The Effect of Orthoses on Treatment of Lateral Epicondylitis: a Systematic Review

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ABSTRACT

Background: Lateral epicondylitis, or tennis elbow, is one of the common disorders in humans. Despite recommended treatments, there is no definite therapy for this disorder. Therefore, the aim of this paper is to review scientific reports on the effects of orthotic devices for treatment (comparing orthoses with other treatments related to lateral epicondylitis parameters), reducing complications, and improving symptoms of this condition.

Methods: Ovid, Scopus, and Web of science were searched to identify studies which reported the effectiveness of orthotic treatment for lateral epicondylitis from 1996 until 2017. Studies were collected based on the inclusion criteria and a few were selected out of a large number of studies. The PEDro scale was used for the quality assessment of the selected articles.

Results: A total of 43 articles were chosen, 16 articles on Orthotics vs. other nonsurgical treatments, 20 articles on the comparison of different orthotics, and 7 reviews.

Conclusion: Based on the results of the selected papers, there was not sufficient evidence to decide on the effectiveness among several orthoses or for comparing orthotic treatment with other treatment methods. However, it should be emphasized that the use of orthosis can be an acceptable treatment for improving some symptoms of this condition such as pain, grip, pain-free grip, no pain, grip strength, function, ROM, and proprioception. 2019© The Authors. Published by JRSR. All rights reserved.

Introduction

Lateral epicondylitis, or tennis elbow, is one of the common disorders in the upper limb body [1]. Patients have pain and tenderness in extensor origin and lateral epicondyle of the humerus [2]. Lateral epicondylitis is believed to be a tendinosis in the origin of the ECRB (extensor carpi radialis brevis) [3]. The incidence of this condition is reported to be 4 to 7 in every 1000 people and appears between the fourth to the fifth decade of life [4]. Concerning the prevalence, 1-3% are suffering from this condition and their daily life is limited for 6 up to 24 months [5]. Only 5 to 10% of professional tennis players have this condition [6]. It is believed that this condition is caused by microtears in ECRB and extensor digitorum communis [7]. Pain often increases when wrist extension is resisted, or fingers [8], especially the middle finger [9], are extended with a combination of wrist supination. In heavy and repetitive activities involving forearm rotation [10], pain can be felt in distal site of lateral epicondyle of humerus [11].
Different factors are involved in developing this disorder among which microtears in the tendon [12], destructive forces from tendon insertion to humerus [4], radial neuropathy, metabolism or histologic characteristics, and bursitis or necrosis in tendon can be mentioned [13]. These factors can cause degenerative tissue changes in the extensor part of the elbow in people with lateral epicondylitis [14]. These changes are mostly seen in extensor digitorum communis and ECRB tendon [12]. The pain in this condition is radiated from proximal to distal of elbow and patients suffer from reduced proprioception as well as grip strength [15, 16]. Therefore, patients have difficulties in doing their daily tasks [17].

In this disorder, treatments can be categorized into two groups including surgery and non-surgery [18]. The most common surgery for this disorder is tenotomy [14]. Kayatha has reported that this type of surgery is effective for lateral epicondylitis but can be costly [19]. Orthotic treatment, corticosteroid injection, laser therapy, occupational therapy, physiotherapy, exercising, and acupuncture are known as the examples of non-surgical treatments for lateral epicondylitis [20]. In mild cases with low inflammation, orthoses are considered as the first therapeutic measure. Orthoses can usually improve grip strength or hand function and reduce pain in people with this disorder [21, 22]. Various orthoses including bands, sleeves, splints, and straps have been used for this purpose [23]. Various studies have suggested the effectiveness or ineffectiveness of orthotic treatments and the advantages of other conservative treatments over orthoses [24-28].

Our aim in this literature review has been to determine the effectiveness of orthotic treatments for lateral epicondylitis.

Some related literature review articles evaluated treatments and mentioned their effectiveness and advantages of one method compared to another. On the other hand, some review articles which only focused on orthoses reported contradiction and lack of reliable results concerning this problem.

