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Review Article

# A Review of Research on the Treatment of Peroneal Nerve Palsy by Acupuncture and Moxibustion

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**ABSTRACT**

**Background:** This was a retrospective review of published articles reporting acupuncture and moxibustion treatment of peroneal nerve palsy.
**Methods:** On-line database searches were carried out using; Cochrane Library, Pubmed, CNKI, NDSL and OASIS to find articles reporting acupuncture and moxibustion treatment for peroneal nerve palsy. Duplicate articles and studies that were not relevant to the topic were excluded, along with review articles and commentaries.
**Results:** 20 studies were selected, 18 clinical case studies (47 patients) and 2 randomized controlled trials (154 patients). Intervention treatments included acupuncture, moxibustion, bee-venom (BV), pharmacopuncture, electroacupuncture and acupotomy. Surprisingly, although peroneal nerve palsy is not a very rare disease, only 2 studies out of 20 carried out a randomized controlled trial.
**Conclusion:** Although studies to date report the efficacy of acupuncture and moxibustion treatment in peroneal nerve palsy patients, the absence of objective evaluation and the absence in the reporting of side-effects remains an issue.



## Introduction

Peroneal nerve palsy is a common nerve injury in the lower extremities [1]. The peroneal nerve is located on the lateral side of the sciatic nerve and contains fibers of L4,5 and S1,2 neural muscles. After separation from the tibial nerve at the distal third of the thigh, it is divided into superficial and deep branches at the anterior compartment of the lower leg, comprising motor nerves and sensory nerves [2].

The nerve is located subcutaneously as it travels above the bone at the fibular neck, and so it is prone to pressure at this site [3]. Pressure may also be caused by nerve compression due to prolonged poor posture or may result from systemic diseases such as diabetes [4]. When the peroneal nerve is paralyzed, dorsi flexion and eversion of the foot become difficult. As a result, foot drop phenomenon arises, where the foot is dragged and appears as if the patient cannot lift it. In order to compensate for this condition, patients walk with a distinctive raised foot in their walking pattern [5].

According to the Health Insurance Review and Assessment Service, peroneal nerve palsy has increased from 1,282 in 2012 to 1,524 in 2016. The number has increased rapidly from 164 in January 2017 to 265 in July 2017 [6].

Peroneal nerve palsy diagnosis can be made by assessing patient history, clinical symptoms, nerve conduction testing, and electromyography. It is also useful to compare body temperature using Digital Infrared Thermal Imaging (DITI), and diagnose range of motion (ROM) of the ankle joint. Brain and lumbar spine magnetic resonance imaging (MRI) can also be used to examine and to rule out stroke and lumbar neuropathy (lumbar intervertebral disc herniation and spinal stenosis) [7].

Conservative treatment of peroneal nerve palsy by trauma is usually performed for 3 months and may include physiotherapy, massage and exercise therapy, but it is recommended that surgical treatment is performed if the degree of nerve damage and the response to conservative treatment is ineffective [8,9].

Peroneal nerve palsy is a medical condition considered as a weakness of limb that is treatable with acupuncture and moxibustion

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at acupoints SP9, SP6, and ST36 [10]. The exact diagnosis and duration of treatment of peroneal nerve palsy is not described in acupuncture medical text books.

To date, there have been only 17 reports of peroneal nerve palsy treatment in the Korean Journal of Korean Medical Sciences. To investigate the diverse array of acupoints, and the effect and duration of treatment of peroneal nerve paralysis, we searched domestic and foreign databases to investigate the practices of acupuncture and moxibustion treatment.

## Materials and Methods

### *Research subjects and search methods*

In order to review the literature related to this research topic, we searched domestic [the National Digital Science Library (NDSL) and the Oriental Medicine Advanced Searching Integrated System (OASIS)] and foreign electronic databases (Pubmed, Cochrane Library, and CNKI).

Searches were performed up to March 14, 2018, and the search period was not limited. For search terms, MeSH (Medical Subject Heading) terms such as "peroneal nerve palsy," "foot drop," "acupuncture," "moxibustion," "electroacupuncture," "pharmacopuncture," "dry needling," and "acupotomy" were used. The following keywords were used for searching and were adjusted to each database: ("peroneal nerve palsy" OR "foot drop" OR/AND ("acupuncture," OR "moxibustion," OR "electroacupuncture," OR "pharmacopuncture," OR "dry needling," OR "acupotomy"). The details are shown in Appendix 1.

