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Review Article

A Systematic Review of Acupuncture for Tennis Elbow

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ABSTRACT

This review analyzed randomized controlled trials and case reports to identify the effectiveness, and level of evidence showing that acupuncture treatment aids the recovery of patients with tennis elbow. A literature search was performed between 1st to 10th September, 2019 which used PubMed, the Cochrane library, the Korean databases Oriental Medicine Advanced Searching Integrated System, Korean Studies Information Service System to retrieve Korean and international studies. Amongst the 243 articles retrieved there were 9 randomized controlled trials and 18 case reports. The level of evidence for the recovery of patients with tennis elbow, for efficacy and safety of acupuncture was low. It was observed that the studies had a high risk of bias, missing acupuncture details, multiple combinations of treatments rather than a single treatment, insufficient indicators of assessment, and lacked robustness. Compliance with international standards such as using consolidated standards of reporting trials, will improve the quality of evidence.

Introduction

Tennis elbow is a tendon injury caused by the sudden change in load pattern, taken to Extensor Carpi Radialis Brevis. Pain occurs when there is tenderness and resistance movement of the lateral epicondyle of the elbow joint, which occurs when there is repeated movement in which the extensor muscle of fingers or hand muscle, where there is tension in the lateral epicondyle [1]. The condition occurs frequently in middle aged people, affects men and women equally and typically occurs on the dominant side [2]. The cause of the condition is multifactorial in most patients and is irrespective of tennis [3]. It has been reported in a Finnish study (N = 5,871) that during 2000-2001, the prevalence of Tennis Elbow was 1.3% in adults aged 30-64 [4]. In Western countries nonsurgical treatment for Tennis elbow includes icing the area, taking painkillers, applying topical non-steroidal anti-inflammatory drugs (NSAIDs), having corticosteroid injections, taking exercise and receiving physiotherapy for the condition, using a support, and having extracorporeal shock wave therapy. Surgical treatments are considered for the patients who suffer from severe, persistent symptoms typically when nonsurgical treatments have proved ineffective [1].

The number of oriental medicine studies on Tennis Elbow using acupuncture is increasing. The acupoints used for the treatment of pain in the elbow were reviewed in 2014 by Ryu et al [5] and in 2016 by Kim et al [6] reviewed the research trends in Korea for acupuncture treatments of Tennis Elbow.

In 2002, the Cochrane review of acupuncture for lateral elbow pain [7] reported that there was insufficient evidence to base any recommendations. Studies would need to be valid, well designed, and reliable with sufficient numbers of patients, to determine efficacy of treatment. The Cochrane review (2002) of orthotic devices for the treatment of Tennis Elbow reported that additional studies were necessary due to insufficient evidence. Similarly, the same recommendation was made for NSAIDs in 2013, and for surgical treatment of Tennis Elbow, in 2011 [8-10]. Tang in 2015 reviewed acupuncture studies in the treatment of lateral epicondylitis (Tennis Elbow) and reported that follow-up studies were needed due to lack of evidence [11]. A valid, reliable treatment method for Tennis Elbow is needed.

The aim of this review was to identify effective, reliable studies for the acupuncture treatment of Tennis Elbow, by analyzing the level of evidence to improve the quality of clinical research design of future studies.

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Materials and Methods

Search strategy

PubMed, the Cochrane library, the Korean database Oriental medicine Advanced Searching Integrated System (OASIS), and the Korean Studies Information Service System (KISS) were used to retrieve literature. The search was performed from September 1st, 2019 to September 10th, 2019. The search words were based on "Medial Subject Headings (MeSH)" and included "tennis elbow" and "acupuncture" (Table 1).

Eligibility criteria

Inclusion criteria

The key research questions and composition of search terms were made using a default format for key research questions in systematic reviews (PICOTS-SD) [12]. The studies included were required to have the full text available. Acupuncture treatment was reviewed in patients affected by Tennis Elbow, and having a control group in the study did not limit inclusion. The effectiveness of the intervention was measured by the relief of symptoms and resolution of the condition (Tennis Elbow). No limitation was put on the type of needle or stimulation, or the style of acupuncture. Burning acupuncture and pharmacopuncture were also included [13]. There was no limitation in the observation period or types of medical institution. Research design was limited to randomized clinical trials, case reports and retrospective research. No limitation was put on language. The studies fulfilling the inclusion criteria, which were published from January 1st, 2000 to the time of the literature search, were included in the review.

Exclusion criteria

Acupuncture is defined as a treatment in which a needle provokes stimulation by penetrating through the skin, so the studies using laser, moxibustion, acupoint pressure which do not penetrate through the skin were excluded. The studies other than the acupuncture treatment of Tennis Elbow were excluded, and non-randomized controlled trials (nRCTs) using acupuncture and systematic reviews were also excluded.

Outcome assessment

After removing the duplicated articles, 2 independent researchers selected the appropriate articles according to the inclusion criteria, and based on the information in the titles and abstracts of the extracted articles. Where there was disagreement regarding the inclusion of an article a third researcher's opinion was sought.

Data extraction and assessment of risk of bias

There were 2 independent researchers who extracted the research design, target patients, intervention, control group, evaluation index, main results and reliability of treatment in the selected studies. Risk of bias was exclusively assessed in randomized controlled trials (RCTs) using the Cochrane risk of bias tool. The third researcher's opinion was accepted when the 2 independent researchers' opinions were different in the extraction of information and the risk of bias assessment.