**Methods**

In this study, the search strategy was prepared with the following keywords based on the PICO via the electrical databases such as Scopus, Ovid, and Web of science. Additionally, to expand the search, the references of the selected papers were screened to find more relevant articles (Figure 1).

The articles that evaluated the effectiveness of orthoses for patients with lateral epicondylitis and the pain these patients coped with were included. Both randomized and nonrandomized studies which were published since 1996 were included as many literature review papers were published after this year. Additionally, studies which reported patients using one of the orthotic treatments such as splints, braces, bands, and sleeves were included too. The selected studies were categorized into two sections. The first group consisted of those which considered use of the orthoses along with steroids, physiotherapy, and exercise. On the other hand, the second group consisted of the studies that evaluated the effectiveness of the orthotic treatments.

All articles that were selected had at least one of the following aims:
1- Evaluating the amount of pain as well as the positive or negative effect of interventions for this disorder.
2- The time patients spent to gain their proper functional activities.
3- Reporting the extent of grip strength with or without

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<thead>
<tr>
<th>PICO</th>
<th>Keywords</th>
<th>Search Strategy</th>
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<tbody>
<tr>
<td>Population</td>
<td>Lateral epicondylitis, lateral epicondylalgia, tennis elbow, tendonitis, elbow (Lateral* W/2 (epicondylitis OR Epicondylalgia OR epidynosis OR epicondylopathy) OR “tennis elbow” OR (elbow W/2 tendonitis)) AND (orthotic* OR orthesis OR brace OR braces OR bracing OR splint* OR ((elbow OR arm OR forearm) AND (support OR sleeve OR strap OR band))) AND (pain OR grip OR “grip strength” OR function)</td>
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<td>Intervention</td>
<td>Orthotic, orthosis, brace, braces, bracing, bondage, splint, elbow sleeve, elbow strap, elbow band, arm sleeve, arm strap, arm band, forearm sleeve, forearm strap, forearm band</td>
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<tr>
<td>Comparison</td>
<td>Steroid, corticosteroid, stretch, physical therapy, physiotherapy, laser, ultrasound, tape, exercise,</td>
<td></td>
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<tr>
<td>Outcome measure</td>
<td>Pain, pain-free grip, grip strength, function</td>
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</tbody>
</table>

Figure 1: Flow diagram of study selection
pain in the participants of the study.
4- Studying the limitations caused by interventions in
the affected limb or other joints of the body.
In this study, the PEDro scale was used which enjoys
a high reliability and determines the quality of papers
as poor quality (PEDro score ≤3), fair quality (PEDro
score 4-5) and high quality (PEDro score 6-10). The
PEDro scale consists of a checklist of 10 scored yes-or-

