Original Research Article

Non-drug Non-invasive Treatment in the Management of Tennis Elbow: RICE and Guided Rehabilitation

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ABSTRACT

Introduction: Tennis elbow is a common disorder of upper extremity. Majority of the patients can be treated conservatively. It is the major cause of disability and time off work, after low back pain. The disease impacts upon activities of daily living, ultimately leading to a loss of functional independence and quality of life.

Purpose: The main purpose of this study was to assess the results of non-drug non-invasive treatment in the management of tennis elbow.

Methods: This study was conducted in the Department of Orthopaedics from December 2010 to December 2015. One hundred and ten outpatients of tennis elbow with a mean age of 45 years were studied. They were managed with non-invasive treatment and were followed for twelve months.

Results: At the twelve-month follow-up visit, the intensity of tennis elbow pain and disability were assessed by using Quick DASH scoring system and Patient-rated elbow evaluation system. According to the physician global evaluation, up to the age of 40 years at twelve-month follow-up, the results were excellent. At 40 to 60 years of age, the results were good to excellent. Over the age of 60 years, the results were good. The patient global evaluation was found very good up to the age of 40 years at twelve-month follow-up, good to very good between 40 to 60 years, and over the age of 60 years it was good.

Conclusions: Non-drug non-invasive interventions can reduce pain and improve function in tennis elbow.

Keywords: non-drug, non-invasive, tennis elbow, treatment
https://doi.org/10.31282/joti.v4n2.77

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INTRODUCTION

Tennis elbow is a common pathology of both athletes and non-athletes, affecting 1 to 3% of the population at large [1, 2]. It is the most common cause of lateral elbow pain, mostly affecting middle-aged patients. It is characterized by pain in the lateral epicondyle of the humerus, which is aggravated during wrist dorsiflexion, supination, and sustained power grip. It could lead to a substantial loss of labour due to the pain experienced by the patients. It usually occurs in the 4th and 5th decade of life without gender disposition. It is caused by generalized extensor inflammation at the lateral epicondyle of the humerus, with resulting microcracks and histological changes of angio-fibroblastic hyperplasia. Extensor carpi radialis brevis (ECRB) and extensor digitorum communis (EDC) are considered to be the most commonly affected tendons. The lack of pathological evidence of inflammation in these types of injuries has led most authors now to refer to this condition as an epicondylitis, abandoning the mislabelled "itis" [3, 4, 5 and 6].

Conservative treatment strategies aim to reduce inflammation through rest, local ice application, activity modification, pain relief, splints, injections, and more recently, extracorporeal shock wave therapy. Nonsurgical treatment of lateral epicondylitis is successful in 70-80% of cases within a year. Various types of orthotics have been developed and popularized for the treatment of tennis elbow. The most commonly used devices include a splint placed around the abdomen of the wrist extensors and a wrist extensor splint. Both of these braces have been used successfully with significant symptom reduction. The paucity of evidence on treatments for lateral epicondylitis may stem from several sources, including the self-limiting nature of the condition, the lack of pathophysiological data, the methodological shortcomings of the current studies, and the existence of multiple factors which may influence the outcome [1, 7].

The aim of our study was to find out the outcome of non-drug non-invasive treatment in the management of tennis elbow.

METHODS

This prospective study was carried out at Orthopaedics Department from December 2010 to December 2015. Institutional medical ethics committee approval was obtained. In this series, 110 patients were enrolled. The average age of patients was 45 years (ranging from 20 to 75 years) **[Table 1]**. The average follow-up was done up to twelve months.

Inclusion criteria

• Age between 20 to 75 years

• No general illnesses or use of medication

• A characteristic history and symptoms of tennis elbow: This is a condition characterized by pain and tenderness at the lateral epicondyle of the humerus due to non-specific inflammation at the origin of the extensor muscles of the forearm. Although, it is sometimes seen in tennis players, other activities such as squeezing clothes, carrying a suitcase etc. are frequently responsible.