Clinical studies using acupuncture and moxibustion as a main treatment intervention were included in the study. We set no limitation on the publication language or format (e.g., thesis, report) in the selection of papers. In addition to the traditional acupuncture treatment, acupuncture treatment included electroacupuncture, bee-venom (BV), pharmacopuncture and acupotomy. Research studies that did not involve acupuncture treatment, and studies where primary intervention was not acupuncture and moxibustion, but CHUNA and MET were excluded (Fig. 1).

The selection and exclusion of duplicate papers was conducted by 2 or more independent people. The publications selected for inclusion proceeded to the second selection/exclusion criteria. Based on these criteria, a total 20 studies including 18 clinical case studies and 2 randomized controlled trials (RCTs), were selected and analyzed.

## Results

### *Analysis of research design*

From a total of 20 clinical studies, 16 domestic studies and 4 international studies were included for analysis. The subjects included in the study were from 18 clinical cases and 2 RCTs (Fig. 2).

### *Analysis of sample size*

There were 17 studies with less than 20 cases, and 1 study with 20 or more cases, in the 18 clinical studies. Among the two RCTs, there was 1 study with 60 or more, but less than 90 patients, and 1 study with 90 or more patients.

There were 47 patients in the 18 clinical cases; 23 males and 24 females. There were 154 patients from 2 RCTs, including 91 males and 63 females.

### *Treatment method*

The treatment method was limited to acupuncture and moxibustion. The categories of treatment included all acupuncture and moxibustion therapies, including general acupuncture, BV, pharmacopuncture, electroacupuncture, acupotomy, indirect and

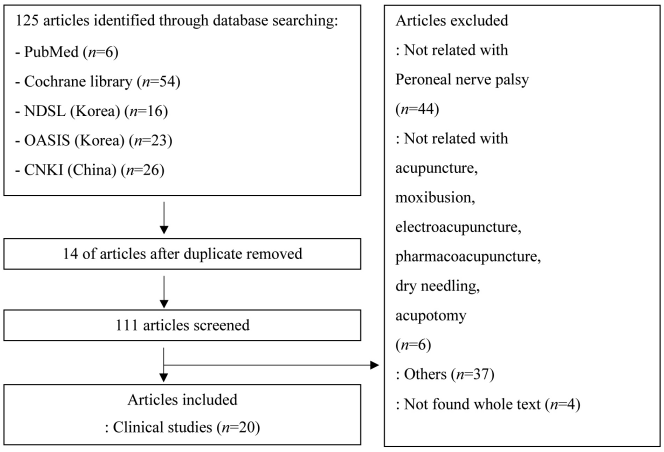


Fig. 1. Article selection flow chart.

NSDL, National Digital Science Library; OASIS, Oriental Medicine Advanced Searching Integrated System.

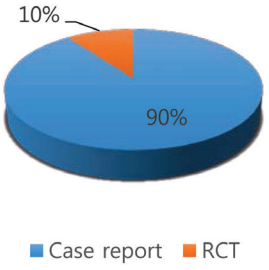


Fig. 2. Analysis of acupuncture and moxibustion treatment of Peroneal nerve palsy study design.

RCT, randomized controlled trial.

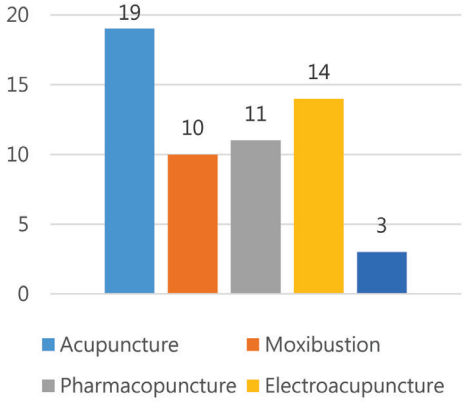


Fig. 3. Analysis of treatment of Peroneal nerve palsy.

direct moxibustion. In the 20 clinical trials, 19 studies conducted a variety of treatments, and 1 study conducted a single treatment. In some studies, additional treatment such as herbal medicine, electrical stimulation, silver spike point, interference current therapy, microwave, transcutaneous electrical nerve stimulation, ultrasound, and taping were performed.