Results

Description of the included studies

A total of 243 articles were retrieved according to the search strategy, and 54 articles were selected according to the inclusion criteria. There were 27 articles without full texts which were excluded from the study. A total of 27 articles were selected (Fig. 1). There were 9 RCTs [16-24] and 18 [25-42] case reports included in the review. The main characteristics of these studies was presented in tables (Tables 2 and 3).

Year of publication

There were 18 articles that were published in the last 10 years. The year of publication of each article was presented in Fig. 2.

Table 1. Search Strategy.

1. Pubmed	#1: Search ((((((“acupuncture”[MeSH Terms] OR “acupuncture”[All Fields] OR “acupuncture therapy”[MeSH Terms] OR (“acupuncture”[All Fields] AND “therapy”[All Fields]) OR “acupuncture therapy”[All Fields]) OR (“acupuncture therapy”[MeSH Terms] OR (“acupuncture”[All Fields] AND “therapy”[All Fields]) OR “acupuncture therapy”[All Fields])) OR (“acupuncture points”[MeSH Terms] OR (“acupuncture”[All Fields] AND “points”[All Fields]) OR “acupuncture points”[All Fields] OR “acupoint”[All Fields])) OR (“electroacupuncture”[MeSH Terms] OR “electroacupuncture”[All Fields])) OR (“acupuncture”[MeSH Terms] OR “acupuncture”[All Fields] OR “pharmacopuncture”[All Fields])) OR (dry[All Fields] AND needling[All Fields])) OR (“acupuncture therapy”[MeSH Terms] OR (“acupuncture”[All Fields] AND “therapy”[All Fields]) OR “acupuncture therapy”[All Fields] OR “acupotomy”[All Fields]) #2: (((“tennis elbow”[MeSH Terms] OR (“tennis”[All Fields] AND “elbow”[All Fields]) OR “tennis elbow”[All Fields]) OR (“tennis elbow”[MeSH Terms] OR (“tennis”[All Fields] AND “elbow”[All Fields]) OR “tennis elbow”[All Fields] OR (“lateral”[All Fields] AND “epicondylitis”[All Fields]) OR “lateral epicondylitis”[All Fields])) OR epicondylitis[All Fields]) OR (lateral[All Fields] AND epicondyle[All Fields]) #3: #1 AND #2
2. Cochrane library	#1: Search (((((((acupuncture) OR acupuncture therapy) OR acupoint) OR electroacupuncture) OR pharmacopuncture) OR dry needling) OR acupotomy): ti,ab,kw (Word variations have been searched) #2: Search (((tennis elbow) OR lateral epicondylitis) OR epicondylitis) OR lateral epicondyle): ti,ab,kw (Word variations have been searched) #3: #1 AND #2
3. OASIS	#1. Search ((tennis elbow) AND (acupuncture) #2. Search ((lateral epicondylitis) AND (acupuncture)) #3. Search ((epicondylitis) AND (acupuncture)) #4. #1 OR #2 OR #3
4. KISS	#1. Search ((tennis elbow) AND (acupuncture)) #2. Search ((lateral epicondylitis) AND (acupuncture)) #3. Search ((epicondylitis) AND (acupuncture)) #4. #1 OR #2 OR #3

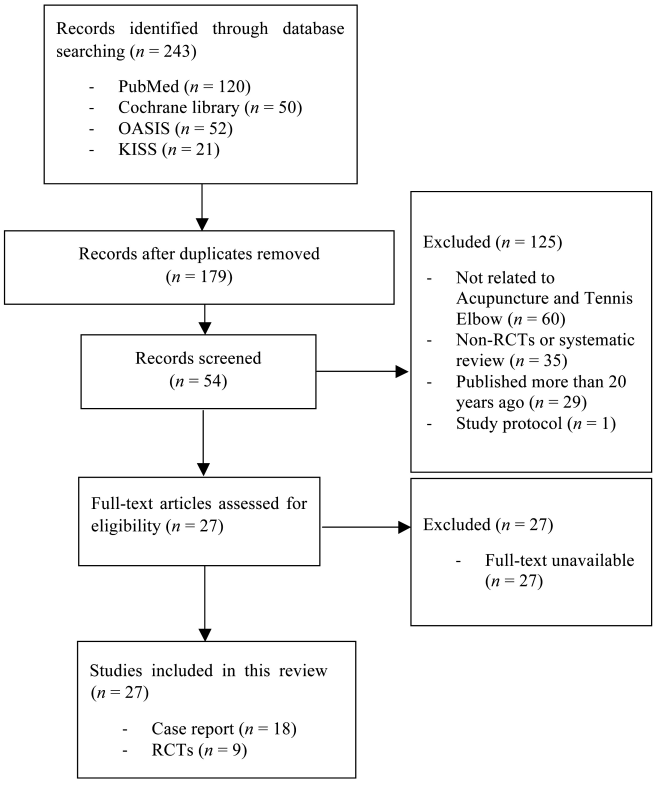

Fig. 1. A PRISMA flow diagram of the literature screening and selection processes. RCT, randomized controlled trial.