• Characteristic clinical signs of tennis elbow local tenderness at lateral epicondyle of humerus: Pain is aggravated by putting the extensor tendons to a stretch; for example, by palmar-flexing the wrist and fingers with the forearm pronated. Cozen's test - Painful resisted extension of the wrist - with elbow in full extension elicits pain at the lateral elbow. Elbow movements are normal.

Exclusion criteria

• Cases were excluded if there had been previous surgery or other elbow pathology such as rheumatoid arthritis, osteoarthritis, or radial tunnel syndrome (pain, paraesthesia, and weakness).

• Investigations are usually not performed in the straightforward case of lateral elbow pain. However, in longstanding cases, plain X-ray (AP and lateral views) of the elbow may show osteochondritis dissecans, degenerative joint changes or evidence of heterotopic calcification. CT scan and MRI are also prescribed to all cases to exclude other abnormality.

A written informed consent was obtained from all the patients; they were explained the treatment plan. The common objectives of all conservative measures are relief of pain and reduction of inflammation followed by guided rehabilitation. Conservative measures have two phases, first phase is for relief of pain and reduction of inflammation and the second phase is for guided rehabilitation. Duration of the first phase is 1-2 weeks

and the second phase is from 2 weeks to 3 months. Follow-up assessments were done at 2 weeks, 6 weeks, 3 months, 6 months, and 12 months. Relief of pain and inflammation is the primary goal of the first phase of nonsurgical treatment. Cessation of the offending activity is required initially, but complete inactivity or immobilization is avoided as this may lead to disuse atrophy, which compromises later rehabilitation. Ice is recommended for its local vasoconstrictive and analgesic effects.

Rest and watchful waiting. Sometimes taking a break from the activity(ies) that triggered tennis elbow symptoms is sufficient to alleviate the symptoms. **RICE protocol**, or the combination of **R**est, **I**ce, **C**ompression, and **E**levation is often employed as a first-line treatment for tennis elbow [8-11]. Analgesics and anti-inflammatory drugs were not formally prescribed for patients during the study period; however, patients were occasionally allowed to take over-the-counter acetaminophen as needed. In addition to rest, cloth-covered ice packs can be applied to the affected area for no more than twenty minutes at a time every two to three hours, two to three times per day. ACE bandages, compression sleeves, or other similar devices can be worn on the affected arm, and the arm can be elevated on a cushion, high table, or other type of platform. This protocol can provide pain relief while also reducing swelling and promoting healing. All patients received wrist extensor stretching, ultrasound, cross-friction massage, heat, and ice during their physical therapy visits.

Upon relief of initial pain and inflammation, the second phase of nonsurgical treatment is begun. This phase emphasizes on continued tissue healing through avoidance of the abusive aspects of the causative activity and guided rehabilitation. If the patient uses aberrant techniques in sports or occupational activities, these should be identified and corrected.

In second phase, the Standard Treatment Group performed isotonic wrist extensor strengthening and the Eccentric Group performed isolated eccentric wrist extensor strengthening. The strengthening and stretching exercises were also prescribed as a home exercise program. Treatments were continued until patients had resolution of symptoms or they were referred back to their physician with continued symptoms. The isolated eccentric strengthening exercise was performed using a rubber bar (Thera-Band Flex Bar; The Hygenic Corporation, Akron OH) which was twisted using wrist flexion of the uninvolved limb and slowly allowed to untwist with eccentric wrist extension by the involved limb. Each eccentric wrist extensor contraction lasted approximately 4 seconds (i.e., slow release). Both upper extremities were reset for the subsequent repetitions. A 30-second rest period was timed between each set of 15 repetitions, and 3 sets of 15 repetitions were performed daily. Intensity was increased by giving the patient a thicker rubber bar if the patient reported no longer experiencing discomfort during the exercise. Exercise protocols with two or three sets of 10 or 15 repetitions were commonly used. The frequency of exercise ranged from three times a week to twice a day, and the duration of intervention ranged from 2 weeks to 3 months. Operative treatment is indicated for debilitating pain that is diagnosed after the exclusion of other pathologic causes for pain and that persists in spite of a well-managed nonoperative regimen spanning a minimum of 6 months.