In the 19 studies analyzed, the majority of treatment methods were acupuncture, with moxibustion treatment in 10 cases, BV and pharmacopuncture in 11 studies, electroacupuncture in 14 studies, and acupotomy in 3 studies including overlapping treatment methods (Table 1, Table 2; Fig. 3).

Table 1. Summary of 18 Case Reports Concerning Patients Treated with Acupuncture and/or Moxibustion.

| Author (y) | Patients gender/ Age (y) | Intervention | Total Number of treatment/ Treatment period | Outcome measures | Results |
|---|---|---|---|---|---|
| Choi (2004) [13] | Male/ 24 | Acupuncture, Moxibustion, BV, Electroacupuncture, H-med, PTx. | 24×/ 2 mo | ROM (Dorsi flexion, Eversion) | Improved |
| Kim (2011) [18] | Female/ 16 | Acupotomy, Acupuncture, Pharmacopuncture, PTx. | 2×/ 2 d | ROM (Dorsi flexion)<br>Tinel sign<br>MMT<br>Takakura's rating scale | Improved |
| Chu (2007) [9] | Male/ 26<br>Male/ 20<br>Female/ 61 | Acupuncture, Electroacupuncture, Taping | 25×/ 25 d<br>45×/ 45 d<br>8×/ 8 d | ROM (Dorsi flexion)<br>VAS<br>DITI | Improved |
| Yu (2017) [22] | Male/ 45 | Acupuncture, Electroacupuncture, Pharmacopuncture, H-med, PTx. | 24×/ 20 d | ROM (Dorsi flexion, Eversion)<br>NRS<br>MMT | improved |
| Lee (2006) [23] | Male/ 21 | Acupuncture, Electroacupuncture, H-med, PTx. | 27×/ 27 d | ROM (Dorsi flexion)<br>VAS<br>Gait disturbance | improved |
| Na (2005) [24] | Female/ 40 | Acupuncture, H-med, PTx. | 20×/ 20 d | ROM (Dorsi flexion)<br>VAS<br>DITI | improved |
| Kim (2014) [14] | Male/ 24 | Acupuncture, BV, H-med, PTx. | 24×/ 12 d | ROM (Dorsi flexion, Eversion, Inversion)<br>VAS<br>NRS<br>DITI<br>AHS | improved |
| Jang (2009) [25] | Male/ 50 | Acupuncture, Moxibustion, Pharmacopuncture | 13×/ 1 d | ROM (Dorsi flexion)<br>Gait Disturbance | Improved |
| Kim (2015) [15] | Female/ 73 | Acupuncture, Electroacupuncture, Pharmacopuncture, Moxibustion, H-med, PTx. | 33×/ 3 mo | ROM (Dorsi flexion)<br>NRS<br>DITI<br>AHS<br>MMT | Improved |
| Hwang (2005) [26] | Female/ 45<br>Female/ 71 | Acupuncture, Electroacupuncture, Moxibustion | 30×/ 1 mo | ROM (Dorsi flexion)<br>Gait disturbance<br>MMT | Improved |
| Kim (2016) [27] | Male/ 55 | Acupuncture, Electroacupuncture, Moxibustion, BV, H-med, PTx. | 39×/ 2 mo | ROM (Dorsi flexion)<br>NRS<br>DITI | Improved |
| Byun (2014) [28] | Female/ 26 | Acupuncture, Electroacupuncture, Pharmacopuncture, PTx. | 39×/ 47 d | ROM (Dorsi flexion)<br>NRS<br>MMT | Improved |
| Kim (2012) [19] | Female/ 16<br>Male/ 53<br>Female/ 23 | Acupotomy, Acupuncture, Pharmacopuncture, PTx. | 2-6×/ 9 d<br>2-6×/ 13 d<br>2-6×/ 30 d | ROM (Dorsi flexion)<br>Tinel sign<br>Motor test<br>Takakura's rating scale | Improved |
| Jo (2012) [8] | Male/ 29<br>Female/ 32 | Acupuncture, Electroacupuncture, Moxibustion, Pharmacopuncture, H-med, PTx. | 69×/ 69 d | ROM (Dorsi flexion)<br>NRS<br>MMT | Improved |
| Kim (2000) [29] | Female/ 30 | Acupuncture, Electroacupuncture, H-med, PTx. | 28×/ 37 d | DITI | Improved |
| Du (2008) [30] | Males/ 13<br>Females/ 11 | Acupuncture, Moxibustion | 1×/ day/ 2 y 3 mo | ROM (Dosi flexion)<br>Relief of symptom | 91.7%<br>Excellent ($n$=18)<br>Good ($n$=4)<br>Poor ($n$=2) |
| Yang (2007) [21] | Female/ 61 | Acupuncture, Moxibustion, BV, H-med, PTx. | 50×/ 25 d | ROM (Dorsi flexion)<br>Gait disturbance | Improved |
| Han (2009) [31] | Female/ 54 | Acupuncture, Electroacupuncture, Moxibustion, H-med | 20 ×/ 20 d | ROM (Dorsi flexion)<br>VAS<br>MMT | Improved |

