Essay on therapeutic effects of ultrasound in the treatment of a soft tissue inju...

Psychology

Introduction

Ultrasound can be defined as the use of high frequency sound waves (having a frequency above the range, which is audible to the normal human ear, i. e. varying between 20 Hz to 20, 000 Hz) for changing the chemical properties of a substance (Ter Haar, 1999). Besides medical imaging, nowadays ultrasound has become an important therapy for the management of several orthopaedic clinical conditions (Ter Haar, 1999). Stimulation of the tissues beneath the skin’s surface using high frequency sound waves is likely to result in several therapeutic benefits.

Tennis elbow (TE) or lateral humeral epicondylitis can be considered as a tendionsis of the tendon of extensor carpi radialis brevis muscle (Kraushaar, and Nirschl, 1999). This soft-tissue lesion, affecting the common extensor-supinator tendon of the elbow, is characterized by lateral pre-epicondylar pain, which is typically aggravated by griping (Peters and Baker, 2001). This is an extremely painful and debilitating musculoskeletal condition which has a significant impact on the patient’s quality of life (Kraushaar, and Nirschl, 1999).

No single treatment option for TE has been shown to be totally effective (Khan et al, 1999). Of the various treatment options available, one modality typically appearing to be a valuable option for the treatment of TE is ultrasound therapy (Ter Haar, 1999). This essay shall be discussing the therapeutic effects of ultrasound in the treatment of a tennis elbow soft tissue injury. A literature review was conducted using the databases such as MEDLINE, Proquest, Pubmed and Cinah (EBSCO) and key words used in the research included, words such as ultrasound, therapeutic ultrasound, tennis elbow, lateral epicondylitis, thermal effects of ultrasound, nonthermal effects of ultrasound and biological effects of ultrasound. The studies conducted between the periods 1996 to 2014 were considered. About 200 studies each could be identified in each of the databases.

Main body

Thermal and non-thermal effects of ultrasound: In cases of TE there is no inflammation of tissue (Maffullet al, 1998). However, there may be formation of a thick mass of scarred tissue (Khan et al, 1999). These structural changes in the tendon, probably, are themselves responsible for producing pain. Use of ultrasound therapy produces several thermal as well as non-thermal which may help in providing pain relief. Both these effects provide relief from pain by organizing array of collagen fibres, renewing their crimp and elasticity, inhibiting abnormal proliferation of vessels, reducing hyperplasia and hypertrophy of tenocytes, repairing collagen microtears and reversing diffuse tendon degeneration (Kraushaar and Nirschl, 1999).

Thermal effect for soft tissue ultrasound: In the human body, portion of energy from the ultrasonic sound waves is absorbed by various body tissues and converted into heat (Ter Haar, 1999). Heat energy generated by sound waves can produce several therapeutic effects (Draper et al, 1996). Insonation causes an increase in the tissue temperature (Draper et al, 1996). Study be Draper et al (1996) have shown an increase in the temperature by 5○C following the application of 1-MHz continuous ultrasound energy at intensity of 1. 5 w/cm applied with a 20-cm transducer over a skin area of 80 cm2 for a period of 10 minutes. This heat energy is thought to stimulate the healing process by causing growth of new cells and producing neovascularization (Draper et al, 1996).

Non-thermal effects of soft tissue ultrasound: Therapeutic ultrasound also produces several non-thermal effects such as acoustic streaming and cavitation (Johns, 2002). It is likely that these effects first cause injury to the cell by producing cavitation and alteration of cellular membranes (Johns, 2002). Then a response of cellular recovery is initiated which is characterized by the increased protein production and breakdown of fibrous tissue (Johns, 2002). The mechanical energy of sound waves and the shearing force of waves may combine to produce mechanical properties, changing the structural conformation of cells by causing alteration of the cellular membranes, thereby facilitating the breakdown of fibrous tissue (Ter Haar, 1999). The sound energy emitted this probe also liquefies the fibrous/dead tissue and specifically breaks up the unhealthy fibrous tissue, thereby promoting tissue healing (Kho et al, 2013).

