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Review Article

A Systematic Review of Acupuncture for Oculomotor Nerve Palsy

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ABSTRACT

Acupuncture treatment for oculomotor nerve palsy has been increasing recently. This study analyzed randomized controlled trials (RCTs) and case reports, using the Cochrane risk of bias tool to investigate the efficacy of acupuncture therapy for oculomotor nerve palsy. This analysis was performed on March 7, 2019, using online databases (PubMed, Cochrane, NDSL, OASIS, CNKI) where 208 articles were retrieved. Of these, there were 18 case reports and 18 RCTs that matched the inclusion criteria, of which 32 studies used acupuncture as the primary intervention, 1 used pharmacopuncture, 1 used fire-needling, and 1 used electroacupuncture. The most commonly used acupoints were BL1, BL2, ST2, TE23, Ex-HN5, LI4, GB14, ST36, GB20 and GB1. Significant findings were reported in all RCTs. Six adverse events were reported in 3 RCTs, with no effect on the outcome. No side effects were reported in the case reports. The risk-of-bias analysis showed that the articles did not report the experimental protocol used and it was not clear whether the study was blinded. Hence, it was difficult to assess the risk of bias. Analysis of 36 studies showed that acupuncture therapy for oculomotor nerve palsy was effective in many cases. It was difficult to evaluate the potential bias.

Introduction

The oculomotor nerve (3rd cranial nerve) contains the oculomotor nerve nucleus which dominates the levator palpebrae muscle, upper rectus muscle, inferior oblique muscle, medial rectus, and inferior rectus muscles, and also contains the Edinger-Westphal nucleus which dominates the sphincter pupillae. The nucleus that dominates the levator palpebrae muscle is a mononucleus, and the other muscles have paired nuclei. The upper rectus muscle is also dominated by the contralateral nucleus, and the other outer muscles of the eye are also dominated by the collateral nucleus [1].

The anatomical structure of the nucleus can cause bilateral oculomotor nerve palsy, which is a normal function of the levator palpebrae superioris, and may also cause unilateral oculomotor nerve palsy which is accompanied by superior rectus paralysis and incomplete ptosis. Damage to the oculomotor nerve nucleus can also cause Weber syndrome, Claude syndrome, and Benedikt syndrome. Oculomotor nerve palsy may be caused by compression due to a tumor, during an aneurysm or temporal herniation. Additionally, any lesion in the neuronal nucleus, nerve bundle, subarachnoid space, cavernous sinus or the superior orbital fissure may cause oculomotor nerve palsy. Generally, it is caused by diabetes, a cerebral aneurysm, meningitis, trauma or inflammatory disease [2,3].

Oculomotor nerve palsy leads to paralysis in 4 extraocular muscles, excluding the medial rectus muscle and the superior oblique muscle. This causes obstructions for upper and lower eye movement and adduction of the eyeball. The eyeball is fixed in the exterior downward state. Significant ptosis appears sometimes accompanied by exophthalmos. If oculomotor nerve palsy is severe, paralysis of internal eye muscles, pupil and ciliary muscles, occurs. Moderate mydriasis results in the loss of direct and indirect pupillary light reflexes, and paralysis of accommodation due to ciliary muscle failure [4].

In Western medicine, with the exception of cases involving aneurysm, traumatic hemorrhage, or tumor, treatment of oculomotor nerve palsy is based on the treatment of the underlying disease; there is no special treatment for the oculomotor nerve

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palsy itself [5]. According to statistics from the Health Insurance Review and Assessment Service in Korea, the number of patients with nerve palsy receiving Western medical treatment increased from 1,891 in 2010 to 2,580 in 2017. Patients receiving Korean medicine treatment for nerve palsy increased from 42 in 2010 to 86 in 2017 [6]. Oculomotor nerve palsy is well documented and studied worldwide. However, in Korea, only case reports have been published; no systematic reviews have been performed. Recently, studies of acupuncture treatment for oculomotor nerve palsy have been increasing. The purpose of this study was to examine the therapeutic efficacy of acupuncture treatment for oculomotor nerve palsy, and to compare the treatment effects with those of Western medicine. Articles were analyzed to determine the type of acupuncture therapy used for oculomotor nerve palsy and the frequency of the common acupoints used in those included studies.

Materials and Methods

Subjects and search methods

Domestic (Korean) and foreign electronic databases were used to collect literature that related to this research topic. PubMed, the Cochran library, the China National Knowledge Infrastructure (CNKI), the Korean databases Oriental Medicine Advanced Searching Integrated System (OASIS) and the National Digital Science Library (NDSL) were used. "Medical Subject Heading" (MeSH) search terms included "oculomotor nerve paralysis," "oculomotor nerve palsy," "third nerve palsy," "acupuncture," "electroacupuncture", "pharmacopuncture," and "dry needling." The search was conducted on March 7, 2019 (Appendix 1).

Clinical articles that used acupuncture, electroacupuncture, pharmacopuncture, and acupotomy as the main treatment intervention were included in the analysis. There were no restrictions placed on the language of the publication, and there were no limits on the format of the published studies. Articles that were excluded included literature reviews, cases of paralysis not due to oculomotor nerve paralysis, and treatment intervention that did not include acupuncture, electroacupuncture, pharmacopuncture, or acupotomy. Two or more independent Korean medical doctors reviewed the 208 retrieved article titles and abstracts according to the selection criteria and excluded duplicate studies. In cases of inconsistency, third parties participated and decided whether to include articles by consensus. Finally, 36 articles, 18 case reports and 18 randomized controlled trials (RCTs), were selected. (Figs. 1 and 2).

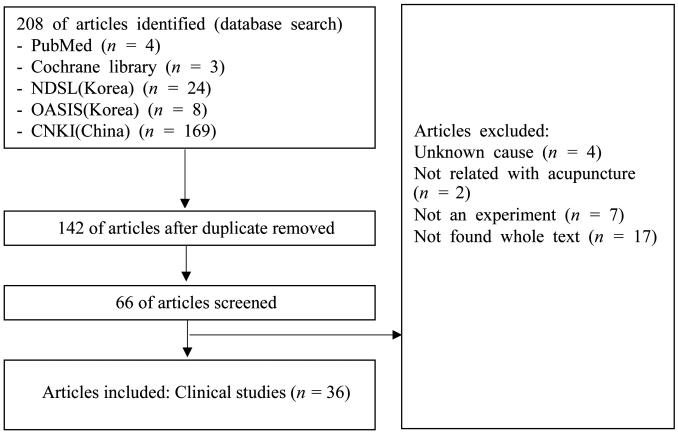

Fig. 1. Flow diagram of selection process.

Results

Research design and number of cases

Of the 36 clinical studies, 14 were conducted in Korea and 22 were conducted in other countries. The 18 case reports consisted of 17 studies with less than 10 cases and 1 study with 30 or more cases (Table 1). Of the 18 RCTs, there was 1 study with less than 30 patients, 6 studies with 30 or more but less than 60 patients, 7 studies with 60 or more but less than 90 patients, and 4 studies with more than 90 patients. The 18 case reports included 50 cases (24 males and 26 females). The 18 RCTs included 1,441 participants (803 males and 638 females). This data is shown in Table 2.

Intervention analysis

There were 33 studies that used acupuncture as the main intervention [7-39], 1 used fire-needling [40], 1 used pharmacopuncture [41], and 1 used electroacupuncture [42] (Fig. 3).

Acupuncture

Among the 33 studies that used acupuncture as the main intervention, there were 18 case reports [7-24] and 15 RCTs [25-39]. Of the case reports, 13 used Korean herbal medication

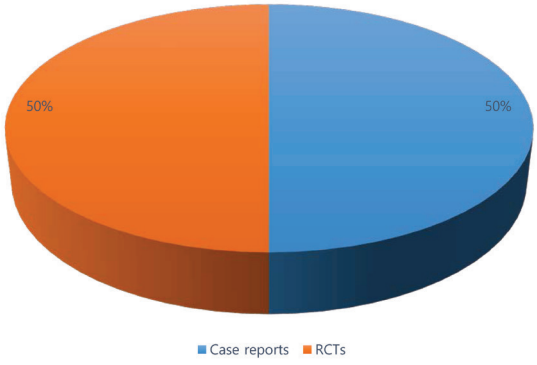

Fig. 2. Analysis of acupuncture treatment of Oculomotor nerve palsy design. RCT, randomized controlled trial.

