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Research Article

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Are there Effective Ultrasound Parameters in the Management of Lateral Elbow Tendinopathy? A Systematic Review of the Literature

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Abstract

Objective: Lateral elbow tendinopathy (LET) is a common clinical condition, and a wide array of physiotherapy treatments is used for treating LET. One of the most common physiotherapy modality is the ultrasound. Ultrasound is a dose response modality. The aim of the present article was to determine the effective ultrasound parameters in the management of (LET) and to provide recommendations based on this evidence.

Methods: Randomized controlled trials (RCTs) identified by a search strategy in six databases were used in combination with reference checking. RCTs that included positive effects with ultrasound, description of ultrasound parameters in details, patients with LET, and at least one of the clinically relevant outcome measure were selected. The Pedro scale was used to analyse the results.

Results: None RCTs fulfilled the criteria and therefore all the conducted trials were excluded in the review. **Conclusions:** Recommendations for the ultrasound parameters in the management of LET were based on animal studies and on studies in conditions similar to LET in clinical behavior and histopathological appearance. Further research with well-designed RCTs is needed to establish the absolute and relative effectiveness of this intervention with the recommended parameters for LET.

Keywords: Lateral elbow tendinopathy; Lateral epicondylitis; Tennis elbow; Ultrasound

Introduction

Lateral elbow tendinopathy (LET), commonly referred to as lateral epicondylitis, lateral epicondylalgia, lateral epicondylosis and/or tennis elbow is one of the most common lesions of the arm. However, LET is the most appropriate term to use in clinical practice because all the other terms make reference to inappropriate etiological, anatomical and pathophysiological terms [1]. The condition is usually defined as a syndrome of pain in the area of the lateral epicondyle [2-4] that may be degenerative or failed healing tendon response rather than inflammatory [5]. Hence, the increased presence of fibroblasts, vascular hyperplasia, proteoglycans and glycosaminoglycans together with disorganized and immature collagen may all take place in the absence of inflammatory cells and prostaglandins [5]. The origin of the extensor carpi radialis brevis (ECRB) is the most commonly affected structure [5]. It is generally a work-related or sport-related pain disorder. The dominant arm is commonly affected, the peak prevalence of LET is between 30 and 60 years of age, [2,6] and the disorder appears to be of longer duration and severity in women [2,6,7].

Pain and decreased function are the main complaints of patients with LET [2,5]. Although the signs and symptoms of LET are clear and its diagnosis is simple, to date no ideal treatment has emerged. Many clinicians advocate a conservative approach as the treatment of choice for LET [2,5]. Physiotherapy is a conservative treatment that is usually recommended for LET patients [8]. A wide array of physiotherapy treatments have been recommended for the management of LET [9-11]. These treatments have different theoretical mechanisms of action, but all have the same aim: to reduce pain and improve function. Such a variety of treatment options suggests that the optimal treatment strategy is not known, and more research is needed to discover the most effective treatment in patients with LET.

Ultrasound has attracted much interest in the last decades as it has been applied to common musculoskeletal conditions such as LET by physiotherapists and occupational therapists. Its effectiveness has been evaluated in four previously published systematic reviews, which have addressed the effectiveness of conservative treatments for LET [9,10,12,13]. The conclusion of these four systematic reviews was that there was a lack of scientific evidence supporting physiotherapy treatments such as ultrasound for LET and demonstrate the importance of improving the current physiotherapy management of LET. To our knowledge, there has been no review to establish only the effectiveness of ultrasound for LET, such as there are reviews for the effectiveness of low level laser therapy for LET [14,15]. In addition, ultrasound is a dose response modality and no review exists to determine if there are appropriate ultrasound parameters for the management of LET. Therefore, the aim of the present article is not to find out the effectiveness of ultrasound treatment for LET, is to determine the appropriate parameters of ultrasound for the management of LET and to provide recommendations based on this evidence.

Methods

Search strategy

Computerised searches were performed using Medline (from 1966 to February 2013), Embase (from 1988 to February 2013), Cinahl (from 1982 to February 2013), Index to Chiropractic Literature (from 1992 to February 2013), Chirolars (from 1994 to February 2013) and Sports Discus (from 1990 to February 2013) databases. Only English language publications were considered. The following search terms

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"tennis elbow", "lateral epicondylitis", "lateral epicondylalgia", "rehabilitation", "ultrasound", "ultrasound therapy", "management", "clinical trials", and "randomised control trials" were used individually or in various combinations. Other references were identified from existing reviews and other papers cited in the publications searched. Further citations were sought from the reference sections of papers retrieved, from contacting experts in the field, and from the Cochrane Collaboration (last search March 2013), an international network of experts who search journals for relevant citations. Unpublished reports and abstracts were not considered. Keywords and search strategy were selected by the researcher only, without the help of an expert librarian with experience in searching databases to computerized health literature.

