INTRODUCTION

Tennis elbow is one of the most commonly encountered upper limb conditions [1]. Its incidence in general practice is 4–7 per 1000 per year [2], with as many as 15% of workers in highly repetitive jobs reporting the condition [3–5]. Its incidence peaks in the 35–54 year old age group [6].

Tennis elbow is a misnomer as it is predominantly seen in non-tennis players [7]; however, elbow pain is encountered in up to 50% of tennis players, with 75–80% of these cases being attributable to tennis elbow [8, 9].

The disorder is usually characterized by pain over the lateral aspect of the elbow commonly associated with resisted wrist and finger extension and gripping activities.

This condition impacts substantially on society and health care systems, with between 10 and 30% of individuals with tennis elbow, taking a leave of absence of an average duration of 12 weeks [2]. It also has a huge economic impact in terms of workers’ compensation claims and even early retirement [10]. However, longitudinal studies have shown that a large proportion of patients improve over time with spontaneous recovery seen in 80–90% of patients within 2 years [11–13].

The aetiology of tennis elbow is poorly understood. Kraushaar & Nirschl’s [14] microscopic study demonstrated the presence of fibroblastic tissue and vascular invasion of the common extensor tendon, described as angiofibroblastic tendonosis, implying a degenerative tendinopathy. However, recent studies have demonstrated the presence of the neuropeptides, substance P and calcitonin related gene peptide (CRGP) in sensory nerve fibres supplying the extensor carpi radialis brevis (ECRB) [15, 16], which could imply the possibility of neurogenic sensitization as an additional source of pain [17].

This lack of understanding regarding its aetiology has led to a large number of treatments, including physiotherapy, being advocated. This would appear to represent a lack of consensus over what is best practice in the management of this condition. As up to 30% of all patients seen in primary care with tennis elbow are referred to physiotherapy [2], the aim of this review is to examine the evidence of effectiveness of frequently used physiotherapy modalities in the management of tennis elbow. For the purpose of this review, modalities were classified as electrotherapeutic or physical interventions.

SEARCH STRATEGY

Computerized searches were performed using Medline, Embase, Cinahl and the Physiotherapy Evidence Database (PEDro) and the Cochrane Register. Randomized controlled trials were reviewed using the terms tennis elbow, lateral elbow pain, lateral epicondylalgia and physiotherapy, either individually or in various combinations. Other references identified from existing reviews or from papers cited in previous publications were also reviewed.

ELECTROTHERAPY INTERVENTIONS

Modalities reviewed include ultrasound, laser therapy and electromagnetic field therapy. For the purpose of this review extracorporeal shock wave therapy (ESWT) was not included as it is not commonly utilized by UK physiotherapists.
Laser therapy
This is used infrequently by physiotherapists in the UK, in the management of tennis elbow [6]. In the short term the efficacy of this treatment modality is questionable as is demonstrated by the differing results seen in previous studies. There is, at present, no evidence of long term effect using laser when compared with placebo treatment [18–22].

Pulsed short wave diathermy
This was used by just under 10% of physiotherapists in Greenfield & Webster’s study [6], despite there being no conclusive evidence regarding its effectiveness in the management of tennis elbow. Only one small study examined its effectiveness vs a placebo, concluding there were no differences between groups at final review, following 8 weeks of treatment [23].

Ultrasound
Pulsed and continuous ultrasound is used by just under half of physiotherapists treating tennis elbow [6], although the overall efficacy of this treatment for musculoskeletal disorders is in debate. Varying effects are seen in trials comparing pulsed ultrasound with placebo [24, 25], using a range of outcome measures. When compared with other modalities, such as injections or transcutaneous electrical nerve stimulation (TENS) [26, 27], there were no significant differences in outcomes between groups, with weak evidence for its effectiveness. Only one study examined the use of phonophoresis [28], which is ultrasound used with a steroid coupling gel. Following nine sessions of treatment, there were no additional benefits in using a steroid coupling gel, compared with using ultrasound alone.