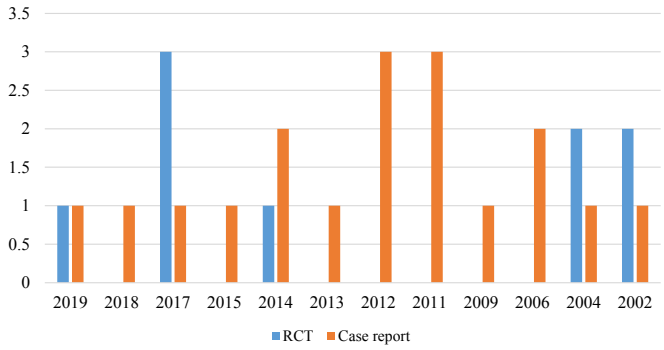

Fig. 2. Year of publication. RCT, randomized controlled trial.

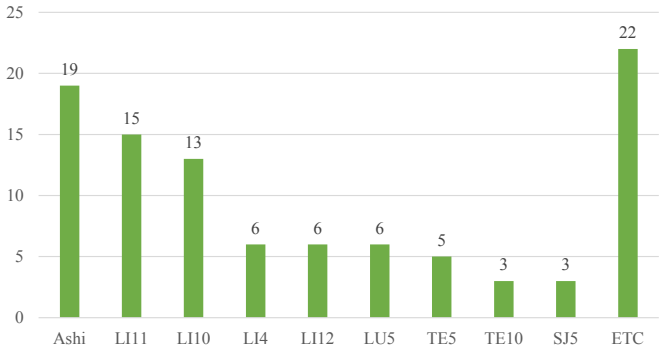

Fig. 3. Frequency of acupoints used.

Sample size of study

The total number of patients included in RCTs was 509, of whom 236 patients were the intervention group, and 273 patients were the control group. The exact number of males and females were not identified in the literature. There was a total of 183 patients in the case reports, with 88 male and 95 female patients. In 1 study [21], patients were divided into 3 groups, with 1 group receiving combination therapy.

Analysis of duration of symptoms

The morbidity period ranged from 4 days to several months, but was not reported in 3 RCT studies [18,22,23].

Frequency of used acupoints

The Ashi point was the most frequently used acupoint in 19 cases (RCT in 6 cases; case reports in 13 cases), followed by LI11 which was used in 15 cases (RCT in 4 cases; case reports in 11 cases), and LI10 in 13 cases (4 cases in RCT, and 9 cases in case reports; Fig. 3).

Analysis of treatment sessions

There were 9 RCTs [16-24], with the highest frequency of treatment sessions in RCTs being 10 sessions [17,20,24], followed by 6 sessions [18,22,23]. There was 1 study with 12 sessons of treatment [16]. In 1 study [21], there were between 7-10 treatment sessions (the exact count was not reported).

The highest frequency of treatment sessions in case reports was 57 [38], and the lowest was 1 session [35,42]. The number of treatment sessions were varied amongst the 18 case reports [25-42].

Details of the included intervention

In the RCTs, the most used intervention was acupuncture which was used in 6 studies [17-19,21,24], followed by electroacupuncture which was used in 2 study cases [20,23], with burning acupuncture [16], and bee venom pharmacopuncture [22] used in 1 study.

In the case reports, the most used intervention was acupuncture which was used in 7 cases [25,27,33,36,38,40,42], followed by bee venom acupuncture which was used in 6 studies [28,29,33,37,38,40], burning acupuncture was used in 4 studies [29,31,32,34], and acupotomy [35], and thread embedding acupuncture were used in 1 study each [26]. In addition, there were many case reports in which combination therapy was used.

Evaluation index

The most used evaluation index was the visual analog scale (VAS) which was used as an evaluation scale in 7 RCTs [16-18,20,22-24], and 12 case reports [27-33,35,37-39]. Numeric rating scale (NRS) was used as a pain evaluation index in 4 case reports [25,26,37,36]. Grip strength was used in 6 RCTs [16,18,20,22-24] and 7 case reports [25,27,28,32,34,37,38]. In addition to these evaluation

Table 2. Key Data of Included RCTs.