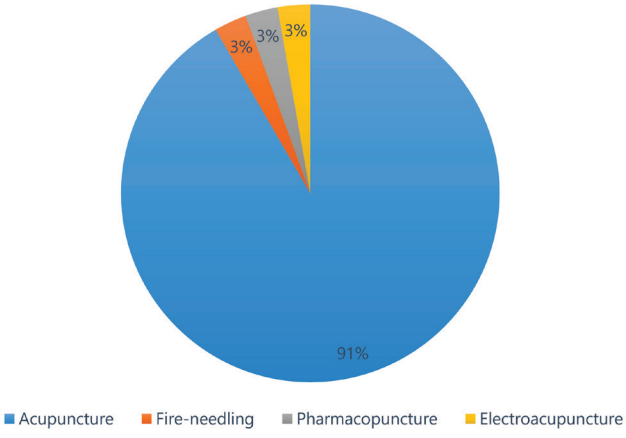

Fig. 3. The number of articles for main intervention.

Table 1. Summary of 18 Case Reports.

Author (y)	Sample (size/ gender)	Main Treatment	Other Treatments	Outcome Measure	Results
Luo (2018) [8]	Female (n =1)	Acupuncture (BL1, BL2, GB14, Ex-HN4, GB1, Ex-HN10, Ex-HN7, ST2, GB20, TE5, SI6, LI4, ST36, Ashi)	Chiropractic	Muscle power grade	Grade 1→Grade 5
Lei (2018) [7]	Female (n =1)	Acupuncture (BL1, BL2, GB14, Ex-HN4, GB1, ST2, GB20, TE5, LI4, ST3, GB4, TE23, LI11, LI6, TE3)		Palpebral fissure width size of pupil position distance of the muscle	palpebral fissure: 6 mm→12 mm size of pupil:5 mm/4 mm→3 mm/3 mm position distance of the muscle innervated by the oculomotor nerve: 0.4 cm→Normal
Yin (2009) [9]	30 Male (n =16) Female (n = 14)	Acupuncture (BL2, Ex-HN10, TE5, LI4, TE23, Ex-HN14, ST8)		Palpebral fissure width size of pupil position distance of the muscle 3rd level: cure/effective/ failed	palpebral fissure 2.43 ± 0.56→6.78 ± 0.436 $p < 0.01$ size of pupil 4.67 ± 0.39→3.45 ± 0.65 $p < 0.05$ measurement of the position distance of the muscles: The medial rectus muscle (n = 20) 8.25 ± 1.36→2.84 ± 1.10 $p < 0.01$ The superior rectus muscle (n = 12) 4.56 ± 0.44→2.32 ± 0.34 $p < 0.05$ The inferior rectus muscle (n = 10) 4.64 ± 0.42→2.40 ± 0.41 $p < 0.05$ The inferior oblique muscle (n = 6) 4.80 ± 0.72→3.97 ± 0.66 $p > 0.05$ cure 10 (33.33%) effective 12 (40.00%) failed 8 (26.67%)
Kim (2017) [10]	Male (n = 1)	Acupuncture (BL2, GB14, Ex-HN4, GB1, ST36, TE23, Ex-HN1, GV26, LI10, SP6, GB39, ST1)	Herb medication, Western medication	K-SARA Palpebral fissure width	K-SARA Subscores 1. Walking: 8→3 2. Standing: 6→2 3. Sitting: 3→1 4. Finger to nose: 20→7 Total score: 20→7 Palpebral fissure: 0 → 9 mm (seat position)/5 mm (lying position)
Frenkel (2002) [11]	Female (n = 1)	Acupucture (GB14, GB1, GB20, LI4, GV26, GB19, LR3, Ashi)		Clinical results	1 wk: pain disappeared 4 wk: ptosisalmost disappeared 9 wk: symptom free
Jeung (2015) [12]	Female (n = 1)	Acupucture (BL2, GB14, Ex-HN4, GB1, Ex-HN10, ST2, LI4, ST36, TE23, ST1, TE17)	Herb medication, Electroacupuncture, Moxibustion, Rehabilitation treatment	Palpebral fissure width (PFW, MRD1, MRD2) 3rd level (ptosis): Mild, Moderate, Severe movement of eyelid: Excellent, Good, Fair, Poor VAS: eye pain	PFW (0→5 mm) MRD1 (0→1 mm), MRD2 (0→4 mm) Ptosis: Severe → Mild Movement of eyelid: Poor → Good Pain: 10 → 0
Jeung (2009) [13]	Male (n = 3)	Acupucture (BL1, BL2, GB14, Ex-HN4, GB1, ST2, GB20, TE23, TE17)	Herb medication, Electroacupuncture, Rehabilitation treatment Pharmacopuncture	VAS: Ptosis, Ocular deviation Clinical results	Case 1 (11 times) Look ahead MRD (1→9) Eye open MRD (3→9) ptosis, Ocular deviation (1→9), diplopia, vertigo, headache - severe→disappearance Case 2 (8 times) Look ahead MRD (1→9), Eye open MRD (4→9), ptosis, Ocular deviation (1→8), diplopia, vertigo - severe→disappearance Case 3 (14 times) Look ahead MRD (2→9), Eye open MRD (3→9), ptosis, Ocular deviation (2→8), diplopia, vertigo - severe→disappearance
Lee (2010) [14]	Female (n = 1)	Acupucture (BL1, BL2, GB1, ST2, TE5, TE23, LI11, LR3, LR2, GB43, GB43, TE3, KI10, TE2)	Herb medication	Palpebral fissure width Clinical photograph VAS: Ocular deviation 3rd level: ptosis: mild/ moderate/severe Movement of eyelid: excellent/good/fair/poor	PFW (0→8 mm), MRD1 (0→3 mm), MRD2 (0→5 mm) Ocular deviation 0→9 Ptosis: Severe → Good Movement of eyelid: Poor → Normal
Kim (2006) [15]	Female (n = 1)	Acupucture (Ashi)	Electroacupuncture	Clinical results	Cure
Kim (2009) [16]	Male (n = 1)	Acupucture (BL1, BL2, Ex-HN4, GB1, LI4, ST36, TE23, LR3, GV20, SI18, ST37, SP9, LR4)	Herb medication	VAS: Eye pain, Nuchal pain Palpebral fissure width (PFW, MRD1) Eye Movement	First treatment Eye pain: VAS10 → 0 Nuchal pain: VAS10 → 1 Ptosis & Abduction exercise: No change Second treatment Eye pain: VAS10 → 0 Nuchal pain: VAS10 → 0 PFW (0 mm→11 mm), MRD1 (0→4 mm) Eye movement: Adduction exercise → Upward exercise
Kim (2004) [17]	Female (n = 1)	Acupucture (BL1, BL2, GB14, GB20, TE23, ST1, KI10, GV20, SP2, HT8, LR1, SP1, LR4, LU8, LR8)	Herb medication, Electroacupuncture	Clinical results	Cure

Table 1. (Continued).

