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Review Article

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.

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].

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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.

PICO	Keywords	Search Strategy
Population	Lateral epicondylitis, lateral epicondylalgia, lateral epicondylitis, tennis elbow, tendonitis, elbow	(Lateral* W/2 (epicondylitis OR Epicondylalgia OR epicondylosis OR epicondylopathy) OR "tennis elbow" OR (elbow W/2 tendonitis)) AND (orthotic* OR orthoses 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)
Intervention	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	
Comparison	Steroid, corticosteroid, stretch, physical therapy, physiotherapy, laser, ultrasound, tape, exercise,	
Outcome measure	Pain, pain-free grip, grip strength, function	

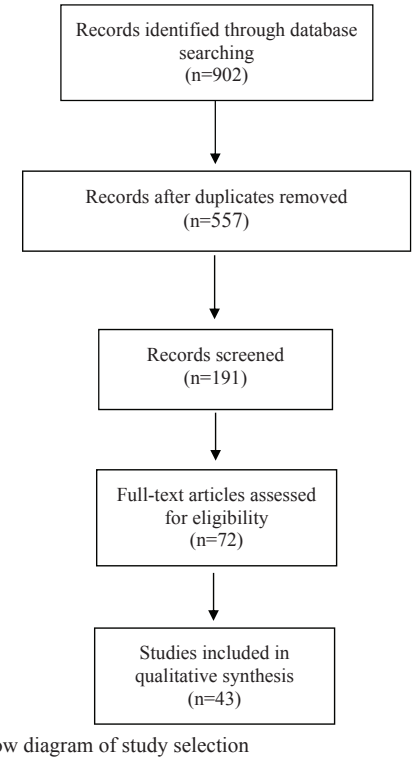

Figure 1: Flow diagram of study selection

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

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 quaility (PEDro score 4-5) and high quality (PEDro score 6-10). The PEDro scale consists of a checklist of 10 scored yes-or-

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

Ref. No.	Authors Year	Study	Design	Outcome	Results	Pedro Scale
[29]	Solveborn 1997	Radial epicondylalgia ('tennis elbow'): treatment with stretching or forearm band. A prospective study with long-term follow-up including range-of-motion measurements	4 study Subject=185 Stretch=94 Forearm band=91 For 1- 3- 9 month	Pain (100-mm visual analog scale (VAS)	Stretch = Forearm band short time= Stretch> Forearm band	6
[30]	Jensen 2001	Comparison of two different treatments for lateral epicondylitis	A randomized clinical trial, S=60 2 group (1=steroids 2=splint) For 6 weeks	Pain (VAS) Grip strength (Jamper Hand dynamometer)	Steroid = splint	4
[20]	Assendelft 2003	Tennis elbow	Clinical review	Comparison study	Orthosis = no evidence	
[31]	Struijs 2004	Conservative treatment of lateral epicondylitis - Brace versus physical therapy or a combination of both - A randomized clinical trial	A randomized clinical trial. 3 group (1=Counterforce brace 2=Physical Therapy 3=Combination)	Pain (VAS) Grip strength Activity of life	Pain= 2>1,3 Grip strength= 1=2=3 ADL= 1>2,3	7
[32]	Buchbinder 2008	Tennis elbow	Clinical evidence Review (1998-2006) 1=Physiotherapy 2=Orthosis 3=Laser	Pain Function	Pain= 2>1,3 Function= 2>1,3	
[3]	Johnson 2007	Treatment of lateral epicondylitis	MultiMate Systematic review (1=brace 2=strap 3=Steroid 4=Physiotherapy)	Pain Grip strength Function	Pain=2 Grip strength=2 Function=1	
	Oken 2008	The short-term efficacy of laser, brace, and ultrasound treatment in lateral epicondylitis: A prospective, randomized, controlled trial	Prospective randomized-control trial, S=65 3 group (1=laser 2=brace(2week) 3=ultrasound)	Pain Grip strength	Pain= 1=3>2 Grip strength= 1 better	6
[33]	Kachanathu 2013	Forearm band versus elbow taping: As a management of lateral epicondylitis	A randomized clinical trial, S=45 3 group (1=band 2=tape 3=combination)	Function Pain free grip	Function= 1>2,3 Pain free grip= 1>2,3	5
[34]	Akkurt 2014	Comparison of high intensity laser therapy and wrist splint in the treatment of lateral epicondylitis	A randomized clinical trial, S=67 2 group (1=laser 2=brace)	Pain (visual analogue scale for pain (VAS)) ROM Grip strength (hand grip strength test) Function	Pain= 1=2 ROM= 1=2 Grip strength= 1=2 Function= 1>2	4
[35]	Kayali 2014	The comparison of splint and exercise effectiveness on patients with lateral epicondylitis,	A randomized clinical trial, S=43 2 groups (1=splint 2=exercise)	Pain (visual analogue scale (VAS) Hand grip strength, (dynamometer) Satisfaction Function ROM (goniometer)	Pain= 1=2 Hand grip strength= 1=2 Satisfaction= 1=2 Function= 1=2 All= 2>1	3

