86	8
	After one week	Group A	102 to 120	106	7
		Group B	100 to 118	108	6
	After three months	Group A	128 to 138	133	6
		Group B	125 to 136	134	9
Oxford elbow score (OES)	Pre-treatment		7 to 9	8.4	0.5
	After one week	Group A	3 to 7	5.5	0.5
		Group B	4 to 8	5.8	0.4
	After three months	Group A	2 to 5	2.9	0.3
		Group B	2 to 5	2.8	0.3

3.6. Handgrip between subjects in Groups (A) and (B)

The mean value ±SD of handgrip for groups (A) and (B) were 98 ± 8 and 101± 6, respectively. The difference between the means of the two groups was 4. There was a non-significant difference between the handgrips of the two groups after the treatment ($p > 0.001$).

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3.7. Functional activities between subjects in Groups (A) and (B)
The mean values ±SD of Oxford elbow scores for groups (A) and (B) were 5 ± 0.9 and 6 ± 0.2, the difference between the means of the two groups was 0.1. There was a non-significant difference between the Oxford elbow scores of the two groups after the treatment ($p > 0.001$). There was no significant difference between the effect of iontophoresis with dexamethasone 4% and Cyirax-type exercises in the treatment of the patients with chronic tennis elbow on the three measurements that were made in the study, i.e., pain, handgrip strength, and the patients' satisfaction ($p > 0.001$).

4. Discussion
Lateral epicondylitis, commonly referred to as tennis elbow, is one of the most common lesions that affect the arm. Many techniques and plans of treatment have been used to decrease the patients' pain and increase their grip strength. This study was conducted to compare the effect of iontophoresis of 4% dexamethasone and cyriax-type exercises in the treatment of chronic cases with tennis elbow among industrial workers. This study was focused on determining quantitative assessments of the patients' pain relief in which pain was assessed VAS, handgrip strength, and the patients' satisfaction during the activities of daily living. Pain may be influenced by many factors, and it is difficult to measure. Therefore, we used hand grip strength measured with a hand dynamometer as a more objective indication of the outcome of treatment. Gripping is mainly carried out by flexors in the forearm. Power grip, however, requires a fixed wrist joint at 15° of dorsiflexion (17). This action of the forearm extensors generates tensile forces at the common extensor origin, which is painful when the person has tennis elbow. Thus, hand grip-strength measures the severity of pain and may serve as a quantitative measure of the response to treatment (8).

In this study, the results from groups (A) and (B) were compared before the treatment and after the last session. They also were compared before the treatment and three months from the last session. The results indicated that both the iontophoresis and Cyriax groups experienced significant improvements in pain, grip strength, and the patients' satisfaction in daily living activities, but there were no significant differences between groups A and B (intra group) one week after the last treatment session or at the follow-up at three months after treatment. These results were in good agreement with the study of (18) in which it was found that the iontophoresis of 4% dexamethasone and Cyriax-type exercises were the most effective techniques used in the treatment of chronic tennis elbow, but that study did not compare the results of the two techniques. Manchanda and Grover reported that Cyriax-type exercises provided the best results in the treatment of the chronic tennis elbow, but this study only compared cyriax-type of exercises with the traditional treatment (19). Oner and Armagan studied the effect of 4% dexamethasone iontophoresis and stretching exercises in comparisone with the traditional treatment of using pulsed low intensity ultrasound and stretching exercises in the treatment of patients with chronic Tennis elbow. The study used the VAS as a measurement of outcomes change of pain level. The result of this study came up with concluding that iontophoresis of 4% Dexamethasone is more effective than pulsed low intensity ultrasound in alleviating pain. In the previous study, the authors focused only on the level of pain for those patients, and they did not measure the changes in their functional activities or the changes in handgrip strength after treatment. Rather, they depended on the assumption that reducing the patients' levels of pain would be reflected in improvements in the patients' functional activities (10).