Author (y)	Sample (size/ gender)	Main Treatment	Other Treatments	Outcome Measure	Results
Eom (2015) [18]	Male (n = 1)	Acupucture (BL1, BL2, GB14, Ex-HN4, Ex-HN10, ST2, LI4, TE23, ST1, TE17, GV20, SI18, LR1, GV24, ST7, LI1, GB15)	Herb medication, Electroacupuncture, Pharmacopuncture	Palpebral fissure width Clinical photograph Corneal reflex VAS: Diplopia	Corneal reflex: 45˚→15˚ PFW: 5.5 mm→9 mm Diplopia: 10→10
Son (2017) [19]	Female (n = 1)	Acupucture (BL2, Ex-HN4, Ex-HN10, ST2, TE5, LI4, ST36, TE23, LI11, LI10, LR3, ST37, CV12, SP10, CV6, CV4)	Herb medication, Electroacupuncture, Moxibustion, Pharmacopuncture	Length from medial canthus to lateral iris VAS: Diplopsia	Length: 14 mm→10.5 mm NRS: 10→1
Jeung (2005) [20]	Male (n = 1)	Acupucture (GB14, LI4, ST36, SP6, ST1, GV20)	Herb medication, Electroacupuncture, Western medication	Eye movement Motor grade	Eye movement: Upward 1→3 Downward 2→4 Adduction 1→5 Abduction 8→10 Motor grade: Upper limb IV→Sl Lower limb IV→Sl
Jeung (2000) [21]	Female (n = 1)	Acupucture (BL1, BL2, Ex-HN4, GB1, Ex-HN10, ST2, GB20, TE5, LI4, ST36, TE23, ST1, LR3, TE17, GB43, GV20)	Herb medication, Electroacupuncture	Palpebral fissure width Eye movement	PFW: 0 mm→8 mm Eye movement: Adduction 0→1/2
Lee (2003) [22]	Female (n = 1)	Acupucture (BL1, BL2, Ex-HN4, Ex-HN10, GB20, TE5, LI4, ST36,TE23, ST1, LR3, GV20)	Herb medication	Clinical results	Cure
Eom (2004) [23]	Male (n = 1)	Acupucture (BL1, BL2, GB14, Ex-HN4, ST2, TE23, ST1)	Herb medication, Electroacupuncture	Palpebral fissure width Ocular deviation	PFW: 5 mm→5.5 mm Ocular deviation: Adduction 0˚→45˚
Jo (2014) [24]	Female (n = 1)	Acupucture (BL2, GB14, Ex-HN10, ST2, LI4, ST36, TE23)	Herb medication, Rehabilitation treatment, Pharmacopuncture, Electroacupuncture	Palpebal fissure width (PFW, MRD1, MRD2) Eye movement Visual acuity test	PFW 5.5→10 MRD1 3→5 MRD2 4→5 Eye movement Ocular deviation 17.0→10.3 Horizontal adduction 2→9 Horizontal abduction 9→10 Elevation 2→9 Depression 3→9 Visual acuity test 0.63/0.36 → 0.63/0.80

CT, computed tomography; MRI, magnetic resonance imaging.

Table 2. Summary of 18 RCTs.

Author (Y)	Sample size/ gender	Main treatment	Outcome Measure	Results	
Yan (2017) [25]	Experimental (n = 13) Control (n = 13) Male (n = 15) Female (n = 11)	Acupuncture (BL2, Ex-HN10 etc.) Insulin, Vitamin B SC injection.	Palpebal fissure width Angle of view 4th level: Excellent, Good, fair, poor	Palpebal fissure width: 3.11 ± 1.23→8.33 ± 1.31 Angle of view: 68.92 ± 22.31→16.23 ± 13.21 4th level: Excellent (n = 10), Good (n = 3), Fair (n = 0), Poor (n = 0) Palpebal fissure width 3.20 ± 1.20→5.21 ± 1.22 Angle of view 67.82 ± 23.73→38.21 ± 14.33 4th level: Excellent (n = 4), Good (n = 7), Fair (n = 2), Poor (n = 11)	Palpebal fissure width $p < 0.05$ Angle of view $p < 0.05$ Total efficiency: 100% $p < 0.01$
Zou (2018) [26]	Experimental (n = 25) Male (n = 11) Female (n = 14) Control (n = 25) Male (n = 13) Female (n = 12)	Acupuncture (BL1, GB14, GB1, Ex-HN10, ST2, TE23, ST1) Acupuncture (Traditional acupoints)	Palpebal fissure width Eye Movement 3rd level: Excellent, Good, Poor	Palpebal fissure width: 6.05 ± 0.43 Eye Movement: 4.54 ± 0.41 3rd level: Excellent (n = 13), Good (n = 11), Poor (n = 1) Palpebal fissure width:4.33 ± 0.30 Eye Movement: 3.54 ± 0.32 3rd level: Excellent (n = 8), Good (n = 10), Poor (n = 7)	Palpebal fissure width $p < 0.05$ Eye movement $p < 0.05$ Total efficiency: 96% $p < 0.05$
Li (2017) [27]	Experimental (n = 30) Male (n = 20) Female (n = 10) Control (n = 30) Male (n = 18) Female (n = 12)	Acupuncture (BL1, Ex-HN4, Ex-HN10, Ex-HN7, GB20, LI4, ST36, TE23, ST1, GV20), Herb medication Western Medication	3rd level: Excellent, Good, Poor Quality of life score	3rd level: Excellent (n = 20), Good (n = 8), Poor (n = 2) Quality of life score 55.70 ± 4.52→76.88 ± 8.65 3rd level: Excellent (n = 15), Good (n = 5), Poor (n = 10) Quality of life score 55.63 ± 4.81→67.29 ± 8.30	Total efficiency: 93.3% p =0.016 Quality of life score p =0.000

Table 2. (Continued).