PHYSICAL INTERVENTIONS
Treatments reviewed include acupuncture, ice therapy, the use of orthotic devices, manual therapy, massage, and exercise therapy.

Acupuncture
Acupuncture is frequently used by physiotherapists in the management of chronic tennis elbow [6]. However, the very few acupuncture studies to date have failed to prove conclusively that the short term relief in pain seen gives rise to long term functional improvement [29–32]. No trials to date have assessed, concentrated or commented on the potential adverse effects of this particular form of treatment. The most recent Cochrane review [33] concludes there is insufficient evidence to support or refute the use of acupuncture. Further trials utilizing appropriate methodology and adequate sample sizes are needed before firm conclusions can be drawn regarding this treatment modality.

Ice
Only one study was identified that investigated the effect of ice therapy on tennis elbow. Manias & Stasinopoulos’s parallel group study [34] compared an exercise and ice group with exercise alone, with the ice being applied for 10 minutes after each exercise session. At 4 months follow-up no significant differences were seen between the two groups, indicating that ice may be ineffective as a treatment in the management of tennis elbow.

Manual therapy and massage
Abbot, Patla & Jensen’s small study [35] demonstrated a favourable initial response to a manual therapy technique, a mobilization with movement (MWM), in terms of pain free grip strength and maximum grip strength. However, these results were only generalizable to a single treatment session and not an episode of care. Vicenzino & Wright [36] utilized a single subject design and found four treatment sessions of MWM, a home programme including MWM, and taping to replicate MWM improved all measures of pain and function. This included pain free grip strength at the end of 6 weeks post-treatment assessment phase, but as follow-up time was short, recurrence rates following this regime are unknown. Kochar & Dogra’s small study [37] compared a 3 week trial of ultrasound and MWM compared with ultrasound alone. Both groups then underwent a 10 week programme of progressive upper limb rehabilitation, including the use of weights. Findings were a significant improvement in the MWM group in terms of pain and the weight test, but no difference in grip strength. The MWM group also had a faster recovery time compared with the ultrasound group. Again though, follow-up time was short. These studies echo the results seen in previous studies with only immediate or short term effects seen, after the application of manual therapy techniques at the elbow and cervical spine [38], with only Struijs et al. [39] reporting outcomes at the end of a 6 week programme. However, there does appear to be some evidence in favour of positive initial effects of mobilization, including MWM, which warrants further investigation.

Very few studies look at the effect of deep transverse frictional massage, which was initially advocated by Cyriax [40]. Verhar et al.’s [41] randomized controlled trial compared a corticosteroid injection with 12 sessions of transverse frictions over a 4 week treatment period. At 6 weeks subjective and objective markers were better in the steroid group, but no differences were found between groups at 12 months follow-up. The authors concluded that friction massage was no better than an injection in the management of tennis elbow. Despite the limited evidence to endorse or refute the effects of frictional massage, it was used as a form of treatment always or frequently by over two thirds of respondents in Greenfield & Webster’s [6] study.

Orthotic devices and taping
Braces or epicondylar clasps are prescribed in up to 21% of cases of tennis elbow [42, 43] Biomechanical studies have show that forearm bracing has a direct effect on reducing stresses on the origin of ERCB, but clinical studies are more equivocal. Struijs et al. [44] have proposed the use of a new clinical test, the extensor grip test, where a clinician manually replicates the effect of a brace, as a predictive factor for the effectiveness of bracing, as a treatment for tennis elbow in the short term.

Jensen et al. [45] compared the use of an off the shelf orthotic with a corticosteroid injection over a 6 week period. Both groups showed significant improvements from baseline measurements,
but no differences were found between groups. However, given that bracing would appear to have the lesser risk of side effects, Jensen et al. advocated its use. Wuori [46] compared an off the shelf orthotic with two different types of placebo brace, as well as a control group, and found no significant differences between the brace and the placebo device on any of the outcome measures used. Faes et al. [47] in a randomized controlled trial compared a new dynamic extensor brace worn for 3 months, with a control group. This study found a significant improvement in pain reduction and pain free grip strength in the bracing group, which was maintained at 6 months follow-up. The most recent Cochrane review [48] concluded that with respect to bracing, there were only a limited number of trials, using too few outcome measures, with limited long-term results. Therefore, no definite conclusions could be drawn concerning the effectiveness of orthotic devices. In conclusion, more well designed and well conducted randomized controlled trials are warranted.