The results were assessed by quick dash scoring system and the patient-rated elbow evaluation system. The quick DASH [12] is a shortened version of the dash scoring system. It consists of 11 items to measure physical function and symptoms in people with any or multiple musculoskeletal disorders of the upper limb. Similar to the DASH, each item has five response options (1 = no difficulty; 2 = mild difficulty; 3 = moderate difficulty; 4 = severe difficulty; 5 = unable to do). From the item scores, a summative score is calculated. The final score ranges between 0 (no disability) and 100 (the greatest possible disability). Only one missing item can be tolerated, and, if two or more items are missing, the score cannot be calculated [13]. The patient-rated elbow evaluation [14] (PREE) consists of two sections investigating pain and function. All questions are scored on a 10-point scale. The pain section has four questions that rate pain from ‘no pain’ to ‘worst ever’. In addition, there is a question that rates how often the patient has pain (‘never’ to ‘always’). The scale for the function questions ranges from ‘no difficulty’ to ‘unable to do’. The function section has 11 questions regarding specific activities of daily living, and four questions regarding personal care, household work, occupational work and recreational activities. Higher scores represent worse functioning [15, 16].

RESULTS

There were 140 elbows of 110 patients (54 males and 56

females) with tennis elbow admitted to our institute were included in the present study. Fifty-six patients (56.11%) were women and fifty-four patients (49.09%) were male. Thirty patients had bilateral tennis elbow and 80 patients had unilateral tennis elbow. There were 90 cases of tennis elbow found on the right side and 50 cases seen on the left side. All the patients were divided into three age groups. In the age group between 20-40 years, there were 22 females and 20 males. In the age group between 40-60 years, there were 16 females and 18 males and in the age group between 60-75 years, there were 18 females and 16 males. The average age of patients was 45 years (ranging from 15 to 75 years) [Table 1]. All patients were followed for twelve months. At the twelve-month follow-up visit, the intensity of tennis elbow pain and disability were assessed by using Quick dash scoring system and Patient-rated elbow evaluation system [Table 2].

Table 1. Age and sex variations in study group (n=110)

Age	Male	Female	Total
20-40	20	22	42
40-60	18	16	34
60-75	16	18	34
Total	54	56	110

Before the treatment, pain, disability and unable to do were severe and worst in both evaluation system scales, in all 100% cases. At the twelve-month follow-up, it was performed the patient-rated elbow evaluation [14] (PREE), which was consisted of two sections investigating the pain and the function. All questions were scored on a 10-point scale. The pain section had four questions that rate pain from 'no pain' to 'worst ever' compared to before the treatment with significant *P* value (P = 0.16, 0.73, and 0.079, respectively, for each age group). After the treatment, the subjective overall assessment below the age of 40 years was done, 100% of the patients were given one point. Between 40-60 years, 75% of the patient had one point, 15% had four to six points and 10% had seven to eight points. Over the age of 60 years, 50% of the patients had one point, 30% had four to six points and 20% had four to five points.

In Quick DASH scoring functional disability scale [12, 13], below the age of 40 years, 100% had full recovery (0% disability). Between 40-60 years, 75% of the patient had full recovery (0% disability), 25% had minor recovery (<20% disability). Above the age of 60 years, 50% had full recovery (0% disability) and 50% had minor recovery (<20% disability). (Table 2)

Table 2. Pre- and post-management evaluation of tennis elbow (n=110)