Author (Y)	Sample size/ gender	Main treatment	Outcome Measure	Results	
Sun (2015) [28]	Experimental (n = 32) Male (n = 16) Female (n = 13)	Acupuncture (BL1, ST1, GB1, LI20, BL2, ST2, GV20, GB20, KI3, SP3, LR3, SP6, GB20)	Palpebral fissure width Size of pupil VAS: Diplopsia 3rd level: Excellent, Good, Poor	Palpebral fissure width 4.82 ± 1.03→3.27 ± 0.51 Size of pupil 2.79 ± 0.64→7.26 ± 0.43 VAS: Diplopsia 4.55 ± 1.33→2.35 ± 0.98 3rd level: Excellent (n = 20), Good (n = 8), Poor (n = 2)	Palpebral fissure width $p < 0.05$ Size of pupil $p < 0.05$ VAS: Diplopsia $p < 0.05$ Total efficiency: 93.75% $p > 0.05$
	Control (n = 29) Male (n = 18) Female (n = 14)	Acupuncture (Group 1 BL20, BL23, ST36, SP6, GB14 / Gruop2 BL20, CV6, ST36, GB14 / Group 3 ST36, LR3, SP6, GB20, GB14 / Group 4 GB14, BL2, GB20, BL17)		Palpebral fissure width 4.66 ± 0.92→3.96 ± 0.58 Size of pupil 2.70 ± 0.62→5.09 ± 0.41 VAS: Diplopsia 4.51 ± 1.27→3.68 ± 1.07 3rd level: Excellent (n = 20), Good (n = 8), Poor (n = 2)	
Yu (2015) [29]	Experimental (n = 43) Male (n = 24) Female (n = 19)	Acupuncture (GV26, PC6, SP6, GV23, Ex-HN3, GB12, LI4, GB20, BL10, Ex-HN5, BL1, Ex-HN7, ST3, ST2 etc.), Western medication	3rd level: Excellent, Good, Poor	3rd level: Excellent (n = 19), Good (n = 10), Poor (n = 11)	Total efficiency: 93.02% $p < 0.05$
	Control (n = 43) Male (n = 25) Female (n = 18)	Acupuncture (GV26, PC6, SP6, Ex-HN3, GV23, GV20, GB12, GB20, BL10, ST2, Ex-HN5, Ex-HN4, Ex-HN7), Western medication		3rd level: Excellent (n = 14), Good (n = 12), Poor (n = 10)	
Pan (2015) [30]	Experimental (n = 46) Male (n = 30) Female (n = 16)	Acupuncture (BL1, Ex-HN4, Ex-HN10, Ex-HN7, ST2, GB20, GV26, SP6), Herb medication, Western medication	4th level: Excellent, Good, fair, poor VAS: Ptosis, Size of pupil, Eye Movement, Diplopsia	4th level: Excellent (n = 13), Good (n = 19), Fair (n = 13), Poor (n = 10) Ptosis 2.68 ± 0.55→7.11 ± 0.46 Size of pupil 4.53 ± 0.32→3.56 ± 0.25 Eye Movement 2.36 ± 0.76→0.78 ± 0.56 Diplopsia 4.42 ± 1.02→2.35 ± 0.56	Total efficiency: 93.48% $p < 0.05$ Ptosis $p < 0.05$ Size of pupil $p < 0.05$ Eye Movement $p < 0.05$ Diplopsia $p < 0.05$
	Control (n = 46) Male (n = 30) Female (n = 16)	Western medication		4th level: Excellent (n = 8), Good (n = 15), Fair (n = 13), Poor (n = 10) Ptosis 2.67 ± 0.57→5.63 ± 0.38 Size of pupil 4.52 ± 0.35→3.89 ± 0.31 Eye Movement 2.34 ± 0.78→1.34 ± 0.95 Diplopsia 4.45 ± 1.05→3.43 ± 0.89	
Wang (2014) [31]	Experimental (n = 55) Male (n = 29) Female (n = 26)	Acupuncture (BL1, Ex-HN4, Ex-HN10, ST2, GB20, LI4, ST36, TE23, ST1, GV20, Ashi)	3rd level: Excellent, Good, Poor light reflex Diopter Palpebral fissure width	3rd level: Excellent (n = 29), Good (n = 18), Poor (n = 8) Light reflex 4.28 ± 0.84→3.41 ± 0.64 Diopter 53.76 ± 9.73→98.56 ± 10.39 Palpebral fissure width 2.72 ± 0.56→6.95 ± 0.79	Total efficiency: 85.5% $p < 0.05$ Light reflex $p < 0.05$ Diopter $p < 0.05$ Ocular width $p < 0.05$
	Control (n = 55) Male (n = 27) Female (n = 28)	Rehabilitation treatment		3rd level: Excellent (n = 21), Good (n = 15), Poor (n = 19) Light reflex 4.34 ± 0.90→3.79 ± 0.73 Diopter 52.04 ± 11.23→92.23 ± 12.12 Palpebral fissure width 2.63 ± 0.71→6.58 ± 0.64	
Chen (2014) [32]	Experimental (n = 20) Male (n = 13) Female (n = 7)	Acupuncture (BL1, BL2, GB14, GB1, LI4, ST36, SP6, ST1, LR3, GB37, SP3)	3rd level: Excellent, Good, Poor Diplopsia Palpebral fissure width	3rd level: Excellent (n = 3), Good (n = 16), Poor (n = 1) Diplopsia 4.25 ± 1.12→3.58 ± 1.25 Palpebral fissure width 2.54 ± 0.31→6.47 ± 0.19	Total efficiency: 95.0% $p < 0.05$ Diplopsia $p < 0.05$ Palpebral fissure width $p < 0.05$
	Control (n = 20) Male (n = 11) Female (n = 9)	Western medication		3rd level: Excellent (n = 1), Good (n = 13), Poor (n = 6) Diplopsia 4.53 ± 1.27→2.67 ± 1.03 Palpebral fissure width 2.44 ± 0.28→6.68 ± 0.21	
Chen (2013) [33]	Experimental (n = 29) Male (n = 16) Female (n = 13)	XNKQ Acupuncture (BL1, Ex-HN4, Ex-HN10, Ex-HN7, ST2, GB20, GV26, SP6, GV20, Ex-HN3, GV23, PC6, GB12, BL10)	4th level: Excellent, Good, fair, poor Palpebral fissure width Size of pupil	4th level: Excellent (n = 21), Good (n = 5), Fair (n = 2), Poor (n = 1) Palpebral fissure width 2.66 ± 0.52→7.15 ± 0.43 Size of pupil 4.58 ± 0.42→3.61 ± 0.34	Total efficiency: 96.55% $p < 0.05$ Palpebral fissure width $p < 0.05$ Size of pupil $p < 0.05$
	Control (n = 26) Male (n = 15) Female (n = 11)	Acupuncture (BL1, Ex-HN4, Ex-HN10, Ex-HN7, ST2, GB20, LI4, GV26, SP6, GV20, Ex-HN3, GV23, PC6, GB12, BL10)		4th level: Excellent (n = 9), Good (n = 7), Fair (n = 4), Poor (n = 6) Palpebral fissure width 2.71 ± 0.65→5.84 ± 0.47 Size of pupil 4.51 ± 0.36→3.96 ± 0.32	

Table 2. (Continued).

Author (Y)	Sample size/ gender	Main treatment	Outcome Measure	Results	
Yang (2012) [34]	Experimental (n = 74) Male (n = 42) Female (n = 32)	Acupuncture (BL2, GB14, Ex-HN4, GB1, ST2, LI4, ST36, TE23, SP6, LR3, BL11, CV12, ST40, KI6, GB43, Scalp), Western medication	4th level: Excellent, Good, fair, poor	4th level: Excellent (n = 45), Good (n = 15), Fair (n = 6), Poor (n = 8)	Total efficiency: 89.2% $p < 0.05$
	Control (n = 58) Male (n = 30) Female (n = 28)	Western medication		4th level: Excellent (n = 20), Good (n = 13), Fair (n = 3), Poor (n = 22)	
Liu (2008) [35]	Experimental (n = 24) Male (n = 13) Female (n = 11)	Acupuncture (BL1, Ex-HN10, ST36, TE23, SP6, LR3, GV20, ST40), Western medication	3rd level: Excellent, Good, Poor	3rd level: Excellent (n = 15), Good (n = 8), Poor (n = 1)	Total efficiency: 95.8% $p < 0.05$
	Control (n = 24) Male (n = 14) Female (n = 10)	Western medication		3rd level: Excellent (n = 9), Good (n = 8), Poor (n = 7)	
Liu (2013) [36]	Experimental (n = 30) Male (n = 17) Female (n = 13)	Acupuncture (BL1, ST1, Ashi)	3rd level: Excellent, Good, Poor Palpebral fissure width	3rd level: Excellent (n = 7), Good (n = 19), Poor (n = 4) Palpebral fissure width 0.80 ± 0.76→5.67 ± 2.70	Total efficiency: 86.7% $p < 0.05$ Palpebral fissure width $p < 0.05$
	Control (n = 30) Male (n = 18) Female (n = 12)	Western medication		3rd level: Excellent (n = 9), Good (n = 8), Poor (n = 7) Palpebral fissure width 0.88 ± 0.72→4.27 ± 2.01	
Yang (2017) [37]	Experimental (n = 30) Male (n = 16) Female (n = 14)	Acupuncture (ST1, BL1, Ex-HN4, GB1, BL2, Ex-HN3, GB14, ST2, GB20, GV23, LI4, LR3)	3rd level: Excellent, Good, Poor VAS: Diplopsia Size of pupil Palpebral fissure width	3rd level: Excellent (n = 17), Good (n = 12), Poor (n = 1) Diplopsia 4.73 ± 0.980→1.33 ± 0.959 Size of pupil 3.350 ± 0.2862→3.180 ± 0.4080 Palpebral fissure width 4.833 ± 0.5213→9.560 ± 0.5399	Total efficiency: 96.67% $p < 0.01$ Diplopsia $p < 0.05$ Size of pupil $p < 0.01$ Palpebral fissure width $p < 0.01$
	Control (n = 30) Male (n = 13) Female (n = 17)	Acupuncture (GB14, BL2, Ex-HN4, TE23, BL60, Ashi)		3rd level: Excellent (n = 10), Good (n = 13), Poor (n = 7) Diplopsia 5.07 ± 0.015→1.93 ± 0.640 Size of pupil 5.300 ± 0.3206→3.710 ± 0.3898 Palpebral fissure width 4.860 ± 0.5449→8.323 ± 0.5380	
Yang (2017) [38]	Experimental (n = 20) Male (n = 12) Female (n = 8)	Acupuncture (BL1, BL2, Ex-HN4, GB1, Ex-HN10, LI4, ST36, TE23), Western medication	3rd level: Excellent, Good, Poor VAS: Diplopsia Palpebral fissure width	3rd level: Excellent (n = 11), Good (n = 8), Poor (n = 1) Diplopsia 4.30 ± 1.49→1.20 ± 1.64 Size of pupil 5.35 ± 1.04→3.45 ± 0.60 Palpebral fissure width 4.85 ± 1.39→7.55 ± 1.19	Total efficiency: 95.0% $p < 0.05$ Diplopsia $p < 0.05$ Palpebral fissure width $p < 0.05$
	Control (n = 20) Male (n = 12) Female (n = 8)	Western medication		3rd level: Excellent (n = 7), Good (n = 9), Poor (n = 4) Diplopsia 4.70 ± 1.17→2.60 ± 2.16 Size of pupil 5.15 ± 0.88→3.95 ± 0.89 Palpebral fissure width 4.35 ± 0.81→6.45 ± 1.32	
Dong (2012) [39]	Experimental (n = 30) Male (n = 16) Female (n = 14)	Acupuncture (Upper eye point 1, 2, 3, Lower eye point 1,2)	3rd level: Excellent, Good, Poor VAS: Diplopsia Size of pupil Palpebral fissure width	3rd level: Excellent (n = 18), Good (n = 10), Poor (n = 2) Diplopsia 4.41 ± 1.11→1.00 ± 1.48 Size of pupil 5.39 ± 0.49→3.13 ± 0.57 Palpebral fissure width 4.72 ± 1.59→9.24 ± 1.80	Total efficiency: 93.3% $p < 0.05$ Diplopsia $p < 0.05$ Size of pupil $p < 0.05$ Palpebral fissure width $p < 0.05$
	Control (n = 30) Male (n = 17) Female (n = 13)	Acupuncture (GB14, Ex-HN4, BL2, BL1, TE23)		3rd level: Excellent (n = 10), Good (n = 14), Poor (n = 6) Diplopsia 4.45 ± 0.89→1.87 ± 1.66 Size of pupil 5.21 ± 0.51→3.65 ± 0.76 Palpebral fissure width 4.58 ± 1.43→8.30 ± 1.92	
Guo (2013) [41]	Experimental (n = 20) Male (n = 13) Female (n = 7)	Pharmacopuncture (BL1, GB14, GB1, Ex-HN10, ST2, GB20)	4th level: Excellent, Good, fair, poor Eyeball movement degree Palpebral fissure width Size of pupil	4th level: Excellent (n = 46), Good (n = 82), Fair (n = 81), Poor (n = 19) Eyeball movement degree Musculus rectus medialis 8.0 ± 1.4→20.6 ± 1.2 Superior rectus muscle 2.2 ± 0.5→4.4 ± 0.5 Musculus rectus inferior 2.3 ± 0.4→4.8 ± 0.3 Infer oblique muscle 3.9 ± 0.2→4.7 ± 0.3 Palpebral fissure width 2.2 ± 0.5→6.8 ± 0.2 Size of pupil 4.5 ± 0.3→3.4 ± 0.3	Total efficiency: 91.7% $p < 0.05$ Eyeball movement degree Musculuc rectus medialis $p < 0.05$ Palpebral fissure width $p < 0.05$
	Control (n = 20) Male (n = 11) Female (n = 9)	Western medication		4th level: Excellent (n = 25), Good (n = 75), Fair (n = 68), Poor (n = 60) Eyeball movement degree Musculus rectus medialis 8.1 ± 1.3→17.1 ± 1.1 Superior rectus muscle 2.4 ± 0.6→4.3 ± 0.4 Musculus rectus inferior 2.6 ± 0.2→4.1 ± 0.3 Infer oblique muscle 4.0 ± 0.1→4.5 ± 0.6 Palpebral fissure width 2.3 ± 0.6→4.9 ± 0.4 Size of pupil 4.6 ± 0.4→3.4 ± 0.2	