First author (year)	Sample size total (I/C)	Intervention	Control	Outcome measure	Summary of results
Wu (2019) [16]	38 (21/17)	Acu + Fire	Acu	1) VAS 2) MGS 3) PRFEQ 4) SF-36	(I/C, Baseline→3 months after treatment) 1) VAS: Pain at rest 3.38 ± 2.31→1.43 ± 2.20/0.94 ± 1.71(p = 0.460), Pain during motion 4.95 ± 2.60→1.90 ± 2.66/1.47 ± 1.88 (p = 0.574), Pain on exertion 6.86 ± 2.44→3.52 ± 2.48/2.47 ± 2.55 (p = 0.207) 2) MGS (kg): 14.33 ± 8.41→21.86 ± 10.63/26.94 ± 10.84 (p = 0.155) 3) PRFEQ: Pain section 26.1 ± 8.35→12.29 ± 10.22/8.18 ± 8.89 (p = 0.2), Function section 5.02 ± 10.97→9.74 ± 10.40/8.26 ± 10.69 (p = 0.670) 4) SF-36: PCS 57.65 ± 19.11→70.81 ± 18.57/78.40 ± 15.44 (p = 0.185), MCS 61.60 ± 22.16→71.45 ± 18.44/73.91 ± 15.88 (p = 0.666)
Fatma (2017) [17]	52 (25/27)	Acu + Conventional therapy	Conventional therapy	1) VAS 2) Algometry 3) DHI 4) CET	(I/C, Baseline→after 10 sessions of treatment) 1) VAS: 8.1 ± 1.0→2.7 ± 1.5 (p < 0.001)/8.2 ± 1.6→6.6 ± 2.7 (p = 0.002) 2) Algometry (with 1cm^2): 1.1 ± 0.5→2.5 ± 0.7 (p < 0.001)/ 1.2 ± 0.5→1.4 ± 0.7 (p = 0.084) 3) DHI: 42.0 ± 8.8→15.3 ± 11.8 (p < 0.001)/ 42.9 ± 15.1→32.1 ± 15.8 (p = 0.001) 4) CET thickness (mm): 4.4 ± 0.6→4.0 ± 0.6 (p = 0.001)/ 4.5 ± 0.8→4.5 ± 0.8 (p = 0.829)
Wong (2017) [18]	34 (17/17)	Acu	ESWT	1) VAS 2) MGS 3) DASH	(I/C, baseline→after treatment→2-week follow-up) 1) VAS: 6.12 ± 2.09/5.47 ± 1.97→3.88 ± 2.26/3.65 ± 2.18→4.06 ± 2.41/ 3.18 ± 2.13 2) MGS (N): 82.96 ± 18.72/89.50 ± 22.42→ 93.95 ± 19.13/ 96.57 ± 22.77→ 93.41 ± 22.06/98.39 ± 22.64 3) DASH: 66.88 ± 14.13/ 64.65 ± 14.56→63.29 ± 14.15/60.76 ± 15.19→60.12 ± 15.34/60.12 ± 15.50 Both treatment significantly improved pain score but no significant difference was found in maximum grip strength and functional outcome.
Esat (2017) [19]	110 (55/55)	Dry needling	NSAIDs, bracing	PRTEE 1) Pain score 2) Functional score	(I/C, pre-treatment→3rd weeks→6th months) 1) pain score: 30.84/32.43→16.03/26.9 (p < 0.01)→10.76/34.09 (p < 0.01) 2) functional score: 60.90/58.95→17.05/52.04 (p < 0.01)→10.60/ 60.17 (p < 0.01)
Li (2014) [20]	86 (43/43)	EA + Massage + Blocking therapy	Blocking therapy	1) VAS 2) GSI 3) MEPS 4) Total effective rates	(I/C, before treatment→at 0→6→12→24 months after treatment) 1) VAS: 6.5 ± 1.9/6.4 ± 1.6→4.6 ± 1.3/4.6 ± 1.7→4.8 ± 1.3/ 4.8 ± 1.2→4.6 ± 1.2/6.6 ± 1.6→6.5 ± 1.6/6.5 ± 1.3 2) GSI: 63 ± 8/63 ± 8→84 ± 6/82 ± 7→82 ± 7/ 82 ± 6→84 ± 6/62 ± 8→64 ± 6/64 ± 7 3) MEPS: 65 ± 7/66 ± 8→85 ± 6/84 ± 7→84 ± 5/ 84 ± 7→80 ± 7/66 ± 6→65 ± 6 /65 ± 7 4) Total effective rates (%): 87.5/85.0→85.0/82.5→80.0/12.5→2.5/5.0
Xia (2004) [21]	100 (40/30/30)	Fu needling + EA	EA (C1), Fu needling (C2)	Total effective rate	(I/C1/C2, Baseline→after treatment) 1) Total effective rate (%): 92.5/90/90
An (2004) [22]	24 (12/12)	BV + US	Acu + US	1) VAS 2) MGS	(I/C, Baseline→after 6th treatment) 1) VAS: 5.08 ± 1.26→1.42 ± 0.76 (p = 0.868)/ 5.17 ± 1.07→2.33 ± 0.75 (p = 0.009) 2) MGS: 24.99 ± 6.20→24.25 ± 6.17 (p = 0.781)/ 24.25 ± 6.17→28.17 ± 5.06 (p = 0.584)
Tsui (2002) [23]	20 (10/10)	EA	MA	1) PVAS 2) PFGS	(I/C, Baseline→after 6th treatment within 2 weeks) 1) PVAS (%): 100→50/100→68 (p = 0.000) 2) PFGS: Improvement was shown in both group (p = 0.045) → EA is superior to MA. → During 2 weeks without treatment before starting any intervention, PVAS decreased about 5% and improvement was not shown in PFGS with statistical significance.
Fink (2002) [24]	45 (23/22)	Acu	Sham	1) MGS 2) VAS 3) DASH	(I/C, Baseline→2 months) 1) MGS (N): 90.5+10.8→142.9+11.11/77.7+9.4→114.2+11.9 2) VAS: 16.46+0.83→6.01+1.36/17.17+0.97→8.73+1.3 3) DASH: 38.08+3.65→11.14+3.5/33.72+3.37→18.85+3.55

I, intervention; C, control; Acu, acupuncture; Acu + Fire, acupuncture plus fire needle; MCS, mental component score; MGS, maximum grip strength; PCS, physical component score; PRFEQ, patient-rated forearm evaluation questionnaire; SF-36, medical outcomes study 36-item short form health survey; NR, not reported; Conventional therapy includes rest, NSAIDs, exercise, bracing.; ESWT, extracorporeal shockwave generator machine; DASH, disability of arms, shoulders and hands questionnaire; N, Newton; PRTEE, patient-rated Tennis Elbow evaluation; NSAIDs, non-steroidal anti-inflammatory drugs; EA, electroacupuncture; GSI, grip strength index; MEPS, mayo elbow performance score; MA, manual acupuncture; PVAS, pain visual analog scale; PFGS, pain free grip strength; Sham, sham acupuncture; BV, bee venom pharmacopuncture; US, ultra sound.