Struijs et al. [49], in a large randomized controlled trial, examined the cost effectiveness of a brace compared with a physiotherapy regime comprising of ultrasound, friction massage and exercises. At 12 months follow-up there was little difference clinically between groups, but physiotherapy was found to be the most cost effective treatment. Direct health care costs were higher in the physiotherapy group, but indirect costs such as work absence were substantially higher in the brace group. This study may suggest that the direct cost of physiotherapy is worthwhile, as cost is often a decisive factor in current medical practice, as to whether an intervention is implemented.

Many therapists use taping as an adjunct to exercise, in order to relieve pain and allow functional restoration of movement patterns. Vicenzino et al’s [50] small study demonstrated that taping may be useful as an adjunct to exercise. When comparing specific diamond taping over the elbow, compared with placebo taping and a control group, diamond taping had a positive effect of the order of 20% on pain free grip strength and pain pressure threshold, which was maintained for up to 30 minutes after the removal of the tape. However, further research is required before firm conclusions regarding the effectiveness of taping can be drawn.

Exercise programmes
The difficulty in reviewing studies using exercise is that most studies use exercise as a co-intervention, and therefore, the results cannot be solely attributed to exercise alone. However, exercise is one of the most commonly used treatments in tennis elbow management by physiotherapists, especially progressive stretching exercises [6]. Of note is that less than a third of all physiotherapists examined and treated the shoulder and trunk, even though this has been recommended by previous studies [14, 51]. It would appear that the majority of treatments given are locally based at the elbow.

In a small study Pienimaki et al. [52] compared a 6–8 week trial of exercises including stretches, with ultrasound. This showed a favourable effect on pain but not maximal grip strength, with the authors concluding that progressive exercise therapy was more effective than ultrasound. In a 3 year follow up study [53] of the same group of patients, the exercise group had significantly less pain and significantly less co-interventions, such as physiotherapy or medical consultations. The exercise group also reported less sickness absence days due to their elbow condition.

Bisset et al. [12] in a sufficiently powered, well-executed trial, compared eight sessions of community based physiotherapy, with a steroid injection or a wait and see approach. The initial results were more favourable in the injection group, but this group had a higher recurrence rate and significantly poorer outcomes at 12 months follow-up in comparison with the physiotherapy group. There were no significant differences between the physiotherapy and the wait and see group, but less co-interventions were sought by the physiotherapy group, echoing the results of previous studies. The physiotherapy group also experienced quicker pain relief than the wait and see group. The authors questioned whether it was it worth the time and cost associated with physiotherapy to gain faster relief and perhaps avoid other treatment, in the knowledge that over the course of the next few months, the outcomes were probably similar. They also queried the use of corticosteroid injections in the use of chronic tennis elbow, with the conclusion being to demedicalize this condition, allow the elbow to recover and consider referral for physiotherapy. This study confirms the finding of a previous study, which found physiotherapy in a primary care randomized controlled trial, gave no added benefit over a wait and see approach [13]. The conclusion drawn from this study was that given appropriate advice, tennis elbow is a self limiting condition, in most cases. It should be noted, however, that the physiotherapy regime used in the above study consisted of friction massage, ultrasound and exercise, which may not reflect the approach taken by many physiotherapists today.

Many more physiotherapists are undertaking eccentric training programmes with patients with tennis elbow. Eccentric strength training programmes are a key element of rehabilitation [54–56], with literature supporting their use in other chronic tendonopathies [57–59], as well as tennis elbow.