Table 2. (Continued).

Author (Y)	Sample size/ gender	Main treatment	Outcome Measure	Results	
Song (2013) [40]	Experimental (n = 24) Male (n = 21) Female (n = 3)	Fire-needle therapy (GB14, BL2, Ex-HN4, TE23, Ex-HN5, ST2, ST36)	3rd level: Excellent, Good, Poor	3rd level: Excellent (n = 15), Good (n = 8), Poor (n = 1)	Total efficiency: 95.8% $p < 0.05$
	Control (n = 24) Male (n = 19) Female (n = 5)	Acupuncture (BL20, BL18, BL23, ST36, GB37, GB20, GB14, BL2, TE23, Ex-HN5, ST2)		3rd level: Excellent (n = 10), Good (n = 7), Poor (n = 7)	
Zhan (2012) [42]	Group 1 (n = 24) Male (n = 10) Female (n = 14)	Electroacupuncture (BL1, BL2, GB14, Ex-HN4, ST2, ST36, TE23, SP6, ST1, SP10)	3rd level: Excellent, Good, Poor	Efficiency 3rd level: Excellent (n = 12), Good (n = 8), Poor (n = 4) Diopter 3rd level: Excellent (n = 12), Good (n = 9), Poor (n = 3)	Total efficiency: Group 1 83.30% Group 3 96.00% $p < 0.05$ Diopter efficiency: Group 1 85.20% Group 3 96.00% $p < 0.05$
	Group 2 (n = 23) Male (n = 12) Female (n = 11)	Rehabilitation treatment		Efficiency 3rd level: Excellent (n = 5), Good (n = 7), Poor (n = 11) Diopter 3rd level: Excellent (n = 5), Good (n = 8), Poor (n = 10)	
	Group 3 (n = 25) Male (n = 16) Female (n = 9)	Electroacupuncture, Rehabilitation treatment		Efficiency 3rd level: Excellent (n = 21), Good (n = 3), Poor (n = 1) Diopter 3rd level: Excellent (n = 21), Good (n = 3), Poor (n = 1)	

RCT, randomized controlled trial.

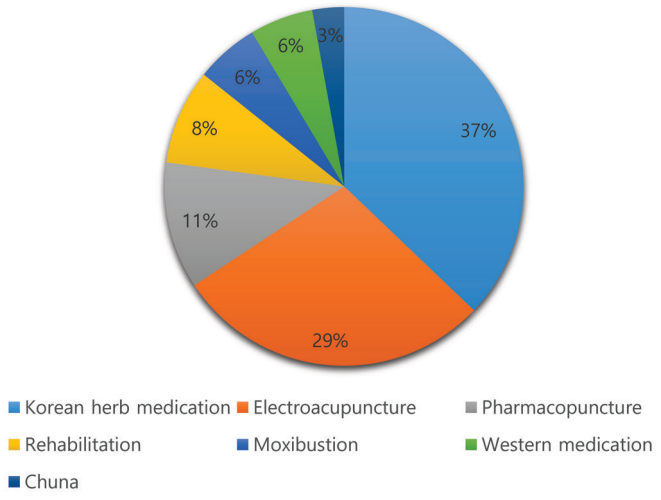

Fig. 4. The number of articles for supplementary intervention.

as a supplementary intervention [10,12-14,16-24], 10 used electroacupuncture [12-15,17-21,23,24], 4 used pharmacopuncture [13,18,19,24], 3 used rehabilitation [12,13,24], 2 used moxibustion [12,19], 2 used Western medication [10,20] and 1 used chuna [7]. Two of the RCTs used Korean herbal medication as a supplementary intervention [27,30] and 9 used Western medication [25,27,29,30,32,34-36,38] (Fig. 4). Frequently used acupoints included BL1, BL2, ST2, Ex-HN5, LI4, GB4, ST36, GB20, GB1 SP6, GV20, and LR3. Seven studies examined the effectiveness of new acupoints for acupuncture treatment of oculomotor nerve palsy compared with traditional acupoints. In studies that used the same intervention, there were significant differences in acupuncture techniques and acupoints used ($p < 0.05$).

Pharmacopuncture

There was 1 RCT that used pharmacopuncture as the main intervention. Of the 456 patients, 237 were men and 219 were women. The experimental group of 228 patients was divided into 4 groups according to Traditional Chinese Medicine (TCM) syndromes such as the syndrome of attack of collaterals by pathogenic wind, the syndrome of deficiency of spleen qi, the syndrome of liver-yang transforming to wind, or the syndrome of stagnation of qi and blood. The efficacy of pharmacopuncture was compared with that of Western intravenous fluid administration. Acupoints included BL1, GB14, ST2, GB1, and BL18. Additional acupoints were added according to the syndrome. GB20 and medical Chinese thorowax root injection were used for the syndrome of attack of collaterals by pathogenic wind, BL20 and medicinal astragalus membranaceus injection were used for the syndrome of deficiency of spleen qi, EX-HN5 and medicinal gastrodin injection were used for the syndrome of liver-yang transforming to wind, and BL17 and medicinal compound red-rooted salvia injection were used for the syndrome of staging of qi and blood. The results were statistically significant in the pharmacopuncture group ($p < 0.05$).