Table 3. Key Data of Included Case Reports.

First author (year)	Sample size/ gender	Main treatment	Other treatment	Outcome list	Summary of results
Jeong (2019) [25]	12/males (n = 3), females (n = 9)	Acu	Muscle contraction/ relaxation strengthen technique + Instrument assisted soft tissue mobilization treatment	1) NRS 2) PDI 3) GS	(Baseline→after last treatment) 1) NRS: 7.58 ± 1.08→4.00 ± 1.41 (p < 0.01) 2) PDI: 24.24 ± 5.70→19.25 ± 5.08 (p < 0.01) 3) GS: 20.49 ± 9.49→22.50 ± 9.76 (p < 0.01)
Kim (2018) [26]	2/males (n = 2)	Thread embedding	BV	NRS	(Baseline→after last treatment) NRS (case 1/2): 8→0.5/5.5→0.5
Park (2017) [27]	3/males (n = 1), female (n = 2)	Acu	Musculotendinous releasing manual therapy	1) VAS 2) GS 3) PRTEE	(Case 1/2/3, Baseline→after last treatment) 1) VAS: 6→3/6.4→1.2/8→1.7 2) GS: 28→35.5/5→13.5/3.5→23 3) PRTEE: 56→25.5/28→5.5/79→19.5
Sin (2015) [28]	2/males (n = 2)	Bloodletting therapy +BV	Acu	1) VAS 2) GS 3) Cozen's test 4) Mill's test 5) ROM	(Case 1/2, Baseline→after last treatment) 1) VAS: 7→1/8→0,2 (R,L) 2) GS: 36.9→37.9/27.5,25.2→32.4,29.5 (R,L) 3) Cozen's test: +→+/+, +,+→-,+ (R,L) 4)Mill's test: +→+/+,+→-/+ (R,L) 5) ROM: full ROM with pain→full ROM without pain/limit of ROM with pain→full ROM without pain.
Jung (2014) [29]	20/males (n = 10), females (n = 10)	Burning Acu + SBV	TENS	VAS	(Baseline→after last treatment) VAS: 10.0 ± 0.00→4.00 ± 2.47 (p = 0.000)
Fermin (2014) [30]	36/males (n = 19), females (n = 17)	US-PNE	EccEx	1) VAS 2) Pain-free pressure 3) Evoked pain by physical test 4) DASH 5) Tendon thickening 6) Hypoechogenicity 7) Hypervascularity	(Baseline→At 6 weeks) 1) VAS (0-100): 60.2 ± 8.0→6.0 ± 12.0 2) Pain-free pressure (kg/cm^2): 7.9 ± 2.1→30.3 ± 7.0 3) Evoked pain by physical test [n (%)]: 36 (100)→2 (5.6) 4) DASH (0-100): 63.6 ± 9→13.6 ± 4.1 5) Tendon thickening (n (%)): 36 (100)→36 (100) 6) Hypoechogenicity [n (%)]: 36 (100)→12 (33.3) 7) Hypervascularity [n (%)]: 6 (17.6)→0 (0)
Kim (2013) [31]	13/males (n = 9), females (n = 4)	Deep thermo-conductive Acu	BV + Acu (n = 6) / None (n = 7)	1) VAS	(Baseline→after last treatment) 1) VAS: 6.08 ± 1.54→3.31 ± 1.92 (p = 0.000)
Lu (2012) [32]	1/male (n = 1)	Fire	EA + Moxa	1) VAS 2) DASH) 3) GS	1) VAS 2) DASH questionnaires scores were significantly improved compared to before. 3) The average grip strength increased from 50 pounds to 100 pounds.
Uhm (2012) [33]	4/males (n = 4)	BV+ Dong-qi Acu + Acu	Taping	1) VAS 2) ROM 3) PSSG	(Baseline→after last treatment) 1) VAS: 10→1.25 2) ROM: improved 3) PSSG: 2.75→0.5
Park (2012) [34]	6/males (n = 2), females (n = 4)	Burning Acu	none	1) NRS 2) GS 3) Cozen's test 4) Mill's test 5) ROM	(Baseline→after treatment) 1) NRS: 10→1.83 2) GS: 24.35→30.85 3) Cozen's test (number of postivie): 6→2 4) Mill's test (number of postivie): 6→0 5) ROM: after treatment, all cases showed full ROM without pain.
Lim [35] (2011)	3/males (n = 2), females (n = 1)	Acupotomy	Herbal medicine	1) Cozen's test 2) VAS 3) Self-consciousness	(Case 1/2/3, Baseline→after last treatment) 1) Cozen's test: +→-/+→-/++→+ 2) VAS: 10→1/10→2/9→4 3) Self-consciousness: improved in all cases

Table 3. (Continued).