<table>
<thead>
<tr>
<th>Ref. No.</th>
<th>Authors Year</th>
<th>Study</th>
<th>Design</th>
<th>Outcome</th>
<th>Results</th>
<th>Pedro Scale</th>
</tr>
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<tbody>
<tr>
<td>[29]</td>
<td>Solveborn 1997</td>
<td>Radial epicondylalgia (‘tennis elbow’): treatment with stretching or forearm band. A prospective study with long-term follow-up including range-of-motion measurements</td>
<td>4 study Subject=185 Stretch=94 Forearm band=91 For 1- 3- 9 month</td>
<td>Pain (100-mm visual analog scale (VAS))</td>
<td>Stretch = Forearm band</td>
<td>6</td>
</tr>
<tr>
<td>[30]</td>
<td>Jensen 2001</td>
<td>Comparison of two different treatments for lateral epicondylitis</td>
<td>A randomized clinical trial, S=60 2 group (1=steroids 2=splint) For 6 weeks</td>
<td>Pain (VAS)</td>
<td>Grip strength (Jamar Hand dynamometer)</td>
<td>4</td>
</tr>
<tr>
<td>[20]</td>
<td>Assendelft 2003</td>
<td>Tennis elbow</td>
<td>Clinical review</td>
<td>Comparison study</td>
<td>Orthosis = no evidence</td>
<td></td>
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<tr>
<td>[31]</td>
<td>Struijs 2004</td>
<td>Conservative treatment of lateral epicondylitis - Brace versus physical therapy or a combination of both - A randomized clinical trial</td>
<td>A randomized clinical trial. 3 group (1=Counterforce brace 2=Physical Therapy 3=Combination)</td>
<td>Pain (VAS)</td>
<td>Grip strength</td>
<td>7</td>
</tr>
<tr>
<td>Oken 2008</td>
<td>The short-term efficacy of laser, brace, and ultrasound treatment in lateral epicondylitis: A prospective, randomized, controlled trial</td>
<td>Prospective randomized-control trial, S=65 3 group (1= laser 2=brace(2week) 3=ultrasound)</td>
<td>Pain</td>
<td>Grip strength</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[33]</td>
<td>Kachanathu 2013</td>
<td>Forearm band versus elbow taping: As a management of lateral epicondylitis</td>
<td>A randomized clinical trial, S=45 3 group (1=band 2=tape 3=combination)</td>
<td>Function</td>
<td>Function= 1&gt;2,3</td>
<td></td>
</tr>
<tr>
<td>[34]</td>
<td>Akkurt 2014</td>
<td>Comparison of high intensity laser therapy and wrist splint in the treatment of lateral epicondylitis</td>
<td>A randomized clinical trial, S=67 2 group (1= laser 2=brace)</td>
<td>Pain (visual analogue scale for pain (VAS))</td>
<td>ROM= 1=2</td>
<td></td>
</tr>
<tr>
<td>[35]</td>
<td>Kayali 2014</td>
<td>The comparison of splint and exercise effectiveness on patients with lateral epicondylitis,</td>
<td>A randomized clinical trial, S=43 2 groups (1= splint 2=exercise)</td>
<td>Pain (visual analogue scale (VAS))</td>
<td>Hand grip strength= 1=2,3</td>
<td></td>
</tr>
</tbody>
</table>

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[27] Tahririan 2014 A randomized clinical trial on comparison of corticosteroid injection with or without splinting versus saline injection with or without splinting in patients with lateral epicondylitis. randomized double-blind clinical trial, S=78 six months 1=splint 2=corticosteroid a prospective, randomized, controlled study 3 group (1=laser 2=placebo 3=counterfece) Pain (visual analog scale (VAS)) Pain= 2>1 Short time

[36] Dundar 2015 4-12 weeks Effectiveness of high-intensity laser therapy and splinting in lateral epicondylitis; a prospective, randomized, controlled study Pain Pain= 1=3 Quality of life Quality of life= 1=3

[26] Salli 2016 Comparison of high intensity laser and epicondylitis bandage in the treatment of lateral epicondylitis A randomized clinical trial, S=65 2 groups (1=Laser 2= forearm band) 6 weeks Pain (activity/rest 0-10 cm VAS) Laser = forearm band Grip strength (Jamper Hand) Function (30-item questionnaire)

[37] Haker E, Lundeberg 1993 Elbow-band, splintage and steroids in lateral epicondylalgia (tennis elbow). Clinical trial Subject=61 Three groups (1= Elbow-band 2= Splint 3= Steroids) For 3 months Pain (VAS) Elbow-band= %36 Splint= %38 Steroids= %42 Quality of life

[38] Strujs 2006 Cost effectiveness of brace, physiotherapy, or both for treatment of tennis elbow A randomized clinical trial, S=patients follow up six months 3 groups (1= brace 2=physiotherapy 3=combination) Pain(VAS) Pain= 3>1=2 Quality of life


[40] Oken 2007 Laser therapy in lateral epicondylitis: Comparison with brace and ultrasound treatment Prospective randomized-control trial, S=65 3 groups (1=laser 2=brace (2week) 3=ultrasound) Pain Pain= 1=3>2 Grip strength Grip strength= 1 better