[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	Pain (visual analog scale (VAS))	Pain= 2>1 Short time	6
[36]	Dundar 2015 4-12 weeks	Effectiveness of high-intensity laser therapy and splinting in lateral epicondylitis; a prospective, randomized, controlled study	a prospective, randomized, controlled study 3 group (1=laser 2=placebo 3=counterforce)	Pain Quality of life	Pain= 1=3 Quality of life= 1=3	7
[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) Grip strength (Jamper Hand) Function (30-item questionnaire) Quality of life	Laser = forearm band	5
[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	5
[38]	Struijs 2006	Cost effectiveness of brace, physiotherapy, or both for treatment of tennis elbow	A randomized clinical trial, S=patients fallow up six months 3 groups (1= brace 2=physiotherapy 3=combination)	Pain(VAS)	Pain= 3>1=2	8
[39]	Luginbühl 2008	No effect of forearm band and extensor strengthening exercises for the treatment of tennis elbow: a prospective randomized study	a prospective randomized study, S=76 1991 to 2001 3group (1=band 2= exercise 3= combination)	Pain (VAS) Grip strength	Pain= 1=2=3 Grip strength= no effect	4
[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 Grip strength	Pain= 1=3>2 Grip strength= 1 better	5
[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) Physical examination Hand and wrist range of motion Gripping force (Jamper dynamometer)	Pain= 2 Physical examination= 2 Hand and wrist ROM= 1 Gripping force= 2	3
[42]	Struijs 2004 Counterforce brace	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) Grip strength Activity of life	Pain= 2>1,3 Grip strength= 1=2=3 ADL= 1>2,3	7

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

Ref. no.	authors year	Study	Design	Outcome	Results	Pedro scale
[25]	Bisset 2005	A systematic review and meta-analysis of clinical trials on physical interventions for lateral epicondylalgia	A systematic review and meta-analysis of clinical trials	Pain (VAS) Grip strength	Orthosis and taping= no effect	

[1]	Altan 2008	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 medium 33/3good 4.2 bad) Splint (48m 48g 4b) 6 weeks= bandage (29/2m 66/7g 4/2b) splint (28m 72g 0b) Splint > bandage	4
[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 group (1=Band 2=Splint) for six weeks	Pain (scale from 1 to 10) Max Grip strength (Patient□Rated Forearm Evaluation Questionnaire) Function	Band = splint	3
[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	Pain Function	Pain= 1=3>2 Function= 3	5
[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)	Pain-free Grip strength Pressure pain threshold	Pain-free= 1=2 Grip strength= 1=2 Pressure pain threshold= 1=2	8
[22]	Saremi 2016	A newly designed tennis elbow orthosis with a traditional tennis elbow strap in patients with Lateral Epicondylitis	non-randomized double-blind clinical trial, S=12 3 groups (1=no orthoses 2=old orthosis 3=new orthosis	Pain (VAS) Grip strength (Jamar dynamometer) Pressure of tendon	Pain= 3>2>1 Grip strength= 3>2>1 Pressure of tendon= 3 After 48 hours	5
[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) Grip strength (Jamper Hand) Hand Function (nine holes peg test) Proprioception (electrical digital goniometer)	Pain= 1=2>3 Grip strength= 1=2>3 Hand Function= 1>2.3 Proprioception in 110°= 2>1>3 Proprioception in 70°= 1>2>3	5
[16]	Wuori 1998	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)	Pain (A visual numeric rating scale mounted)	Pain= 1=2=3=4	5
[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) Fatigue ROM	Grip strength= no very effect Fatigue= no effect ROM= no effect	3
[47]	Schsuss 2000	The effect of epicondylitis bondages for the biomechanical point of view: An experimental model.	11 different epicondylitis bandage P= 30 N	Relieve the tendon Pressures Blood flow	relieve the tendon= + Pressures= + Blood flow= +	2
[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	Pain (VAS) Load	Reduce 13-15% load of ECRB	3