Age group	Quick dash scoring system		Patient-rated elbow evaluation system	
	Before treatment	After treatment	Before treatment	After treatment
20-40	100% had Severe difficulty to Unable to do	100% had No difficulty	100% had Worst pain and Unable to do	100% had No pain and No difficulty
40-60	100% had Severe difficulty to Unable to do	75% had No difficulty and 25% had Mild difficulty	100% had Worst pain and Unable to do	75% had No pain and difficulty, 25% had Mild pain and Mild difficulty
60-75	100% had Severe difficulty to Unable to do	50% had No difficulty and 50% had Mild difficulty	100% had Worst pain and Unable to do	50% had No pain and difficulty, 50% had Mild pain and Mild difficulty

In Global Assessment of tennis elbow, below the age of 40 years, 100% had full improvement. Between 40-60 years, 75% of the patient had full improvement, 25% had minor improvement. Above the age of 60 years, 50% had full improvement and 50% had minor improvement. In objective physician global evaluation, below the age of 40 years, 100% had full improvement. Between 40-60 years, 75% of the patients had full improvement, 25% had minor improvement. Above the age of 60 years, 50% had full improvement and 50% had minor improvement. In the patient global evaluation, below the age of 40 years, 100% had no difficulty. Between 40-60 years, 75% of the patient had no difficulty, 25% had minor difficulty. Above the age of 60 years, 50% had no difficulty and 50% had minor difficulty. Below the age of 40 years, at 6 months, complete subjective, functional, and clinical recovery had occurred in almost 100% of the patients. From 40 to 60 years of age at 6 months,

Table 3. Results in study group (n=110)

Age group	Subjective overall assessment [Patient-rated elbow evaluation system]	Quick dash scoring system functional disability scale	Global Assessment of tennis elbow	Physician global evaluation	Patient global evaluation
20-40	100% full recovery	100% full recovery	100% full recovery	Excellent	Very good
40-60	75% full recovery	75% full recovery	75% full recovery	Good-excellent	Good-very good
	25% minor recovery	25% minor recovery	25% minor recovery		
60-75	50% full recovery	50% full recovery	50% full recovery	Good	Good
	50% minor recovery	50% minor recovery	50% minor recovery		

complete subjective, functional, and clinical recovery had occurred in almost 75% of the patients. Twenty percent of the patients had minor recovery even at 24 months, but their severity became lowered significantly. Over the age of 60 years at 6 months, complete subjective, functional, and clinical recovery had occurred in almost 50% of the patients, the other 50% had minor recovery even at 24 months, but their severity became lowered significantly. According to the result of the physician global evaluation, up to the age of 40 years at 2-year follow-up were excellent. At 40 to 60 years of age, it was good to excellent. Over the age of 60 years, it was good. The patient global evaluation were found very good up to the age of 40 years at 2-year follow-up, good to very good between 40 to 60 years and over the age of 60 years it was good [Table 3].

DISCUSSION

Tennis elbow (Lateral epicondylitis) is an overuse injury involving the extensor muscles, especially in the extensor carpi radialis brevis. Histopathological finding is fibrous granulation tissue at the origin of the common extensor tendon [17] and vascular infiltration and degeneration of the common tendon origin [18, 19]. Others claimed that the main pathology in tennis elbow was entrapment of the anterior interosseous branch of the radial nerve and suggested surgical decompression of the nerve [20, 21]. Tennis elbow occurs most commonly in people aged 40 to 50 years with an equal distribution between men and women [3, 22, and 23]. The dominant arm is involved in 75% of patients, and the incidence most directly relates to playing time in amateur players [3]. In our study, fifty-six patients (56.11%) were women and fifty-four patients (49.09%) were male. 30 patients had bilateral tennis elbow and 80 patients had unilateral tennis elbow. There were 90 cases of tennis elbow found on the right side and 50 cases seen on the left side. The average age of patients was 45 years (ranging from 20 to 75 years).