[41] Bicilioglu 2009 Comparison of the therapeutic approaches of the patients with lateral epicondylitis: Splint versus splint and physical therapy randomized controlled study, S=21 2 groups (1=splint 2=physical therapy) Pain (VAS) Pain= 2 Physical examination Physical examination= 1 Hand and wrist range of motion Hand and wrist ROM= 1 Gripping force (Jamper dynamometer) Gripping force= 2

[42] Strujs 2004 Conservative treatment of lateral epicondylitis: brace versus physical therapy or a combination of both-a randomized clinical trial A randomized clinical trial, 1999 to 2000 3 groups (1=brace 2=Physical Therapy 3=Combination) Pain (VAS) Pain= 2>1,3 Grip strength Grip strength= 1>2<3 ADL= 1>2,3 Activity of life

Table 2: Studies that reported the effect of different types of orthoses

<table>
<thead>
<tr>
<th>Ref. no.</th>
<th>authors year</th>
<th>Study</th>
<th>Design</th>
<th>Outcome</th>
<th>Results</th>
<th>Pedro scale</th>
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</thead>
</table>

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Conservative treatment of lateral epicondylitis: comparison of two different orthotic devices
Clinical trial S=50
2 groups (1=bandage 2=splint)
For 2 and 6 weeks-
Pain at rest (algometer score)
Hand grip strength (A Jamar dynamometer)
2 weeks= bandage (62/50 mm medium 33/3 good 4.2 bad)
Splint (48m 48g 4b)
6 weeks= bandage (29/2m 66/7g 4/2b) splint (28m 72g 0b)

[43] Van de streek 2004
The effect of a forearm/hand splint compared with an elbow band as a treatment for lateral epicondylitis
A randomized clinical trial, S=43
Two groups (1=Band 2=Splint) for six weeks
Max Grip strength (Patient-Rated Forearm Evaluation Questionnaire)

[21] Sadeghi 2013
The immediate effects of orthoses on pain in people with lateral epicondylalgia
S=52
3 group (1=sleeve 2=placebo 3=wrist splint)
3 weeks
Function
Pain
Function

[44] Bisset 2014
Immediate effects of 2 types of braces on pain and grip strength in people with lateral epicondylalgia: a randomized controlled trial
Crossover –double blinded randomized control trial, S= 34
2groups (1=forearm brace 2=forearm elbow brace)
Grip strength
Pressure pain threshold
Pain-free
Grip strength= 1=2
Pressure pain threshold= 1=2

[22] Saremi 2016
A newly designed tennis elbow orthosis with a traditional tennis elbow strap in patients with Lateral Epicondylitis
S=52
3 group (1=sleeve 2=placebo 3=new orthosis)
3 weeks
Pressure of tendon
Grip strength (Jamar dynamometer)
Pressure of tendon= 3 After 48 hours

[45] Batati 2019
The immediate sensorimotor effects of elbow orthoses in patients with lateral elbow tendinopathy: a prospective crossover study.
A randomized clinical trial, S=50
(1= tennis elbow strap 2=elbow sleeve 3=no orthosis)
No fallow up
Pain (activity/rest 0-10 cm VAS)
Pain= 1=2>3>4
Grip strength (Jamar Hand)
Hand Function= 1>2>3
Proprioception in 110°= 2>1>3
Proprioception in 70°= 1>2>3

Strength and pain measures associated with lateral epicondylitis bracing
Clinical trial S=50
4 groups (1=brace 2=placebo 3=elbow support 4=no brace)
Pressure of tendon
Pain (A visual numeric rating scale mounted)
Proprioception (electrical digital goniometer)

[46] Knebel 1999
Effects of the forearm support band on wrist extensor muscle fatigue
Research report S=50 random Forearm Support
Grip strength (Jamar® dynamometer)
Grip strength= no very effect
Fatigue= no effect

[47] Schuss 2000
The effect of epicondylitis bandages for the biomechanical point of view: An experimental model.
11 different epicondylitis bandage
Relieve the tendon
Blood flow
Blood flow= +