Fire-needling

There was 1 RCT with fire-needling as the main intervention. The study reported the effects of dry needling and fire-needling on the acupoints. Of the 48 included patients, 40 were male and 8 were female. In the experimental group, 24 patients underwent fire-needle acupuncture at GB14, BL2, EX-HN4, TE23, EX-HN5, ST2, and ST36. Dry needling was performed at BL23, ST36, GB37, GB20, GB14, BL2, TE23, EX-HN5, and ST2. The results were statistically significantly different in the fire-needling group compared to the control group ($p < 0.05$).

Electroacupuncture

There was 1 RCT that used electroacupuncture as the main intervention. Electroacupuncture, rehabilitation, electroacupuncture and rehabilitation were used to study the

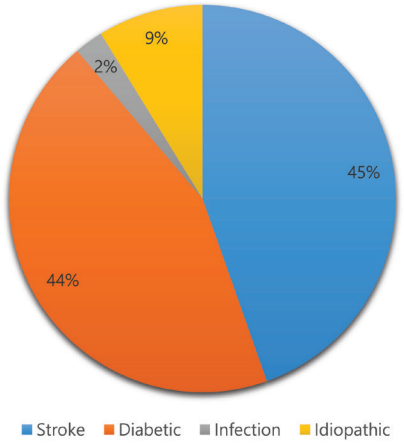

Fig. 5. The number of causes for oculomotor nerve palsy in articles.

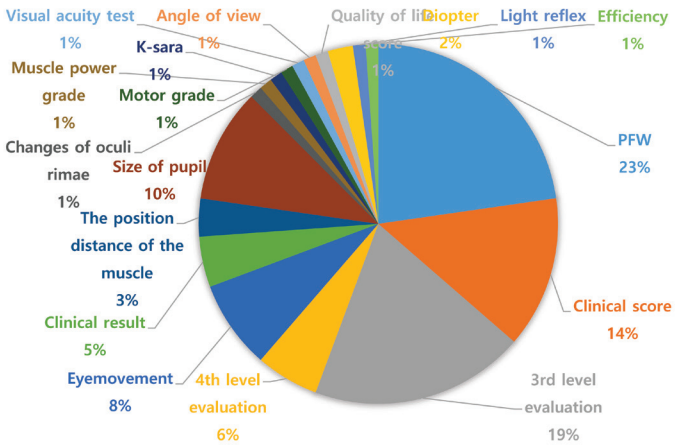

Fig. 6. The number of evaluation tools in articles.

significance of each treatment. Of the 72 included patients, 38 were men and 34 were women. Electroacupuncture, rehabilitation treatment, and combination therapy were conducted on individuals in an experimental group and a control group. Combination therapy was shown to be significantly more effective than electroacupuncture or rehabilitation alone ($p < 0.05$).

Analysis of causes

In 17 studies, stroke, diabetes, trauma, infection, and idiopathic causes were recorded, but 19 studies did not document the cause of oculomotor nerve palsy. There were 223 stroke patients [9,10,18,20,21,29,30,33,36], 221 diabetic patients [24,25,34-36], 12 infections reported [9,36], and 44 idiopathic cases [13,14,32] (Fig. 5).

Analysis of evaluation tools

Twenty studies used the palpebral fissure width (PFW) to analyze efficacy, 12 used clinical scores, 17 used 3rd level evaluations, 5 used 4th level evaluations, 7 used eye movement, 4 used clinical results, 3 used the position distance of the muscle, 9 used the size of the pupil, 1 used changes of oculi rimae, 1 used muscle power grade, 1 used the Korean version of the Scale for the Assessment and Rating of Ataxia (K-sara), 1 used motor grade, 1 used the visual acuity test, 1 used the angle of view, 1 used the quality of life score, 2 used diopters, 1 used the light reflex, and 1 used efficiency (Fig. 6).

Adverse reactions and side effects

Three RCTs reported side effects. All 6 adverse events did not affect the results. In the study by Li [27], 2 of the experimental groups complained of nausea, and the defect rate was 2.47%. After treatment, side effects disappeared. In the experimental group in Yu and Zeng's study [29], 1 patient had a hematoma, and the defect rate was 6.98%. Dong's study [39] reported bleeding in 1 patient in the treatment group and 1 patient in the control group, but these adverse events did not affect the results. There were no adverse effects reported in the case reports.

Risk of bias

The risk of bias was assessed for 18 RCTs according to the Cochrane handbook (Fig. 7).

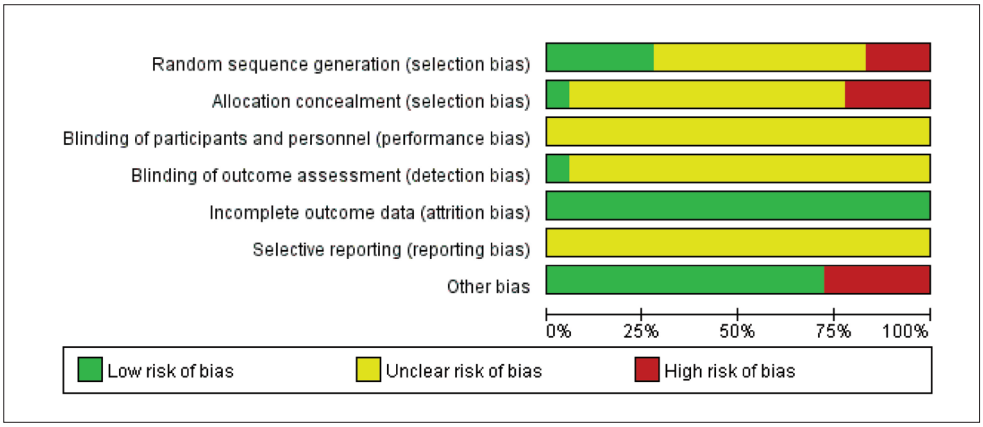

Fig. 7. Risk of bias graph.

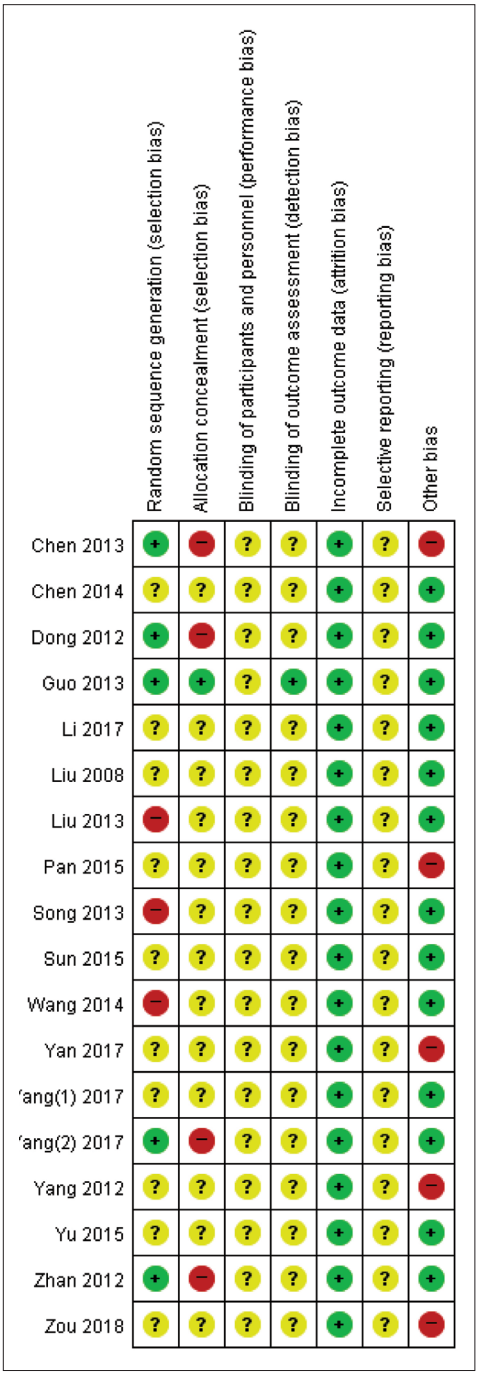

Fig. 8. Risk of bias summary.