It has been reported that nearly 50% of all tennis players over 35 years old and 60% of players over 50 years old suffer from tennis elbow at some point in their career [3]. Most such injuries are related to direct trauma or repetitive stress, and account for a significant amount of "down time" for the athlete in sports where the arm is utilized for throwing, catching, or swinging. Elbow biomechanics play a very important role in many overhead sporting activities, including tennis. The amount of tension and the location of the stress within the elbow joint are dependent on the stroke used and the mechanics of each stroke [24]. Electromyographic (EMG) studies of elbow function in tennis have shown that the serving motion creates a larger demand on the elbow than does the groundstroke [24]. That being said, it is well known amongst tennis players that improper backhand mechanics is one of the main causes for elbow injuries. In fact, the incidence of lateral epicondylitis has been clinically linked to a one-handed backhand, and greater wrist extension and pronation activity [24]. Some tennis instructors teach a double-hand backstroke, a stroke which minimizes wrist pronation, and/or a stroke that avoids leading with the elbow to minimize the potential for improper mechanics.

Traditionally, the term tennis elbow has been synonymous with lateral epicondylitis. However, the term epicondylitis suggests an inflammatory process, and as Boyer has pointed out – there is no evidence of acute or chronic inflammation in the publications examining the pathological specimens of patients who were operated on for this condition [25]. Repetitive muscle contraction will produce tensile forces within a tendon of an involved muscle, potentially causing micro trauma. If the natural healing process fails, pathological alteration of tissue results in a fibroblastic and vascular response called angiofibroblastic degeneration [3, 4, 5

and 6]. The pathology of tennis elbow is thus most likely to be angiofibroblastic degeneration at the origin of the wrist extensors, and more suitably referred to as lateral epicondylosis [3, 4, 5 and 6]. The current understanding of this condition places the specific pathology at the extensor carpi radialis brevis [3, 4, 26 and 27]. The origin of the extensor carpi radialis brevis is covered by the extensor carpi radialis longus and the extensor communis origin. In fact, the common extensor origin consists of the fused tendons of extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi, and extensor carpi ulnaris.

Biomechanical studies of tensile force at the lateral epicondyle further indicate that stretching extensor carpi radialis brevis, extensor digitorum communis and the superficial head of the supinator produce a large increase in tensile force at the epicondyle [28]. Obviously, a thorough understanding of the anatomical arrangement of these muscles and their specific actions is necessary to make a correct diagnosis. Additionally, it is important to rule out other differential diagnoses such as capitellum fracture, lateral collateral ligament injury, osteochondritis dissecans, posterior interosseus nerve syndrome, radial head fracture and synovitis [26].

Radiographic analysis of lateral epicondylitis may reveal calcification along the lateral epicondyle. However, radiographs, as an initial step in diagnosing lateral epicondylosis, is not necessary [29]. On the other hand, a diagnostic ultrasound of the common extensor origin can be used to confirm lateral epicondylitis in patients with elbow pain and add additional information in regards to the severity [30].

Most authors suggest that over 90% of patients will respond to conservative care, which may include rest, bracing, strengthening, therapeutic modalities, and steroid injections [3, 31, 32, 33 and 34]. In our study, below the age of 40 years, at 6 months, complete subjective, functional, and clinical recovery had occurred in almost 100% of the patients. From 40 to 60 years of age at 6 months, complete subjective, functional, and clinical recovery had occurred in almost 75% of the patients. Twenty percent of the patients had minor recovery even at 24 months, but their severity became lowered significantly. Over the age of 60 years at 6 months, complete subjective, functional, and clinical recovery had occurred in almost 50% of the patients, the other 50% had minor recovery even at 24 months, but their severity became lowered significantly.