Therapeutic effect ultrasound in tennis elbow and the method of using ultrasound therapy for cases of tennis elbow: Application of ultrasound probe over the area of tenderness is a commonly recommended therapy for TE. Deep heat energy generated by ultrasound helps in increasing blood flow by causing dilatation of blood vessels (Ter Haar, 1999). Furthermore, the non-thermal effects of ultrasound may also help in reducing the pain and muscle spasm by producing effects such as acoustic streaming and cavitation (Johns, 2002).

Treatment under ultrasound guidance can be considered as an option for treatment of recalcitrant case of TE before considering further surgical intervention. Percutaneous radiofrequency thermal lesioning under ultrasound guidance for recalcitrant TE has produced statistically significant beneficial results (Lin et al, 2011).

Ultrasound therapy is a novel procedure for treating TE and is based on the actual pathology involved (Khan et al, 200). This method attempts to break up the scarred tissue and stimulate the healing response by encouraging growth of new tissues (Cook et al, 2000). It also helps in reversing the structural changes and restoring more normal mechanical properties of the tendon, thereby leading to the resolution of pain related to TE (Cook et al, 2000). Stages of tendon healing comprise of various stages involving breaking down of scarred tissue, opening up of channels for blood flow, stimulating body's healing response, guiding tissue remodelling, and restoring tissue strength and endurance by stimulating the cellular growth and repair process (Paine et al, 2000).

The use of ultrasound initiates the process of tissue healing through the various mechanisms. Exposure to ultrasound is also likely to cause an increase in intracellular calcium within the fibroblast cells by disrupting the normal functions of the membranes, thereby permitting the leakage of calcium inside the cells (Johns, 200). Calcium is used as a cofactor in the regulation of activity of several enzymes, which are involved in the signal-induction pathways (Ter Haar, 1999). This may result in gene activation and resultant protein production, again facilitating the healing process (Ter Haar, 1999).

For application of ultrasound therapy, an ultrasound probe is placed over the region of maximal tenseness in the lateral epicondyle for a period of 20 minutes every day (Ono et al, 1998). A coupling gel is applied to the probe before placing it over the region of elbow. The patients are instructed to use the device daily over a 3 month period. In this technique, both thermal and non-thermal effects of ultrasound are utilised for promoting tissue healing (D'Vaz et al, 2006).

Literature review: Review of the available evidence shows that the use of ultrasound therapy for treatment of TE appears to be a lucrative option, because it is directed towards the treatment of pathophysiology of the disease process (D'Vas et al, 2006). Use of LIUS (low-intensity ultrasound therapy has been found to be associated with encouraging results related to repair of tendons (Cook et al, 2001 and Takakura et al, 2001). The results of the study by Kristiansen et al (1997) showed that the use of sound energy (via its thermal and non-thermal effects) encourages the healing of tissues of the distal radial metaphysis. Presently available literature does not provide enough scientific evidence to significantly favour or disfavour the use of ultrasound therapy for the treatment of acute lateral epicondylitis (Heckman et al, 1994; Cook et al, 2001 and Taka kure et al 2001; D'vaz et al, 2006). The results of the various studies clearly demonstrate the requirement of properly designed randomised controlled trials in the future for evaluating various types of therapies (D'az et al, 2006).

Conclusion

Appendices:

A literature review was conducted using the databases such as Medline, proquest, pubmed, and Cinah (EBSCO) and key words used in the research included, words such as ultrasound, therapeutic ultrasound, tennis elbow, lateral epicondylitis, etc. The studies conducted between the periods 1996 to

2014 were considered. About 200 studies each could be identified in each of the databases.

Use of boolean operators

- The boolean operator " and" was used between the terms ‘ therapeutic ultrasound and tennis elbow’ to narrow (restrict) searches.
- The boolean operator " or" was used between the terms ‘ tennis elbow or lateral epicondylitis’ to broaden search results.
- The boolean operator " not" was used between the terms ‘ tennis elbow, not surgical management’ by eliminating terms from a search.

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