[49]	Markus walter 2002	Biomechanical evaluation of braces used for the treatment of epicondylitis		Pain (VAS) Offloading	Brace= reduce load padding is Effective	3
[50]	Meyer 2003	Modeled Evidence of Force reduction at the extensor carpi radialis brevis origin with the forearm support band	Clinical Pilot Study, S=5 cadaver	Pressure Force on forearm	Pressure= - Force on forearm= -	2
[51]	Foley 2003	A full-contact proximal forearm brace	practice forum	Pain Function Exercise	Pain= - Function= + Exercise= +	
[52]	Chan 2003	Effect of counterforce forearm bracing on wrist extensor muscles performance	S=15 people (all right elbow)	Pain (VAS) Muscles performance	Pain= - Muscles Performance= no effect	4
[53]	Ng 2004	the immediate effects of tension of counterforce forearm brace on neuromuscular performance of wrist extensor muscles in subjects with lateral humeral epicondylosis	Research report, S=15 (Counterforce Forearm Brace)	Pain ROM Threshold pain	Pain= - ROM= + Threshold pain= +	4
[54]	Borkholder 2004	The efficacy of splinting for lateral epicondylitis: A systematic review	Systematic review 11/98 study 6 splints in 5 classmen	Pain Grip strength	Splint= no effect Effective= 2 study	
[55]	Derebery 2005	The effects of splinting on outcomes for epicondylitis	A randomized clinical trial, S=4614		Function = +	3
[56]	Miriam faes 2006	Dynamic extensor brace for lateral epicondylitis	A randomized clinical trial, S=63 2 groups (1=brace 2=no brace)	Pain Function Grip strength	Pain= - Function= + Grip strength= no effect	6
[57]	Kroslak 2007	Tennis elbow counterforce bracing	A systematic review Studies and clinical practices Review (1991-2007) (counterforce brace)	Grip strength (a Jamar™ dynamometer) Pressure Fatigue	Grip strength= + Pressure= - Fatigue= -	
[17]	Jafarian 2009	The immediate effect of orthotic management on grip strength of patients with lateral epicondylosis	Randomized cross-over, S=52 4 groups (1=sleeve 2=wrist splint 3=elbow strap 4=placebo)	Free pain strength (100-mm visual analog scale) Max grip strength (digital analyzer grip dynamometer) Grip force Improvement grip strength	Free pain strength= 1=2=3>4 Max grip strength= 1=2=3=4 Grip force= 1=2=3>4 Improvement grip strength= 1=3	4
[6]	Garg 2010	A prospective randomized study comparing a forearm strap brace versus a wrist splint for the treatment of lateral epicondylitis	A prospective randomized study S=70 (74 elbow) 2groups (1=forearm strap 2=brace 2=wrist splint)	Pain (VAS) Function	Pain= wrist splint Function= forearm strap Brace (counterforce) is better	4
[8]	Shamsoddini 2010	Immediate effects of counterforce forearm brace on grip strength and wrist extension force in patients with lateral epicondylosis	S=50 2 groups (1=bandage 2=splint) 12 months	Force grip Grip strength (Jamar dynamometer) Wrist extension Rom effect	Force grip= - Grip strength= + Wrist extension= + Rom= no effect	4
[58]	Najafi 2016	Effect of a new hand-forearm splint on grip strength, pain, and function in patients with tennis elbow	clinical trial, S=28 2 groups (1=healthy 2=new splint)	Pain (visual analog scale (VAS)) Function Reduce pressure ROM (dynamometer)	Pain= 2>1 Function= 2>1 Reduce Pressure= 2>1 ROM=1>2	4

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

hand. Therefore, more evidence is required for a more conclusive evaluation.

Conflict of interest: None declared.