Random sequence generation

Low risk was observed in 5 studies (28%). Three studies (17%) used random numbers, and 2 studies (11%) used computers to generate random sequences. Three studies (17%) showed high risk. One study (6%) was categorized without random assignment, and 1 study (6%) was assigned according to treatment time. One study (6%) was assigned using odd and even numbers. The remaining 10 studies (56%) did not clearly specify the randomization method.

Allocation concealment

Low risk was observed in 1 study (6%). One study (6%) used a serial numbered envelope [34]. Four studies (14%) had high risk. Four studies (14%) used a random number table [35,36,41,42], and the remaining 13 studies (72%) were classified as unclear hazards with no record of concealment methods.

Blinding of participants and personnel

Blinding was not performed in any of the 18 studies (100%). However, it was classified as an unclear risk as it was difficult to judge the effect of blinding on the evaluation of the result, because it was evaluated together with objective items such as PFW and efficiency rate.

Blinding of outcome assessment

Low risk was categorized using a single-blind method to avoid observer bias in 1 study (6%) [34]. Seventeen studies (94%) were classified as unclear risk.

Incomplete outcome data

Low risk was observed in 18 studies (100%). In 1 study (6%), 19 participants dropped out, but a sufficiently large number of participants were included in the study to prepare for dropouts [34]. 17 studies (83%) had no dropouts.

Selective reporting

There were no reports on protocols and predefined plans therefore, all 18 studies (100%) were classified as unclear hazards.

Other bias

Five studies (28%) were considered to have a high risk of bias. In 2 studies (11%), there were differences in the number of participants in the experimental and control groups at the experimental design stage, so there was a concern that the design of the study and the derivation of the results may not have been processed properly because there was no mention of the experimental design [35,37]. There was no mention of the number of treatments or the duration of treatment in 1 study (6%) [30], there was no mention of treatment in the control group in 1 study (6%) [26], and there was no mention of treatment in the experimental or control groups in 1 study (6%) [25]. In 13 studies (72%), there was no possibility of additional prejudice; these were classified as low risk (Fig. 8).

Summary of research trends

There were 36 studies that satisfied the inclusion criteria of this study. There were 14 South Korean studies and 22 studies from other countries. Of the foreign studies, 21 were in Chinese and 1 was in Israeli. All of the studies from Korea were case reports; there were no RCTs using acupuncture treatment for oculomotor nerve palsy. Of all the case reports, 8 (44.44%) were published after 2010, and 10 (55.56%) were published before 2010. Among all the RCTs, 17 (94.44%) were published after 2010, and 1 (5.56%) was published before 2010. All the studies that related to electroacupuncture, pharmacopuncture, and fire-needling were published in China after 2010 (Fig. 9). RCTs have been published relatively recently in China, but in Korea, only case reports have been recently published.

Acupoints were used in all 36 articles selected for this study. Acupoints around the eye such as BL1, BL2, ST2, TE23, Ex-HN5, LI4, GB14, ST36, GB20, and GB1 were mainly used. The frequency of each acupoint's use is shown in Table 3. There was 1 study that used scalp acupuncture [34] and 1 used acupoints around the eyelids [39].

Discussion

The oculomotor nerve is the third cranial nerve that divides into motor and parasympathetic fibers. Starting from the third cranial nerve nucleus, located in front of the middle cerebral cortex, the motor fibers dominate the levator muscles and the extraocular muscles, including the upper rectus muscle, inferior oblique muscle, medial rectus muscle, and lower rectus muscle. Parasympathetic nerve fibers dominate the circular fiber of the pupillary sphincter and the ciliary muscle. The nerve fibers pass through the cavernous sinus and enter the orbit through the superior orbital fissure, where they are divided into upper and lower branches. The upper branch dominates the upper rectus muscle and levator muscle, and the lower branch dominates the medial rectus muscle, lower rectus muscle, inferior oblique muscle, pupillary sphincter, and ciliary muscle [43].

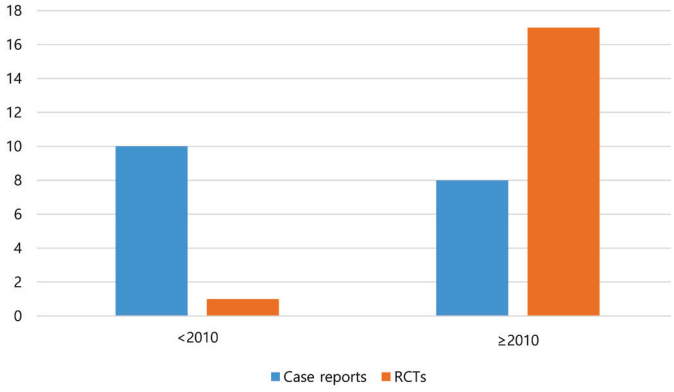

Fig. 9. The year articles were published. RCT, randomized controlled trial.

Table 3. Frequency of acupoints in 36 articles.

Frequency	Acupoint
24	BL1, BL2
22	ST2, TE23
21	Ex-HN5
20	LI4
19	GB14
18	ST36
17	GB20
16	GB1
13	GV20
12	LR3
11	SP6
7	TE5
5	GV26, EX-HN7
4	GV23, TE17
3	LI11, GB12, BL10
2	CV12, GB43, GB39, SI6
1	LI10, GB41, KI10, SI18, ST37, LR1, SP10, SP3, BL18, BL20, ST40, Ashi

Oculomotor nerve palsy causes unilateral ptosis, impairment of upper, lower, and medial oculomotor movement, and visual impairment. The eyeballs are displaced downward at rest. The sphincter pupillae muscle can also cause problems with the pupil size and reactivity [44].

The most common cause of oculomotor nerve palsy is ischemic damage to the oculomotor nerve. Other causes include head trauma, vascular disease, aneurysms, tumors, diabetes, and inflammatory diseases [45]. In Rush's retrospective study, causes of oculomotor nerve palsy included unknown origin in 26.3% of cases, trauma in 19.7%, vascular disease in 17.2%, neoplasms in 14.3%, aneurysms in 7.1%, and other in 15.4% [46].

In Western medicine, oculomotor nerve palsy is examined using brain magnetic resonance imaging, magnetic resonance angiography, and lumbar puncture. Clipping is performed for aneurysms, and resection is performed for tumors. If there is no abnormality upon examination, the individual is diagnosed with ischemic oculomotor nerve palsy. Follow-up examination is performed to determine the prognosis of the oculomotor nerve palsy. If there is no improvement within 1 year of observation, surgical treatment of the extraocular muscle and levator muscle is usually performed [47,48]. Covering the affected eye to avoid diplopia is recommended in the early stage of paralysis. When deviation is within 10Δ, use of prism glasses is recommended [49]. In other cases, corticosteroids, vitamins, and botulinum toxin can be injected.

According to a study by Lee et al on the recovery of oculomotor nerve palsy, 46.8% of patients had complete or partial recovery from oculomotor nerve palsy, while Rush and Young reported 48% and 57.3%, respectively. In a study by Park et al, the recovery rate was 44.8% [50].

In the diagnosis of differential TCM symptoms, the causes of oculomotor nerve paralysis are classified into attack of wind to the collaterals, wet phlegm obstruction, wind heat affection, wind of liver moving inside, stagnation of qi and blood, deficiency of endowment, and unilateral properties [51]. Conservative Korean medical treatment, such as herbal medicine, acupuncture, pharmacopuncture, electroacupuncture or moxibustion, is performed according to the cause of oculomotor nerve paralysis.

In the case reports, clinical symptoms were improved with the use of additional interventions such as chiropractic treatments, herbal medicine, Western medicine, moxibustion, rehabilitation, pharmacopuncture or electroacupuncture.

Eight of the RCTs reported acupuncture therapy to be significantly more effective than Western medication alone [7,9,14,16-18,20]. Six of the RCTs reported efficacy by comparing experimental acupoints with traditional acupoints [26,28,29,33,37,39]. Sun et al conducted acupuncture treatment according to diagnosis of TCM syndrome in the control group. The experimental group showed significant improvement with acupoint treatment around the eyes [28]. Two studies have reported that Xingnao Kaiqiao acupuncture therapy is more effective than traditional acupuncture therapy in cerebrovascular patients [29,33]. Yang et al reported that the efficacy of acupoints around the eyes was improved using a multi-needle shallow puncture technique rather than conventional methods [37]. Wang's study compared effects in 3 groups using rehabilitation. There was significant improvement in the group that combined acupuncture

and rehabilitation treatment [31]. There were 2 RCTs using nontraditional acupoints. Yang performed scalp acupuncture [34], and Dong used upper eye point 1, upper eye point 2, upper eye point 3, lower eye point 1, and lower eye point 2 [39]. Both studies reported significant improvement when compared with traditional acupoints.