Eccentric exercise
It is claimed that eccentric training results in tendon strengthening stimulating mechanoreceptors in tenocytes to produce collagen, which is probably the key cellular mechanism that determines recovery from tendon injury [60–62]. In addition eccentric training may induce a response that normalizes the high concentrations of glycosaminoglycans. It may also improve alignment of collagen within the tendon and stimulate collagen cross linkage formation, both of which improve the tensile strength of tendons and tendon remodelling [60–65], which is supported by animal studies [66]. However, as the basic pathophysiology of tendinopathy is poorly understood, the mechanisms by which eccentric exercise may help resolve tendinopathy is also poorly understood [67].

Martinez-Silvestrini et al.’s [68] study compared eccentric exercise plus stretches, concentric exercise plus stretches and a stretching alone group. There were no significant differences in outcome between groups; however, the programme of exercise undertaken was of short duration, with only a short term follow-up. Other studies involving longer exercise programmes have shown more favourable results. Svenlov & Adolfsen [69] small
randomized controlled trial of 3 months of eccentric exercise compared with daily stretches, found that the eccentric training programme produced significant improvements in grip strength, with complete resolution of symptoms in 86% of this group. A more recent study comparing isokinetic eccentric work with a standard rehabilitation programme, demonstrated a reduction in pain and an absence of grip deficit in individuals, following the eccentric programme. The study also showed normalization of ultrasound findings in 48% of the eccentric group compared with 28% in the other treatment group [70]. However, this study used specialized equipment for the isokinetic group, which is not freely available to most patients. Finestone & Rabinovitch [71] suggested that a free weight programme may produce equally beneficial results, but there are no data available to support this.

In conclusion, there is some evidence to support the use of eccentric training programmes in tennis elbow, but further investigation is warranted with more rigorous methodological design. The most common failings in the studies above was short follow-up time, inadequate therapist, assessor and subject blinding, lack of intention to treat analysis and the use of poor outcome measures. Very few studies failed to use pain free grip strength as a primary outcome measure, although its use has been recommended in the literature.

**Outcome measures**

Grip dynamometry is an established outcome measure used in tennis elbow research studies, as it has shown to have excellent inter-observer reliability [72]. Greenfield & Webster’s [6] study of physiotherapy practice showed that testing grip strength with a dynamometer was undertaken by over 60% of physiotherapists, but there was little consensus on testing position. However, standardized testing positions need to be undertaken, as previous studies have shown significant differences in grip strength with different positions of the elbow [73,74]. Also, most physiotherapists recorded maximal grip strength, although this has been shown to be less valid than pain free grip strength. Stratford et al. showed maximal grip strength demonstrated a greater responsiveness to change during a single intervention, but it had poor validity as a measurement of clinically important change over time [75]. Pain free grip strength has been shown to be more sensitive in measuring change over time, with a strong correlation between levels of disability and deficits in pain free grip strength. This responsiveness to change coupled with its high reliability, has promoted its use as an outcome measure in both the research and clinical setting.

**DISCUSSION**

There is a paucity of evidence for physiotherapy in the management of chronic tennis elbow especially that of long term effect, which may be due to methodological differences in the research reported to date. Two previous reviews concluded more research was needed to investigate the effectiveness of physiotherapy in the management of tennis elbow [76,77]. Also, many previous studies have been undertaken in the secondary care setting. Future research should also address the fact that results from hospital based studies are not generalizable to the primary care setting. Patients recruited in secondary care represent an unknown group of individuals who probably have more severe, persistent complaints.

Also, many systematic reviews concerning physiotherapy have failed to address the issue of adequate treatment procedures and the optimal doses of treatment needed to produce significant treatment effects [78–81]. It is no longer valid to include trials in systematic reviews with non-optimal treatment doses. This is in order to ensure adequate methodology under equal terms to balance evidence of effects for both physical and medical interventions.

The best available evidence to date would appear to support the use of exercise, supplemented by manual therapy techniques and taping. However, the tape and manual therapy studies only show evidence of a moderate to large initial effect, with lack of long-term follow-up data. Therefore, these preliminary findings would appear to warrant further investigation. Currently, there is insufficient evidence to recommend the use of passive modalities such as electrotherapy and acupuncture in the management of tennis elbow. Treatment should be directed to improve the limited function of the upper limb, and not merely be aimed at symptomatic relief.

References


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