References

1. Altan, L. and E. Kanat, Conservative treatment of lateral epicondylitis: comparison of two different orthotic devices. Clinical Rheumatology, 2008. 27(8): p. 1015-1019.
2. Nourbakhsh, M.R.P.T.P.O.C.S. and F.J.P.T.D.O.C.S.F. Fearon, The Effect of Oscillating-energy Manual Therapy on Lateral Epicondylitis: A Randomized, Placebo-control, Double-blinded Study. Journal of Hand Therapy January, 2008. 21(1): p. 4-14.
3. Johnson, G.W., et al., Treatment of lateral epicondylitis. American Family Physician, 2007. 76(6): p. 843-848.
4. Staples, M.P., et al., A randomized controlled trial of extracorporeal shock wave therapy for lateral epicondylitis (tennis elbow). Journal of Rheumatology, 2008. 35(10): p. 2038-2046.
5. Tosun, H.B., et al., Comparison of the effects of sodium hyaluronate-chondroitin sulphate and corticosteroid in the treatment of lateral epicondylitis: a prospective randomized trial. Journal of Orthopaedic Science, 2015. 20(5): p. 837-843.
6. Garg, R., et al., A prospective randomized study comparing a forearm strap brace versus a wrist splint for the treatment of lateral epicondylitis. Journal of Shoulder and Elbow Surgery, 2010. 19(4): p. 508-512.
7. Faes, M., et al., A dynamic extensor brace reduces electromyographic activity of wrist extensor muscles in patients with lateral epicondylalgia. Journal of Orthopaedic & Sports Physical Therapy, 2006. 36(3): p. 170-178.
8. Shamsoddini, A., et al., Immediate effects of counterforce forearm brace on grip strength and wrist extension force in patients with lateral epicondylosis. Hong Kong Journal of Occupational Therapy, 2010. 20(1): p. 8-12.
9. Forogh, B., et al., The effects of a new designed forearm orthosis in treatment of lateral epicondylitis. Disability and Rehabilitation: Assistive Technology, 2012. 7(4): p. 336-339.
10. Orchard, J. and A. Kountouris, Management of tennis elbow Authors' reply. British Medical Journal, 2011. 342.
11. Nimgade, A., M. Sullivan, and R. Goldman, Physiotherapy, steroid injections, or rest for lateral epicondylosis? What the evidence suggests. Pain Practice, 2005. 5(3): p. 203-215.
12. Kraushaar, B.S. and R.P. Nirschl, Current concepts review-tendinosis of the elbow (Tennis Elbow). Clinical features and findings of histological, immunohistochemical, and electron microscopy studies. JBJS, 1999. 81(2): p. 259-278.
13. Lam, L.K.Y. and G.L.Y. Cheing, Effects of 904-nm low-level laser therapy in the management of lateral epicondylitis: a randomized controlled trial. Photomedicine and laser surgery, 2007. 25(2): p. 65-71.
14. Lakhey, S., et al., Percutaneous extensor tenotomy for chronic tennis elbow using an 18G needle. Kathmandu University medical journal (KUMJ), 2007. 5(4): p. 446-448.
15. Anderson, M.A. and R.A. Rutt, The effects of counterforce bracing on forearm and wrist muscle function. Journal of Orthopaedic and Sports Physical Therapy, 1992. 15(2): p. 87-91.
16. Wuori, J.L., et al., Strength and pain measures associated with lateral epicondylitis bracing. Archives of Physical Medicine and Rehabilitation, 1998. 79(7): p. 832-837.
17. Jafarian, F.S., E.S. Demneh, and S.F. Tyson, The Immediate Effect of Orthotic Management on Grip Strength of Patients With Lateral Epicondylosis. Journal of Orthopaedic & Sports Physical Therapy, 2009. 39(6): p. 484-489.
18. Goguin, J.-P. and F. Rush, Lateral epicondylitis. What is it really? Orthopaedics and Trauma, 2003. 17(5): p. 386-389.
19. Kayatha, N., et al., Treatment Outcome of Tennis Elbow by Percutaneous Needle Tenotomy. Medical Journal of Shree Birendra Hospital, 2013. 11(2): p. 32-35.
20. Assendelft, W., et al., Tennis elbow. BMJ (Clinical research ed.), 2003. 327(7410): p. 329.
21. Sadeghi-Demneh, E. and F. Jafarian, The immediate effects of orthoses on pain in people with lateral epicondylalgia. Pain Research and Treatment, 2013. 2013.
22. Saremi, H., V. Chamani, and R. Vahab-Kashani, A Newly Designed Tennis Elbow Orthosis With a Traditional Tennis Elbow Strap in Patients With Lateral Epicondylitis. Trauma Monthly, 2016. 21(3).