First author (year)	Sample size/ gender	Main treatment	Other treatment	Outcome list	Summary of results
Choi (2011) [36]	2/ (*n* = 2)	PA + Acu	ICT, MW, Hot pack	1) NRS 2) ROM 3) Physical exam	(Baseline→after last treatment) 1) NRS (Case1/2): 9→1/9→2 2) ROM and 3) Physical exam were improved compared to before.
Ahn (2011) [37]	1/female (*n* = 1)	BV	Acu	1) VAS 2) GS	(Baseline→after last treatment) 1) VAS: 10→1 2) GS: 5.8→19
Kim (2009) [38]	1/female (*n* = 1)	BV + Acu	Moxa, ICT, TENS, MW, Hot pack	1) VAS 2) MGS 3) ROM	(Baseline→after last treatment) 1) VAS: 10.0→1.50 2) MGS (kg): 6.4→16.6/13.1→19.2 3) ROM: no limitation after treatment.
Park (2006) [39]	2/females (*n* = 2)	PA	None	1) VAS 2) PPT	(Case1/2, Baseline→after last treatment) 1) VAS : 10→1/10→1 2) PPT: 2.02→5.53/1.40→3.03
Kim (2006) [40]	1) 13/males (*n* = 5), females (*n* = 8) 2) 8/males (*n* = 4), females (*n* = 4)	1) BV + Acu 2) Acu	None	VAS	(Case1/2, Baseline→after last treatment) 1) VAS: 5.85 ± 1.21→1.69 ± 0.48 (Z = -3.222, *p* = 0.001)/ 6.00 ± 0.76→2.50 ± 0.93 (Z = -2.585, *p* = 0.01)
Song (2004) [41]	50/males (*n* = 21), females (*n* = 29)	PA	Moxa	Total effective rate	30 cases were cured, 18 cases were improved, and 2 cases failed. The total effective rate was 96%.
Wu (2002) [42]	1/male (*n* = 1)	Acu	None	NRS	The disorder was cured by only one session of treatment with no recurrence in a one-year follow-up.

PDI, pain disability index; US-PNE, ultrasound-guided percutaneous needle electrolysis; EccEx, eccentric exercise; NRS, Numeric rating scale; Moxa, moxibustion; ICT, interferential current therapy; TENS, transcutaneous electrical nerve stimulation; MW, microwave; PA, pharmacopuncture; SBV, sweet bee venom pharmacopuncture; Fire, fire needle therapy; GS, grip strength; ROM, range of motion; PPT, pressure pain threshold; PSSG, patient's subjective symptom grade.

indexes, the questionnaire survey, physical examination, and evaluation of the range of motion were used.

Analysis of treatment effect

In RCTs, acupuncture was statistically significantly and more effective as a treatment in all the evaluation items in 3 case reports [17,19,21] compared to the control group. In 1 study [18], both the experimental group and control group showed a statistically significant reduction in pain index scores when pre- and post-treatment were compared using other evaluation items there was no statistical difference. In 1 study [24], the intervention group showed a statistically significance difference between acupuncture treatment compared with the control group in all the items, 2 weeks after the end of the treatment. However, both the intervention group and the control group showed no statistically significant differences in all items except the disability of arms, shoulders and hands questionnaire (DASH). In another study [20], electroacupuncture showed a statistically significant difference in all items compared with the control group 12 months after the end of the treatment. The authors suggested that electroacupuncture was effective would slow relapses. However, at the 6 and 24 month time points there was no statistical significance between the intervention group and the control group. In 1 study [23], the elctroacupuncture treatment showed a statistically significant difference in all items pre and post treatment, and had excellent beneficial effect. In another study [16], burning acupuncture showed no statistically significant differences in the treatment group compared with the control group, so it was reported that there need to be additional research. In 1 study [22], bee venom pharmoacopuncture showed no statistically significant difference in increasing grip strength pre- and post-treatment, but it was perceived by patients to be statistically significantly more effective than acupuncture.

All 18 case reports showed the effectiveness of treatment, but only 5 cases showed statistical significance. The interventions conducted in each study were combination therapies including acupuncture [25], the combination therapy of burning acupuncture and bee venom pharmacopuncture [29], electroacupuncture associated with eccentric exercise (EccEx) and stretching [30], and the combination therapy of bee venom pharmacopuncture and a single acupuncture treatment [40].

The evaluation time in 4 RCT [17,21-23] and 15 case reports [25-29,31,33-40,42] were assessed immediately after the last treatment. In the studies which conducted follow up appointments after the last treatment, 1 study had a 4-month duration from the start of treatment to last visit [32], and 1 case report had a 6-week duration [30]; 1 had a 2-week duration [18], 1 had a 2-month duration [24],

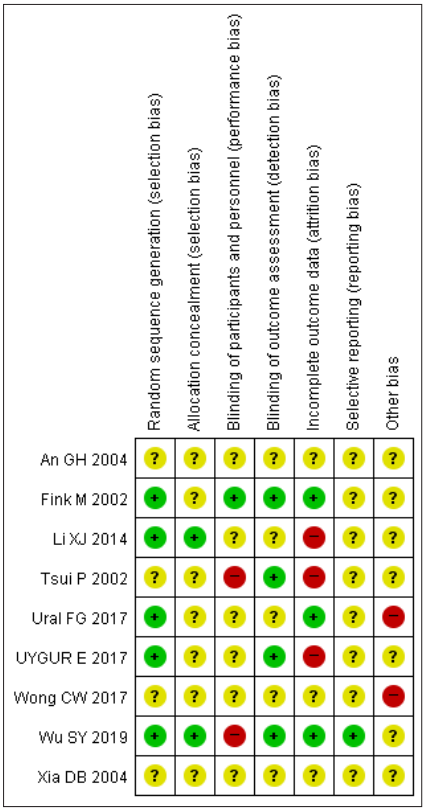

Fig. 4. Risk of bias summary for randomized controlled trials.