Additionally, it has been reported in cases where surgery was required that over 90% of patients responded well [35]. The attempted meta-analysis in 1992 by Labelle *et al*. reviewed 185 articles on the subject of tennis elbow treatment. However, only a single paper was considered to be of a good quality design for controlled therapeutic trials. They concluded that there was insufficient evidence to support any single current method of treatment [36]. This conclusion was reiterated even more recently in the meta-analysis by Bisset *et al.* that identified 28 randomized controlled trials, which met their minimum criteria [7]. These authors suggested that there was a lack of evidence for the long-term benefit of physical interventions in general [7]. There have been a number of studies comparing therapeutic modalities with placebo for the treatment of soft tissue injuries such as lateral epicondylosis. There is insufficient evidence to support the use of most physiotherapy interventions and only weak evidence for the efficacy of therapeutic ultrasound in the treatment of tennis elbow [7, 36, 37 and 38]. Basford *et al.* assessed patients for pain, tenderness to palpation, grip strength, medication usage, and subjective perception of pain after a double masked, placebo controlled, randomized trial utilizing a low intensity laser. The results of this study showed that there were no significant differences, and they concluded that there was no demonstrable beneficial effect of laser therapy [39]. The 2004 systematic review for the efficacy of splinting for lateral epicondylitis identified early positive, but not conclusive evidence supporting the effectiveness of splinting [40]. Similarly, there have been conflicting results on the use of braces and orthotic devices, which may be useful in the initial stages of therapy [41, 42 and 43]. The ability to control the pain associated with lateral epicondylalgia may be achieved through acupuncture.

A recent systematic review suggested that acupuncture was effective in the short-term relief of lateral epicondyle pain [44]. The Fink *et al*. randomized controlled trial for chronic epicondylitis also showed that real acupuncture points showed a reduction of pain and an improvement of function at early follow-up [45]. More long-term follow-up would be useful to assess whether acupuncture has a greater role than simply pain modulation. In addition to the acupuncture findings, manipulations and/or mobilizations have been suggested to have a hypoalgesic effect.

The works of Strujis *et al*. and Paungmali *et al*. have shown that manipulation of the wrist and mobilization of the elbow may play a role in the management of the pain associated with lateral epicondylitis [46, 47]. The preliminary evidence does suggest that manipulation and mobilization may have some positive effects in the reduction of pain and improvement of function [37]. Historically, a popular choice for treating tendonitis have been deep friction massages. However, as evidenced by the 2002 Cochrane review, there was simply not a large enough sample size to draw any conclusions in regards to control of pain or improvement in function [48]. The concepts of cross-friction techniques have since evolved into an augmented soft tissue mobilization, more commonly known as the "Graston Technique Instrument-Assisted Soft Tissue Mobilization" or simply Graston [49]. The Graston protocol for epicondylosis uses specifically designed stainless steel instruments, which are moved with multidirectional strokes around the bony prominence of the elbow. Preliminary studies utilizing this Graston technique had shown promising results when compared to a traditional physiotherapy protocol in the treatment of lateral epicondylitis [50]. Perhaps the most popular of soft tissue techniques to gain recent notoriety is Active Release Technique or ART®. This therapy is based on the observation that the anatomy of the forearm has traversing tissues situated at oblique angles to one another that are prone to reactive changes producing adhesions, fibrosis, and local edema, and thus pain and tenderness [51, 52]. During active release therapy, the clinician applies a combination of deep digital tension at the area of tenderness and the patient actively moves the tissue through the adhesion site from a shortened to a lengthened position [51, 52]. For example, in order to treat extensor carpi radialis brevis, the clinician applies proximal tension distal to the lateral epicondyle while the patient extends the elbow and pronates and flexes the wrist [51]. In the present study, the physician global evaluation up to the age of 40 years at 2-year follow-up were excellent. At 40 to 60 years of age, it was good to excellent. Over the age of 60 years, it was good. The patient global evaluation was found very good up to the age of 40 years at 2-year follow-up, good to very good between 40 to 60 years and over the age of 60 years it was good.

CONCLUSION

The majority of tennis elbow patients can be treated with non-drug non-invasive forms of treatment, and only selected cases may benefit from more invasive operative treatments. Tennis elbow is certainly a challenging musculoskeletal condition to treat and this is largely due to the lack of definitive evidence for the clinical efficacy of the myriad of treatment approaches seen within the literature.

Acknowledgement

Nil

Conflict of interest

Nil

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