23. Struijs, P.A., et al., Orthotic devices for the treatment of tennis elbow, Review. Cochrane Database of Systematic Reviews, 2002. 1: p. CD001821.
24. Nilsson, P., E.C. Lindgren, and J. Månsson, Lateral epicondylalgia. A quantitative and qualitative analysis of interdisciplinary cooperation and treatment choice in the Swedish health care system. Scandinavian Journal of Caring Sciences, 2012. 26(1): p. 28-37.
25. Bisset, L., et al., A systematic review and meta-analysis of clinical trials on physical interventions for lateral epicondylalgia. British Journal of Sports Medicine, 2005. 39(7): p. 411-422.
26. Salli, A., et al., Comparison of high intensity laser and epicondylitis bandage in the treatment of lateral epicondylitis. Archives of rheumatology, 2016. 31(3): p. 234.
27. Tahririan, M.A., et al., 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. Journal of Research in Medical Sciences, 2014. 19(9): p. 813-818.
28. Beard, J.M., S.M. Safranek, and D. Spogen, What treatment works best for tennis elbow? Journal of Family Practice, 2009. 58(3): p. 159-161.
29. Solveborn, S.A., Radial epicondylalgia ('tennis elbow'): treatment with stretching or forearm band. A prospective study with long-term follow-up including range-of-motion measurements. Scandinavian Journal of Medicine & Science in Sports, 1997. 7(4): p. 229-237.
30. Jensen, B., H. Bliddal, and B. Danneskiold-Samsøe, Comparison of two different treatments of lateral humeral epicondylitis "tennis elbow". A randomized controlled trial. Ugeskrift for Laeger, 2001. 163(10): p. 1427-1431.
31. Struijs, P.A.A., et al., Conservative treatment of lateral epicondylitis - Brace versus physical therapy or a combination of both - A randomized clinical trial. American Journal of Sports Medicine, 2004. 32(2): p. 462-469.
32. Buchbinder, R., S.E. Green, and P. Struijs, Tennis elbow. BMJ clinical evidence, 2008. 1117.
33. Kachanathu, S.J., et al., Forearm band versus elbow taping: As a management of lateral epicondylitis. Journal of Musculoskeletal Research, 2013. 16(1).
34. Akkurt, E., et al., Comparison High Intensity Laser Therapy and Wrist Splint in the Treatment of Lateral Epicondylitis. Arthritis & Rheumatology 2014. 66: p. S491.
35. Kayali Y, I.N.G.N., The comparison of splint and exercise effectiveness on patients with lateral epicondylitis. Fizyoterapi Rehabilitasyon, 2014. 25(1): p. S95.
36. Dundar, U., et al., Effectiveness of high-intensity laser therapy and splinting in lateral epicondylitis; a prospective randomized controlled study. Lasers in Medical Science, 2015. 30(3): p. 1097-1107.
37. Haker, E. and T. Lundeberg, Elbow-band, splintage and steroids in lateral epicondylalgia (tennis elbow). Pain Clinic, 1993. 6(2): p. 103-112.
38. Struijs Pa, K.-d.B.I.B.v.T.M.W.v.D.C.N.B.L.M.A.W.J., Cost effectiveness of brace, physiotherapy, or both for treatment of tennis elbow. British journal of sports medicine, 2006. 40(7): p. 637-43.
39. Luginbühl, R., F. Brunner, and A.G. Schneeberger, No effect of forearm band and extensor strengthening exercises for the treatment of tennis elbow: a prospective randomised study. La Chirurgia degli organi di movimento, 2008. 91(1): p. 35-40.
40. Oken, O., et al., Laser therapy in lateral epicondylitis: Comparison with brace and ultrasound treatment. Annals of the Rheumatic Diseases, 2007. 66: p. 241-241.
41. Bicilioğlu, C., et al., Comparison of the therapeutic approaches of the patients with lateral epicondylitis: Splint versus splint and physical therapy. Journal of Rheumatology and Medical Rehabilitation, 2009. 20(4): p. 120-125.
42. Struijs Pa, K.G.M.A.W.J.V.D.C.N., Conservative treatment of lateral epicondylitis: brace versus physical therapy or a combination of both-a randomized clinical trial. The American journal of sports medicine, 2004. 32(2): p. 462-9.
43. Van De Streek, M.D., et al., The effect of a forearm/hand splint compared with an elbow band as a treatment for lateral epicondylitis. Prosthetics and Orthotics International, 2004. 28(2): p. 183-189.