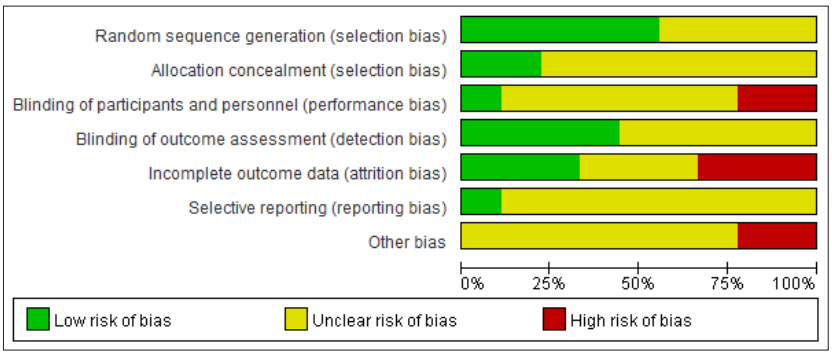

Fig. 5. Risk of bias for randomized controlled trials.

1 had a 3-month duration [16], 1 had a 6-month duration [19] and 1 had a 24-month duration [20]. The evaluation time was not reported in 3 studies including 2 RCTs [21,23] and 1 case report [41].

Analysis of side effect

No side effects were reported in 2 RCTs [16,24] and 2 case reports [30,40], but there were cases of side effects in 2 RCTs (soreness after acupuncture [18], local hemorrhage after dry needling [19]), and reports of side effects in 2 case reports (a small wound resulting from burn injury after fire needle therapy [32], swelling and itching after bee venom acupuncture combined with acupuncture [37]). In the remaining studies, there was no side effects.

Risk of bias (Figs. 4 and 5)

Random sequence generation

A total of 5 studies had a low risk of bias. The table of randomization was used in 2 studies [16,24], and a computer was used to generate random numbers in 3 studies [17-19]. In the remaining 4 studies [18,21-23], the risk of bias was unclear because they did not cover the related contents.

Allocation concealment

A total of 2 studies had a low risk of bias. The allocation order was kept, and released in an opaque sealed envelope, on which a serial number was recorded in 1 study [16]. One study was managed by a designated officer [20], and the remaining 7 studies had an unclear risk of bias because they did not cover the related contents.

Blinding

One study [24] had a low risk of bias because it was double blinded. Two studies [16,23] were high risk because the study was not blinded. The remaining 6 studies had an unclear risk of bias because they did not cover the related contents.

Blinding of outcome assessment

There were 4 studies [16,19,23,24] that had a low risk of bias because the study was blinded to the assessor, but the other studies had an unclear risk of bias because there were no remarks on the related contents.

Incomplete outcome data

Two studies [19,23] had considerable numbers of values missing, and 1 study [20] had missing values in the intervention group, but there was no comments made on the reason for the missing values, therefore both studies had a high risk of bias. Two studies [17,21] were considered to have a low risk of bias because they had no missing values, and 2 studies [16,24] had a low risk of bias because the missing values occurred similarly between the intervention groups, and the reason for the missing values were similar. One study [22] was unclear because it did not cover the related contents.

Selective reporting

One study [16] had a low risk of bias because there was a protocol for the study and it dealt with the results in a predetermined way in the study. There were 8 studies [17-24] that had an unclear risk of bias because they did not cover the related content.

Other bias

There were 2 studies [17,18] that were at high risk of bias because the patients diagnosed with Tennis Elbow were placed into the same group [17], and there was no identification or confirmation of pain medication [18]. The remaining 7 studies had an unclear risk of bias.

Discussion

There were 9 RCTs (509 patients) and 18 case reports (180 patients) analyzed in this systematic literature review. It showed

that the number of studies on Tennis Elbow is gradually increasing because approximately 66% of the reports were published in the last decade.

In this review, 4 RCTs [17,19,21,23] and 1 case study [19] showed the effectiveness of dry needling was evaluated against NSAIDs and bracing, with the intervention group showing a statistically significant effect in all evaluation items, compared with the control group. There were 5 studies, that reported additional research was needed due to the lack of statistical significance in the treatment outcome of the intervention group compared with the control group [16], and there were 2 studies where there was partial improvement in evaluation items [18,22]. In addition, there were 2 studies in which the evaluation outcome was different according to the time of follow-up [20,24]. In particular, in 2 studies [18,24], it was shown that additional research was needed because contrary results were observed for the beneficial effect of acupuncture compared with DASH, the common evaluation item, although there was a difference in the follow-up period. In all 18 case reports, effectiveness of acupuncture was stated, but only 5 studies [25,29,30,31,40] showed a statistical significance, and only 1 study [40] out of the 5 studies conducted acupuncture as a single treatment. Combination therapy was conducted and showed there was a statistically significant benefit to receiving combination therapy, but it could not be determined that the effectiveness of treatment was due to acupuncture treatment. Therefore, it can be evaluated that the level of evidence for acupuncture being an effective treatment aiding the recovery of patients with Tennis Elbow is low.