The results of this study did not disagree with those of Verhaar et al., who compared local corticosteroid injection with Cyriax physiotherapy and concluded that there was greater satisfaction with the steroid injections even though no significant differences were found between the groups after one year. The authors did not offer any description or reference regarding the techniques they used; therefore, it is not clear whether their application of Cyriax physiotherapy differed from that of the present study (20). The reported significant improvement noted in the Cyriax group in this study may be due to Mill's manipulation, which lengthens the scar tissue after the adhesions rupture, thereby decreasing the tension on the scar, which converts a "V-shaped" tear into a tear that resembles a "U," thereby reducing the pain. Permanent lengthening occurs as a result of fibrous tissue's filling the resulting gap, resulting in the reduction or elimination of pain. It has been claimed that friction massage act as an analgesia prior to the manipulation and soften the scar (16). Some have hypothesized that the pain-relief mechanism associated with friction massage may be due its reduction of pain resulting from the stimulation of nerve cells in the spinal cord. This hypothesis also is referred as the gate control theory (21). To date, there is no published proof that the proposed mechanism is a valid representation of the actual effects of Cyriax physiotherapy. Further, to date, there is no consensus concerning the mechanisms involved even though there is a lot of support for the use of manual therapy for musculoskeletal pain (16, 22). Many recent reports have indicated that corticosteroid injections provide no long-term benefit, but they are still used as the intervention of choice for lateral epicondylitis (23). This is especially

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interesting, since medication can be applied without penetrating the skin when iontophoresis is used. There is compelling evidence that iontophoresis can be used to administer dexamethasone to decrease the pain associated with lateral epicondylitis (9), and the process non-invasive, effective, has no known side effects (24). It has been reported that sites of enthesopathies (including lateral epicondylitis) usually have significant quantities of glutamic acid, which is a pain-signaling neurotransmitter, even in the absence of inflammatory cells or cytokines. This acid can be blocked by corticosteroids, resulting in reduced pain. The delivery method may have more to do with the lack of a long-term benefit from corticosteroid therapy than with the medication itself. The goal of using corticosteroids in treating the pain associated with lateral epicondylitis is to diminish the pain at least to the extent that patients can undergo therapy and learn to modify their behavior to allow long-term recovery and prevent recurrences (23, 24).

5. Conclusions

The study provided evidence to support the use of Cyriax-type exercises and iontophoresis of 4% dexamethasone as an effective, non-invasive treatment for the patients with chronic tennis elbow. No significant differences were observed between the two methods of treatment.

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Conflict of Interest:

There is no conflict of interest to be declared.