44. Bisset, L.M., N.J. Collins, and S.S. Offord, Immediate Effects of two Types of Braces on Pain and Grip Strength in People With Lateral Epicondylalgia: A Randomized Controlled Trial. Journal of Orthopaedic & Sports Physical Therapy, 2014. 44(2): p. 120-128.
45. Barati, H., et al., The immediate sensorimotor effects of elbow orthoses in patients with lateral elbow tendinopathy: a prospective crossover study. Journal of shoulder and elbow surgery, 2019. 28(1): p. e10-e17.
46. Knebel, P.T., et al., Effects of the forearm support band on wrist extensor muscle fatigue. Journal of Orthopaedic & Sports Physical Therapy, 1999. 29(11): p. 677-685.
47. Schauss, S., et al., The effect of epicondylitis bondages for the biomechanical point of view: An experimental model. Zeitschrift Fur Orthopadie Und Ihre Grenzgebiete, 2000. 138(6): p. 492-495.
48. Meyer, N.J., et al., The effect of the forearm support band on forces at the origin of the extensor carpi radialis brevis: A cadaveric study and review of literature. Journal of Hand Therapy, 2002. 15(2): p. 179-184.
49. Walther, M., et al., Biomechanical evaluation of braces used for the treatment of epicondylitis. Journal of Shoulder and Elbow Surgery, 2002. 11(3): p. 265-270.
50. Meyer, N.J., et al., Modeled evidence of force reduction at the extensor carpi radialis brevis origin with the forearm support band. Journal of Hand Surgery-American Volume, 2003. 28A(2): p. 279-287.
51. Foley, E. and E. Maday, A full-contact proximal forearm brace. Journal of Hand Therapy, 2003. 16(1): p. 59-61.
52. Chan, H.L. and G.Y.F. Ng, Effect of counterforce forearm bracing on wrist extensor muscles performance. American Journal of Physical Medicine and Rehabilitation, 2003. 82(4): p. 290-295.
53. Ng, G.Y.F. and H.L. Chan, The Immediate Effects of Tension of Counterforce Forearm Brace on Neuromuscular Performance of Wrist Extensor Muscles in Subjects with Lateral Humeral Epicondylosis. Journal of Orthopaedic and Sports Physical Therapy, 2004. 34(2): p. 72-78.
54. Borkholder, C.D., V.A. Hill, and E.E. Fess, The efficacy of splinting for lateral epicondylitis: A systematic review. Journal of Hand Therapy, 2004. 17(2): p. 181-199.
55. Derebery, V.J., et al., The effects of splinting on outcomes for epicondylitis. Archives of Physical Medicine and Rehabilitation, 2005. 86(6): p. 1081-1088.
56. Faes, M.M., et al., Dynamic Extensor Brace for Lateral Epicondylitis. Clinical Orthopaedics & Related Research January, 2006. 442: p. 149-157.
57. Kroslak, M. and G.A.C. Murrell, Tennis elbow counterforce bracing. Techniques in Shoulder and Elbow Surgery, 2007. 8(2): p. 75-79.
58. Najafi, M., et al., Effect of a new hand-forearm splint on grip strength, pain, and function in patients with tennis elbow. Prosthetics and Orthotics International, 2016. 40(3): p. 363-368.
59. Juul-Kristensen, B., et al., Poorer elbow proprioception in patients with lateral epicondylitis than in healthy controls: A cross-sectional study. Journal of Shoulder and Elbow Surgery, 2008. 17(1): p. 72S-81S.
60. Takasaki, H., et al., Strain reduction of the extensor carpi radialis brevis tendon proximal origin following the application of a forearm support band. Journal of Orthopaedic & Sports Physical Therapy, 2008. 38(5): p. 257-261.
61. Ng, G., The effects of forearm brace tension on neuromuscular performance in subjects with lateral humeral epicondylosis: A review. International Sportmed Journal, 2005. 6(2): p. 124-129.
62. Barrington, J.M.D. and W.D.M.D. Hage, Lateral epicondylitis (tennis elbow): nonoperative, open, or arthroscopic treatment? Current Opinion in Orthopaedics, 2003. 14(4): p. 291-295