Excluding 2 RCTS [19,21] from the selected studies (9 RCTs), the number of patients included in the RCTs was small. In the future, RCTs should be powered to ensure that enough patients are recruited to detect if a difference exists between groups. Amongst the 18 case reports, a lot of studies indicated that acupuncture treatment was effective in the treatment of Tennis Elbow, but due to the high risk of bias caused by the small study effect, any interpretation of results must be carefully considered.

In addition, due to the lack of acupuncture details included in the studies in this review, the validity of the acupuncture treatment comes into question. With reference to some items, studies were reviewed according to standards for reporting interventions in clinical trials of acupuncture (STRICTA) [14] which was developed to improve the completeness and transparency of intervention reporting. In cases of not reporting the number of needle insertions per patient, per session, this occurred most frequently in 6 RCTs [16,17,19,20-22], and 12 case reports [27,29,31-34,36-40,42]. In cases of not reporting responses sought, there were 2 RCTs [19,22], and 11 case reports [25-27,29,30,33,36-40]. In cases of not reporting the frequency and duration of treatment, there was 1 RCT [22] and 5 case reports [25,29,31,40,42]. When acupoints and meridians were reviewed, the Ashi point was chosen the most frequently in all the RCTs and case reports. The most used meridian was LI, which was used 4 times and the second most used which was TE. These findings can be referenced in acupuncture treatment of Tennis Elbow in real clinical settings, and it is necessary to perform RCTs in compliance with STRICTA in future studies.

In the reporting of the number of treatments used in the studies included in this review, it was varied, and in particular, it was difficult to make a quantitative evaluation amongst the case reports because the number of treatments ranged from 1 to 57.

Of the interventions included in this review, acupotomy and thread embedding acupuncture featured only in case reports, and was reported to show improvements in patients with Tennis Elbow. Evaluation of effectiveness proved to be difficult because the studies were retrospective and few in number, evidence evaluation would be possible if large-scale RCTs were conducted. In addition, in 1 RCT [20], electroacupuncture and massage were conducted together in the intervention group preventing conclusions being made about acupuncture alone. In the case reports, multiple interventions were applied simultaneously, except for 4 case reports [34,39,40,42].

The outcome evaluation indicators were mainly composed of subjective pain index, functional disability evaluation questionnaire and grip strength, and tenderness as a relatively objective indicator. Various evaluation indexes were selected in most studies, but evaluation indicators need to be supplemented because subjective pain index was evaluated using a single evaluation item in 1 RCT [21] and 4 case report studies [26,29,31,40]. Improvements in condition must be reported however, the evaluation item was missing in 2 case report studies [41,42]. In 1 case study, the authors measured tendon thickening, hypoechogenicity, and hypervascularity using ultrasonic equipment [30]. It is important to carefully interpret the outcome because there could be a possibility that the evaluator's supervision might be involved in the ultrasound reading.

In 19 case studies there was no mention of the side effects. It was difficult to accurately evaluate the safety of acupuncture in this review. Acupuncture studies in the future need to report the side effects of the treatment.

There was uncertain risk of bias mostly in RCTs where appropriate randomization may not have been conducted. There were 4 case studies where random order generation was not covered and there were 7 case studies where allocation concealment was not covered. Considering the Schulz's report [15] in which effect estimates were reported 40% larger in the studies using inappropriate allocation concealment. It is necessary to interpret the outcome of these studies carefully because estimates of the effectiveness of acupuncture can be overestimated. Blind studies may be difficult due to the nature of acupuncture, and daily management of Tennis Elbow, e.g. bracing. In 1 case study [18] in particular, it was necessary to carefully interpret the outcome of the study because pain medication (which may have affected the outcome assessment) was not checked, due to poor control over the medication the patients received. In addition, it is necessary to observe CONSORT [43] with the compensation of missing values and pre-protocol reports in order to reduce incomplete outcome data, and selective reporting.

Finally, this review is limited because it only provides information on acupuncture treatment, and cannot provide information such as stimulating acupoints. In addition. most studies did not provide long-term follow-up outcomes of acupuncture treatment. Moreover, there is reporting bias due to the incompleteness of the data. Furthermore, due to the diversity of the inventions included in the studies, there was a risk of inaccurate conclusions about the effectiveness of treatment, and thus it could not deal with quantitative synthesis such as meta-analysis.

Conclusion

The level of evidence for efficacy and safety of acupuncture was low in the treatment of patients with Tennis Elbow. High risk of bias, missing reports on acupuncture details, multiple combinations of treatments rather than a single treatment, insufficient indicators of assessment, and missed reports on safety were key factors that lowered the level of evidence. Clinical trials in future should be compliant with international standards for clinical trials, such as CONSORT [43].

Conflicts of Interest

The authors have no conflicts of interest to declare.

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