Selection of studies

To be included within the review, studies had to fulfill the following conditions: it had to be a RCT, with or without follow up, which included subjects, aged 18 and above treated for LET. RCTs that did not support the use of ultrasound in the management of LET were excluded. The treatment had to be any type of ultrasound evaluated against at least one of the following: (a) placebo; (b) no treatment; (c) another treatment, conservative (physical therapy intervention or medical) or operative. RCTs in which the ultrasound was given as part of the treatment—for example, non-steroidal anti-inflammatory drugs and ultrasound or ultrasound and exercise programme and Extracorporeal Shock Wave Therapy (ESWT) -were excluded, because we would not know how each modality contributed to the results. However, the effectiveness of these management strategies has not been assessed in the literature. Data were sought for one of the following four primary outcome measures: pain (scales or descriptive words), function (scales, tests, or descriptive words), grip strength (pain-free or maximum), and a global measure (overall improvement, proportions of patients recovered, subjective improvement of symptoms). The description of the ultrasound parameters would be in detail.

The titles and abstracts of all studies were assessed for the above eligibility criteria. If it was absolutely clear from information provided in the title and/or abstract that the study was not relevant, it was excluded. If it was unclear from the available abstract and/or the title, the full text article was retrieved. There was no blinding to study author, place of publication, or results. The researcher assessed the content of all full text articles, making the selection criteria.

Quality assessment

The PEDro scale was used to rate the trials for quality. The scored portion of the PEDro scale assesses 8 items pertaining to internal validity and 2 items added to ensure that the statistical results would be interpretable to the reader [16]. For each item on the PEDro scale; a *yes* or *no* response was obtained. A *yes* response earned 1 point, whereas a *no* received zero points, for a possible cumulative score of 10 points. The closer the score was to 10, the better the quality of the study. Methodological quality of each trial was independently assessed by the author of the study.

Data abstraction

Raw data on means for all outcomes, as well as the authors' report of the study results, were extracted from the full manuscripts by the reviewer. Data on adverse events were abstracted from the studies. Furthermore, basic data were extracted including characteristics of participants (e.g., age, gender, previous treatments, and duration of disorder) and outcomes (type of outcome measure and instrument).

Results

From the initial examination of citations, yielded from the literature search, 13 studies were included. After review of the completed texts, all studies were excluded, leaving zero eligible RCTs, to be included in the review. The reasons that trials were excluded from the review were:

Two studies were pilot and no RCTS [17,18].

Four studies did not support the use of ultrasound with the chosen parameters in the management of LET [19-22].

In four studies ultrasound was used as part of the traditional physiotherapy treatment [23-26].

Three studies showed positive effects with the use of ultrasound, but did not describe in detail the parameters of the modality making replication difficult [27-29].

Discussion

The aim of this review was to determine the appropriate ultrasound parameters in the management of LET. Although a plethora of studies was found in the literature research, all these studies were excluded from the review because they did not fulfill the inclusion criteria. Therefore, it is impossible to find out the appropriate ultrasound parameters in the management of LET based on previously conducted RCTs. Recommendations will be provided based on animal studies and on studies in conditions similar to LET in clinical behavior and histopathological appearance, such as patellar and Achilles tendinopathies.

Ultrasound is a modality that physiotherapists use daily in their clinical practice [30]. There is strong evidence that ultrasound has positive effects on tendon healing [31,32]. This strong evidence is supported by animal studies. The effectiveness of ultrasound based on its parameters. The parameters of ultrasound are: frequency, mode, intensity, duration of treatment, movement or not of the soundhead (transducer), coupling medium, treatment intervals and effective radiated area.

Therapeutic ultrasound has a frequency range between 0,75 and 3.3 MHz. Higher the frequency the more superficial is the depth of penetration. LET is a superficial condition and the ideal frequency is 3 MHz [33]. The 4 studies that showed negative effects of ultrasound in the management of LET, the frequency of ultrasound was 1 MHz. Therefore, the negative effects of ultrasound in these studies were expected as one of the most important ultrasound parameter, the frequency, was in wrong direction.

The mode of ultrasound can be pulsed or continuous. Continuous ultrasound is used to produce thermal effects, whereas pulsed or continuous ultrasound in low intensities (0.1 w/cm [2] or 0.2 w/cm [2]) is used to produce non-thermal effects [34]. Pulsed ultrasound is recommended for the management of soft tissue healing [35]. The more acute the presentation, the more pulsed the machine output should be. Pulse ratio should be 1:4 for acute lesion, whereas pulsed ratio should be 1:1 for chronic lesion [34].

The ultrasound intensity applied in W/cm [2]. The advice is to always use the lowest intensity that produces the required therapeutic effect, as higher intensities may be damaging. The intensity used should be between 0.1 and 0.3 W/cm [2] and should not be higher than 0.5 W/cm [2] for acute conditions [34]. For more chronic conditions, the levels would typically be between 0.5 and 0.8 W/cm [2] and should be no higher than 1 W/cm [35].