[48] Meyer 2002
The effect of the forearm support band on forces at the origin of the extensor carpi radialis brevis:
Clinical pilot study, S=9
Load
Pain (VAS)
Reduce 13-15% load of ECRB
<table>
<thead>
<tr>
<th>Reference</th>
<th>Year</th>
<th>Title</th>
<th>Study Design</th>
<th>Participants</th>
<th>Outcomes</th>
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<tr>
<td>[49]</td>
<td>2002</td>
<td>Markus Walter</td>
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<td>Pain (VAS)</td>
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<td>Biomechanical evaluation of braces used for the treatment of epicondylitis</td>
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<td>Modeled Evidence of Force reduction at the extensor carpi radialis brevis origin with the forearm support band</td>
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<td>Pressure on forearm</td>
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<tr>
<td>[51]</td>
<td>2003</td>
<td>Foley</td>
<td>practice forum</td>
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<td>Pain</td>
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<td></td>
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<td>A full-contact proximal forearm brace</td>
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<td>[52]</td>
<td>2003</td>
<td>Chan</td>
<td>S=15 people all right elbow</td>
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<td>Exercise</td>
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<td>Effect of counterforce forearm bracing on wrist extensor muscles performance</td>
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<td>Muscles performance</td>
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<td>[53]</td>
<td>2004</td>
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<td>Research report, S= 15 (Counterforce Forearm Brace)</td>
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<td>Pain</td>
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<td>the immediate effects of tension of counterforce forearm brace on neuromuscular performance of wrist extensor muscles in subjects with lateral humeral epicondylitis</td>
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<td>ROM</td>
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<td>Threshold pain</td>
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<td>[54]</td>
<td>2004</td>
<td>Borkholder</td>
<td>Systematic review 11/98 study 6 splints in 5 classmen</td>
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<td>Pain</td>
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<td>The efficacy of splinting for lateral epicondylitis: A systematic review</td>
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<td>Grip strength</td>
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<td>The effects of splinting on outcomes for epicondylitis</td>
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<td>[56]</td>
<td>2006</td>
<td>Miriam faes</td>
<td>A randomized clinical trial, S= 63 2 groups (1=brace 2=no brace)</td>
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<td>Pain</td>
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<td>Dynamic extensor brace for lateral epicondylitis</td>
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<td>Tennis elbow counterforce bracing</td>
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<td>[17]</td>
<td>2009</td>
<td>Jafarian</td>
<td>Randomized cross-over, S= 52 4 groups (1=sleeve 2=wrist splint 3=elbow strap 4=placebo)</td>
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<td>Free pain strength (100-mm visual analog scale)</td>
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<td></td>
<td>The immediate effect of orthotic management on grip strength of patients with lateral epicondylitis</td>
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<td>Max grip strength (digital analyzer grip dynamometer)</td>
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<td>Grip force</td>
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<td>Improvement grip strength</td>
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<td>A prospective randomized study</td>
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<td>Function</td>
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<td>S=70 (74 elbow) 2groups (1=forearm strap 2=brace 2=wrist splint)</td>
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<tr>
<td>[8]</td>
<td>2010</td>
<td>Shamsoddini</td>
<td>Immediate effects of counterforce forearm brace on grip strength and wrist extension force in patients with lateral epicondylitis</td>
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<td>Force grip</td>
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<td>S=50 2 groups (1=bandage 2=splint) 12 months</td>
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<td>Grip strength (Jamar dynamometer)</td>
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<td>Wrist extension Rom effect</td>
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<td>ROM=1=2</td>
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</table>
no questions pertaining to the internal validity and the statistical information provided. If a paper has a criterion mentioned in PEDro, then it receives one point. In the end, the studies with greater and less than 6 points were categorized as high-quality and low-quality articles respectively.

Then, all the articles were categorized to be evaluated, compared, and analyzed in an advanced method. All studies were classified into these four groups:

1- Studies that compared orthotic treatment with other non-surgical interventions.

2- Studies that reported the effect of different types of orthoses.

Results

A total of 72 articles were determined and subdivided in two groups: 16 articles were related to Orthotics vs. other nonsurgical treatments; 20 articles dealt with comparing different orthotics; and 7 reviews.