### *Acupuncture*

There were 18 clinical case studies and 1 RCT included in the total of 19 studies. Mostly, multiple points such as ST36, GB43, ST41, GB39, ST40, LR3, and ST37 were used. Among them, the ST36 was used the most on 17 occasions, and the next was used 14 times in GB34. There was 1 RCT using single point KI5, and 1 case report using various points (LU8, KI7, KI3, SP3). Acupuncture treatment was performed once or twice a day (Table 3).

### *Moxibustion*

The 10 studies on moxibustion consisted of 9 clinical case studies and 1 RCT. Nine of them used indirect moxibustion and 1

Table 2. Summary of 2 RCT Concerning Patients Treated with Acupuncture and/ or Moxibustion.

| Author (y) | Group | Sample size/ Gender | Main treatment | Main outcomes | *p* |
|---|---|---|---|---|---|
| Wu (2009) [20] | Experimental group | 32/ Male (uninformed)<br>Female (uninformed) | Acupotomy<br>(KI1) | Total efficiency 90.6% ($p < 0.05$)<br>Excellent ($n = 19$, 59.3%)<br>Good ($n = 10$, 31.3%)<br>Poor ($n = 3$, 9.4%) | Q-DASH<br>baseline $p = 0.185$<br>2 weeks $p = 0.083$<br>6 weeks $p = 0.227$ |
| | Control group | 32/ Male (uninformed)<br>Female (uninformed) | Electroacupuncture<br>(ST36, LI5) | Total efficiency 68.9 ($p < 0.05$)<br>Excellent ($n = 13$, 40.6%)<br>Good ($n = 9$, 28.1%)<br>Poor ($n = 10$, 31.3%) | VAS<br>baseline $p = 0.071$<br>2 weeks $p = 0.021$<br>6 weeks $p = 0.129$ |
| Yang (2014) [21] | Experimental group | 45/ Male ($n = 29$)<br>Female ($n = 16$) | Electroacupuncture, Moxibustion, Moving Cupping<br>(Needle type: thickness 0.35mm, length 40mm)<br>GB34, ST36, GB39, LR3: depth 25mm<br>GB41, ST41: depth 13mm | Total efficiency 97.8% ($p < 0.01$)<br>Excellent ($n = 24$)<br>Very good ($n = 17$)<br>Good ($n = 3$)<br>Poor ($n = 1$) | Total efficiency<br>$p < 0.05$<br>VAS<br>$p < 0.05$ |
| | Control group | 45/ Male ($n = 31$)<br>Female ($n = 14$) | Western medication<br>(vitamin B1 10mg 3×/ day,<br>Mecobalamine 0.5mg 3×/ day) | Total efficiency 82.2% ($p < 0.01$)<br>Excellent ($n = 11$)<br>Very good ($n = 13$)<br>Good ($n = 13$)<br>Poor ($n = 8$) | |

Table 3. Summary of 19 Case Reports & RCT Concerning Patients Treated with Acupuncture.