In the past, practitioners recommended ultrasound treatment for 5-10 minutes in length; however these times may be insufficient. The duration of ultrasound treatment depends upon the area of the injury. Typically, the area should be divided into zones that are approximately the same size as the treatment head, and then each zone should be treated for 1 minute [33,34]. Therefore, in order to find out the duration of ultrasound treatment multiple 1 minute with the pulse ratio with number of times treatment head fits onto tissue to treat [34-36]. According to that, for acute LET, the duration of treatment is 5 minutes (1×5×1), whereas for chronic LET is 2 minutes (1×2×1).

In the past, treatment techniques that involve both moving the transducer and holding the transducer stationary have been recommended. The stationary technique was most often used when the treatment area was small or when pulsed ultrasound was used at a low intensity. However, this stationary technique has been demonstrated to produce disruption of blood flow, platelet aggregation and damage to the venous system; so the stationary technique is no longer recommended [33,34].

The purpose of the coupling medium is to exclude air from the region between the patient and the transducer so that ultrasound can get to the area to be treated. Water, light oils, topical analgesics, gel packs, gel pads and various brands of ultrasonic gel have been recommended as coupling agents [33]. Water is an effective coupling medium, especially in relation to the treatment of small areas and body parts with significant bony protuberances, although with the advent of the small treatment head this is now less of a clinical problem [34]. Water –soluble gels seem to have the most desirable properties necessary for a good coupling medium [33]. There is no clinically relevant difference between currently available coupling gels [37].

The interval between successive treatments depends upon the nature of the injury. The more acute the lesion, the better result will be achieved with daily treatment once even twice with a gap of at least six hours is maintained between ultrasound interventions [34]. In chronic conditions, ultrasound treatment may be done on alternating days [33,34,36]. The question is often asked, how many ultrasound treatments can be given? In the past, it has been recommended that ultrasound be limited to 14 treatments, although this has not been documented scientifically [33]. Today, ultrasound treatment can occur for several weeks [33].

The effective radiating area (ERA) is the total area of the surface of the transducer that actually produces the sound-wave [33]. The appropriate size of the area to be treated using ultrasound is two-three times the size of the ERA (roughly twice or three times the size of the soundhead of the ultrasound) [33-36]. It has been recommended that the transducer should be moved slowly at approximately 4cm/sec in overlapping circular motions or in a longitudinal stroking pattern [33]. There are different diameters ultrasound transducers ranged from 1 cm [2] to 10 cm [2].

Implications for Practice

According to the above the ultrasound parameters in the management of acute LET might be recorded as:

Frequency: 3 MHz

Mode: pulsed, pulsed ratio 1:4

Intensity: 0.1-0/3 W/cm [2]

Duration of treatment: 5 minutes

Movement or not of the soundhead (transducer): No stationary technique

Coupling medium: ultrasound gel

Treatment intervals: every day once or twice

Effective radiated area: The area of pain, usually the insertion of extensor carpi radialis brevis using small transducer-approximately 1 cm [2], moving the soundhead slowly in circular or in longitudinal pattern

On the other hand, the ultrasound parameters in the management of chronic LET might be recorded as:

Frequency: 3 MHz

Mode: pulsed, pulsed ratio 1:1

Intensity: 0.5-0/8 W/cm [2]

Duration of treatment: 2 minutes

Movement or not of the soundhead (transducer): No stationary technique

Coupling medium: ultrasound gel

Treatment intervals: every other day/3-4 times per week

Effective radiated area: The area of pain, usually the insertion of extensor carpi radialis brevis using small transducer-approximately 1 cm [2], moving the soundhead slowly in circular or in longitudinal pattern

Limitations

Ultrasound is a dose response modality. Based on the literature the above ultrasound parameters are recommended. The next step is to use the above recorded parameters in clinical studies to determine the absolute and relative effectiveness of ultrasound treatment in the management of LET. In addition, future studies should be conducted using the ultrasound as part of the rehabilitation process. Today, the most promising treatment in the management of LET is the eccentric training [38]. Future studies should be conducted using ultrasound and eccentric training in the management of LET, in order to find out whether the combination of the two treatments is more effective than the eccentric training alone in the management of LET. Similar studies have been conducted for other physical modalities such as low level laser therapy [39]. These studies showed that using a therapeutic modality with eccentric training, patients with LET managed quicker. Similar results might be found for ultrasound.

Conclusion

Recommendations for the ultrasound parameters in the management of LET were based on animal studies and on studies in conditions similar to LET in clinical behavior and histopathological appearance, such as patellar and Achilles tendinopathies, because the conducted trials with ultrasound in the management of LET did not fulfill the inclusion criteria. Therefore, further research with well-designed RCTs is required to provide meaningful evidence on the effectiveness (absolute and relative) of ultrasound for the management of LET using the parameters referred in this article.

Key Messages

- Ultrasound is a common dose response physiotherapy modality in the management of LET
- Recommendations for the ultrasound parameters in the management of LET were based on animal studies and on

studies in conditions similar to LET in clinical behavior and histopathological appearance, due to the lack of well designed RCTs with ultrasound in the management of LET

- Further research with well-designed RCTs is needed to establish the absolute and the relative effectiveness of this intervention with the recommended parameters for LET

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