1- Studies that compared orthotic treatment with other non-surgical interventions

Nineteen studies were selected for this group (Table 1):

2- Studies that reported the effect of different types of orthoses

A total of 24 studies were selected for this group (Table 2):

Discussion

Lateral epicondylitis or tennis elbow is a common disorder among humans. In this condition, pain increases with wrist dorsiflexion and extension along with wrist supination and the pressure of hand grips. Various orthotic treatments such as supportive braces, straps, bands, and sleeves have been used to limit dangerous movements which could cause pain in lateral epicondyle. There are few studies on the effectiveness of orthotic treatment in this disorder, but none of them provided enough evidence to support the usefulness of orthoses. Additionally, the quality as well as the sample size of these studies have been low. Most of them have evaluated the immediate effect and had a short-term follow-up. In selected papers, various methods including orthotic treatment, corticosteroid injection, laser therapy, occupational therapy, physiotherapy, exercising, acupuncture, and etc. were discussed. There was no valid evidence to support the higher efficiency of orthoses over to other conservative treatments.

For pain, many studies have reported the effectiveness of orthoses in reducing pain for patients with lateral epicondylitis. Some of these papers suggested the higher efficiency of orthoses compared to other treatments. Forearm band had a better result in reducing pain compared to stretching band [29]. Cock-up splint and corticosteroid injection had a similar effect in reducing pain [30]. The effectiveness of counterforce brace was shown to be far less than that of physiotherapy but it was similar in cases when both were used. Elbow orthoses had a better effect compared to physiotherapy and laser therapy [42]. Laser therapy had a better outcome compared to ultrasound and both treatments had a better result compared to counterforce in reducing pain [32]. These differences in reducing pain were also mentioned in other studies [1, 25, 27, 36, 38, 47, 59, 60].

For grip strength, many studies have reported the effectiveness of orthoses in improving grip strength for patients with lateral epicondylitis whereby they felt normal and did not have any pain. Some studies mentioned the higher efficiency of orthoses compared to other treatments. Orthotic treatment and corticosteroid injection had a similar effect in improving grip strength. Likewise, laser therapy and counterforce brace had a similar effect in improving grip strength [3]. On the other hand, counterforce brace, exercise, and their combination had no significant effect on grip strength [34]. Counterforce brace and elbow orthoses showed a very a similar effect [43]. These differences in improving or reducing grip strength were also mentioned in other studies [7, 17, 21, 22, 44, 60-62]. Counterforce brace and elbow sleeve reported to be effective at increasing proprioception or boosting the joint position reproduction sense in different angles [38].

Many studies reported the effectiveness of orthoses in improving function, the range of motion, and other treatment parameters for patients with lateral epicondylitis. Some studies mentioned the higher efficiency of orthoses compared to other treatments. Orthotic treatment had a significant effect compared to physiotherapy and laser therapy in improving function [32]. On the other hand, laser therapy showed a better result compared to orthoses [34]. Laser therapy and forearm band had a similar effect in improving hand function [26]. However, forearm band had no effect in the range of motion [46]. Some papers reported improvement in pain [6, 59] and function [6, 52, 59] as well as grip strength [8] and wrist extension [43]. There were two studies which did not find any improvement in pain [52, 53] with one study reporting no effect on ROM [8].

Limitations of this study:

1- Difficulties in gaining access to all papers

2- Not enough evidence about the effectiveness of orthoses

3- Lack of a comprehensive study comparing several orthoses

Additionally, no study had evaluated the effect of orthoses on proprioception of elbow joint and future studies are proposed to consider this parameter.

Conclusion

Based on the conflicting results of existing studies, it is not possible to judge the effectiveness of orthoses or to determine whether they are more effective than other treatment methods. However, it can be mentioned that in some treatment parameters such as reducing the treatment costs, orthoses are appropriate and more effective. Additionally, it can be concluded from this literature review that there are few studies on some issues such as proprioception of elbow joint and coordinated movements of shoulder, elbow, wrist and
References


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