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References

1) Vicenzino B. Lateral epicondylagia. A review of epidemiology, pathophysiology, aetlogy and natural history. Physical therapy reviews, 2006;1:23-34
2) Wood WA, Strawart A. Lateral epicondylagia: and overview. J Physical Therapy. 2006; 11: 155-60. doi: 10.1179/108331906X99092
3) Ciccotti MC. Schwartz MA. Cicotti MG. Diagnosis and treatment of medial epicondylitis of the elbow. Clin Sports Med. 2011; 23:693-705. doi: 10.1016/j.csm.2004.04.011, PMid: 15474230
4) Amit V. Nagrale; Christ opher R. Herd; Shyam Ganvir; Gopichand Ramteke, Cyriax Physiotherapy Versus Phonophoresis with Supervised Exercise in Subjects with Lateral Epicondylalgia: A Randomized Clinical Trial, J Man Manip Ther. 2009; 17(3): 171-8
5) Stoeckart R, Vleeming A. Anatomy of the extensor carpi radialsbrevis muscle related to tennis elbow. Clin Biomech 4: 10-15.
6) Kushner S. Reid DC. Manipulation in the treatment of tennis elbow. J orthop sportsphys Ther. 1999; 7: 264-72. doi: 10.2519/jospt.1986.7.5.264
7) Soderberg J. Grooten WJ.and Bigol BO. Effects of eccentric training on hand strength Sports, 2012; 22: 797-803.
8) Nirschl RP, Rodin DM, Marratmanaa-Moe. Iontophoresic administration of Dexamethasone sodium phosphate for tennis elbow. A randomized, double-blinded, placebo-controlled study. Am J Sports Med. 2003; 31: 189-95. PMid: 12642251
9) Oner C, Armagan O. The treatment of lateral epicondylitis with iontophoresis of ibuprofen and low level LASER. Am J Sports Med. 2003; 36: 245-251
10) Grossi E, Monza GC, Pollavini S, Bona L. NASID ionization in the management of soft-tissue rheutism: role played by the drug. Electrical stimulation and suggestion. Clin Exp Rheumatol. 2002; 4: 265-7.
11) Runeson L, Haker E. Iontophoresis with cortisone in the treatment oflateral epicondylitis a double blind study. Scand J Med Sci sports; 2002; 12; 136-42. doi: 10.1034/j.1600-0838.2002.02142.x, PMid: 12135445
12) Stefanou A, Marshall N, Holdan W, Siddiqui A. A randomized study comparing corticosteroid injection to costicosteroid Iontophoresis for lateral epicondylitis. J Hand Surg Am, 2012; 37: 104-9. doi: 10.1016/j.jhsa.2011.10.005, PMid: 22196293
13) Cyriax, H.J. and Cyriax J.P. Cyriax's illustrated manual of orthopedic medicine. Oxford: Butterworth-Heinemann. 1983
14) James Cyriax. Book of Orthopedic Medicine (11th edn. Vol 1) AICBS Publication. 2001
15) Stasinopoulos, D., and Johnson, I.M. Cyriax physiotherapy for tennis elbow/ lateral epicondylitis. Br.J. Sports Med., 2004; 38: 675-7. doi: 10.1136/bjsm.2004.013573, PMid: 15562158 PMCid: PMC1724968

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16) Van Gemert JGWA. Arthrodesis of the wrist joint. Acta Orthop Scand, 1984;55:Suppl 210, 1-146. doi: 10.3109/17453678409154150
17) Thurtle OA, Tyler AK, Cawley MI. Grip strength as a measure of response to treatment for lateral epicondylitis. Br J Rheumatol, 1984; 23:154-5. doi: 10.1093/rheumatology/23.2.154, PMid: 6722412
18) Manchanda, G. and Grover, D. Effectiveness of movement with mobilization compared with manipulation of wrist in case of lateral epicondylitis. Ind. J. Physiotherapy and Ocuup. Therapy, 2008; 2(1): 1345-8.
19) Verhaar, J., Walenkamp, H., and Mameren, H.L. Local corticoid injection versus Cyriax-type physiotherapy for tennis elbow. J, Bone Joint Surg. 2008; 78: 128-32.
20) De Bruijn R. Deep transverse friction: Its analgesic effect. Int J Sports Med 1984; 05: S35-S36 doi: 10.1055/s-2008-1025944
21) Nagrale AV, Herd CR, and Ganvir S. Cyriax physiotherapy Versus Phonophoresis with supervised exercises in the subjects with lateral epicondylagia: a randomized clinical trial. J Man Manip Ther, 2009; 17 n 3: 171-179. doi: 10.1179/jmt.2009.17.3.171
22) Smidt N, Assendelft WJ, van der Windt DA, Hay EM, Buchbinder R, Bouter LM. Corticosteroid injections for lateral epicondylitis: a systematic review. Pain, 2002; 96:23-40. doi: 10.1016/S0304-3959(01)00388-8
23) Stefanou A, Marshall N, Holdan W, Siddiqui A. A randomized study comparing corticosteroid injection to costicosteroid Iontophoresis for lateral epicondylitis. J Hand Surg Am 37: 104-109. doi: 10.1016/j.jhsa.2011.10.005, PMid: 22196293
24) Yarrobino TE, Kalbfleisch JH, Ferslew KE, Panus PC. Lidocaine iontophoresis mediates analgesia in lateral epicondylalgia treatment. Physiother Res Int, 2006;11:152–60. doi: 10.1002/pri.338, PMid: 17019945

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