In a systematic review of the therapeutic acupoints for oculomotor nerve palsy using 23 previously reported studies, the frequency of use for each acupoint was as follows: BL2 7.2%, BL1 6.8%, TE23 6.5%, LR3 6.5%, Ex-HN4 5.8%, GB14 5.4%, ST36 5.0% 4.7%, GB20 4.3%, Ex-HN10 4.0%, SP6 4.0%, and LI4 4.0%. By body part, the face was used in 60.8% of studies, upper limb in 23.0%, lower limb in 7.5%, nuchal in 6.2% and the back in 2.2%. In summary, acupuncture treatment for oculomotor nerve palsy was considered to be effective at giving a strong and sustained stimulation to the acupoint around the eyes with multi-needle. Acupoints around the eye seem to be effective when chosen according to TCM syndrome.

In the Guo study, Western medication and pharmacopuncture were used differently according to TCM syndrome. The therapeutic effect, degree of movement of the affected eyeball, and changes in the oculi rimae and pupil, were analyzed. The therapeutic effect was 92.2% in the attack of wind to the collaterals, 91.0% in the deficiency of spleen qi, 91.6% in the hyperactivity of liver-yang transforming to wind, and 91.7% in the stagnation of qi and blood ($p < 0.05$). There was a significant difference in the degree of movement of the muscle rectus medialis, superior rectus muscle, muscle rectus inferior and inferior oblique muscle in both experimental and control groups ($p < 0.05$). However, when comparing the experimental and control groups, the difference in the degree of movement was only apparent in musculus rectus medialis. When comparing changes in the pupil, there were significant differences among all groups after treatment ($p < 0.05$), but when comparing changes in the oculi rimae, significant differences were only noted when the experimental group and control group were compared ($p < 0.05$) [16].

According to Song's study, the efficacy in the experimental group using fire-needling at BL2, BL20, BL18, BL23, GB14, GB37, GB20, ST2, ST36, TE23, Ex-HN4, and Ex-HN10 was superior to the acupuncture treatment group ($p < 0.05$) [41].

Zhan et al's study [42] compared electroacupuncture, rehabilitation, and combined electroacupuncture and rehabilitation treatments. Efficiency and diopters were effective in the electroacupuncture group, but significantly more effective in the combination group ($p < 0.05$). The efficacy rate of rehabilitation, which accounted for a large proportion of non-surgical treatments in Western medicine was 52.17%, the effective rate of electroacupuncture was 83.30%, and the efficacy rate of combination treatment was 96.0%. Significance was reported in all studies compared with conservative Western medical therapy. It is therefore effective to use a combination of various treatments when using acupuncture in clinical practice.

PFW was the most common method used to evaluate efficacy. It measures the distance from the midpoint of the upper eyelid to the midpoint of the lower eyelid. Clinical scores, clinical results, and evaluation level, which are qualitative evaluations, differ in detailed symptom evaluation. They do not evaluate objective measures and it is not enough to evaluate specific treatment effects. The visual analogue scale score and the quality of life score are subjective evaluations and are considered to be supplementary evaluation items. The K-sara and motor grade were used to assess stroke sequelae. The evaluation methods should utilize objective measurement values such as PFW, size of the pupil, angle of view, diopters, light reflex and movement of the eyeball.

Three RCTs reported side effects, but none of them directly affected the study results. In the study by Li [27], 2 participants in the experimental groups complained of nausea and improved after treatment. The side-effect rate was 2.47% [27]. In Yu and Zeng's study [29], 1 patient in the experimental group had a hematoma, nausea, and vertigo. The side-effect rate was 6.98%. In the control group, 1 patient had hematoma, erythema and nausea. There was not a significant difference between side-effect rates between control and experimental groups. Dong's study [39] reported bleeding in 1 patient in the treatment group and 1 in the control group. However, there were no effects on the study results. There were no reports of adverse events in the case reports included in this study. Reports of side effects should be reported quantitatively and in detail. In the future, evaluation of the consistency of acupuncture treatment is warranted.

The 18 RCTs included in this study were analyzed according to the Cochrane Handbook's Risk of Bias Assessment. It is impossible to apply the blinding method to both the therapist and the patient because of the nature of the study comparing acupuncture with other treatment interventions. Treatment without blinding may result in reduced expectations of controls, and differences in behavior between groups. Overall, the quality of the studies assessed was low. In subsequent studies, as it is difficult to blind the subjects and the practitioner, the evaluators should clearly indicate how the study has been blinded.

Most articles in this study reported the effectiveness of acupuncture-based treatment of oculomotor nerve palsy. Case reports were reported before 2010, but RCTs have been actively reported since 2010. In all studies, acupuncture alone or in combination showed improvement and statistical significance in the experimental group compared with the control group. Many frequent acupoints used in the experimental groups were around the eyes. Strong stimulation therapy showed a tendency to be more effective. PFW, clinical score, and level evaluation were used as evaluation methods, but there were no unified criteria between studies. It has been shown that acupuncture therapy studies of oculomotor nerve palsy are increasing and that acupoints around the eyes are effective.

This study had some limitations. In the study-selection process, the main word and intervention was selected, regardless of the quality. A systematic review of the literature was conducted, including all studies satisfying inclusion criteria. Additionally, this study searched 5 databases but did not include other non-English language studies or ongoing clinical trials, and gray texts not listed in the database that were missing. Moreover, the classification of acupuncture therapy had various limitations, such as order and depth, which made it difficult to analyze.

Conclusion

This study analyzed 36 articles according to the inclusion criteria of the study design. Eighteen case reports and 18 RCTs were included in the analysis. Acupuncture treatment for oculomotor nerve palsy was significantly more effective than Western medicine monotherapy. Dry needling, pharmacopuncture, electroacupuncture, and fire-needle therapy can be used alone or in combination for treatment of oculomotor nerve palsy.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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Appendix 1.

NDSL		
#1	Search (((“oculomotor nerve paralysis”) OR (“oculomotor nerve palsy”)) OR (“third nerve palsy”)))	2469
#2	Search (((“Acupuncture”) OR (“Electroacupuncture”)) OR (“Pharmacopuncture” OR (“Dry needling”)) OR (“Acupotomy”)))	50560
#3	Search (#1) AND #2	24
Cochran library		
#1	Search (((“oculomotor nerve paralysis”) OR (“oculomotor nerve palsy”)) OR (“third nerve palsy”)))	41
#2	Search (((“Acupuncture”) OR (“Electroacupuncture”)) OR (“Pharmacopuncture” OR (“Dry needling”)) OR (“Acupotomy”)))	11773
#3	Search (#1) AND #2	3
CNKI		
#1	Search (((“oculomotor nerve paralysis”) OR (“oculomotor nerve palsy”)) OR (“third nerve palsy”)))	1117
#2	Search (((“Acupuncture”) OR (“Electroacupuncture”)) OR (“Pharmacopuncture” OR (“Dry needling”)) OR (“Acupotomy”)))	107883
#3	Search (#1) AND #2	169
OASIS		
#1	Search (((“oculomotor nerve paralysis”) OR (“oculomotor nerve palsy”)) OR (“third nerve palsy”)))	22
#2	Search (((“Acupuncture”) OR (“Electroacupuncture”)) OR (“Pharmacopuncture” OR (“Dry needling”)) OR (“Acupotomy”)))	6233
#3	Search (#1) AND #2	8
Pubmed		
#1	Search ((oculomotor nerve paralysis) OR oculomotor nerve palsy) OR third nerve palsy	5171
#2	Search ((((Acupuncture) OR Electroacupuncture) OR Pharmacopuncture) OR Dry needling) OR Acupotomy	30418
#3	Search (#1) AND #2	15