| Author (y) | Gender/Sample size | V (Voltage), mA (electric current), Hz (Frequency) | Frequency/Treatment period | Time (m) |
|---|---|---|---|---|
| Choi (2004) [13] | Male/ 24 | Constant, 9V, 1.3-20Hz | 1×/d/ 2 mo | 15 |
| Chu (2007) [9] | Male/ 26<br>Male/ 20<br>Female/ 61 | DC 12V, 850mV, 50Hz | 1× /d /8~40 d | 20 |
| Yu (2017) [22] | Male/ 45 | Mixed 2-4Hz | Mon~Fri: 1×/ d<br>Sat,Sun: 2×/ d<br>Total 24×/ d/ 20 d | 15 |
| Lee (2006) [23] | Male/ 21 | DC 12V, 850mA, Mixed 2Hz & 120Hz | 1×/ day/ 1 mo | 20 |
| Kim (2015) [15] | Female/ 73 | 2-4Hz | 1×/ d<br>Total 33×/ 1 mo | 15 |
| Hwang (2005) [26] | Female/ 45<br>Female/ 71 | 9V, 280mA, 2-4Hz | 1× in 2 days/ 1 mo | 20 |
| Kim (2016) [27] | Male/ 55 | 2-4Hz | 1×/ d<br>Total 39×/ 18 d | 15 |
| Byun (2014) [28] | Female/ 26 | 10V, 1mmA | 5 ×/ wk/ 2 mo | 15 |
| Jo (2012) [8] | Male/ 29<br>Female/ 32 | Constant, 60Hz | 1×/ d /69 d | 15 |
| Kim (2000) [29] | Female/ 30 | Uninformed | 1×/ d<br>Total 28×/ 28 d | Uninformed |
| Yang (2007) [21] | Female/ 61 | Mixed 3Hz | 1×/ d/ 25 d | 20 |
| Han (2009) [31] | Female/ 54 | 80V, 9mA, 60Hz | 1×/ d/ 20 d | 20 |
| Wu (2009) [20] | Male/ 32 (uninformed)<br>Female/ 36-48 (uninformed) | 100Hz | 1×/ d/ uninformed | 20 |

RCT, randomized controlled trial.

used direct moxibustion. It was performed 3 to 9 times a day, and the acupoints selected were similar to those used for acupuncture (Table 4).

### *BV and pharmacopuncture*

All 11 cases of BV and pharmacopuncture were case studies. Different types of pharmacopuncture were used in each case. BV was used in 3, placenta extract injection was used in 3, Oogong injection was used in 2, Hwanglyeonhaedok injection was used in 1, and Shinbaro injection was used in 1 study. In 1 study, Xinyang-hu injection and BV were used at the same time. The BV and the pharmacopuncture were mainly injected to ST36 and GB34 (Table 5).

### *Electroacupuncture*

There were 14 studies included in the analysis that used electroacupuncture treatment, consisting of 12 clinical case studies and 2 RCTs. Most of these studies used electroacupuncture as the main treatment. All were performed with acupuncture and were performed once a day, using some or all points. In one of the RCTs, electroacupuncture was used in the control group and acupotomy was used in the experimental group. In the RCT, acupotomy was compared to electroacupuncture (Table 6).

### *Acupotomy*

The 3 studies on acupotomy consisted of 2 clinical case studies and 1 RCT. All cases were treated using a single point; GB34 in 2 clinical case studies and KI1 in the RCT. In 2 case studies, 3 or 4 disposable needles were used each time, and the depth of penetration was measured using ultrasonic waves for each acupoint, usually within a range of 0.5 - 1 cm. The needles were removed immediately after stimulation. The practitioner had 21 years of clinical experience. No control group was assessed in this study (Table 7).

Table 4. Summary of 10 Case Reports & RCT Concerning Patients Treated with Moxibustion.

| Author (y) | Gender/ Sample size | Indirect or direct/ Amount | Frequency/ Treatment period |
|---|---|---|---|
| Choi (2004) [13] | Male/ 24 | Indirect, 2/ points | 1×/ d/ 2 mon |
| Jang (2009) [25] | Male/ 50 | Indirect, 3/ points | Uninformed |
| Kim (2015) [25] | Female/ 73 | Indirect, uninformed | 1×/ d Total 33×/ 18 d |
| Hwang (2005) [26] | Female/ 45<br>Female/ 71 | Indirect, 9/ points | 1×/ d/ 1 mo |
| Kim (2016) [27] | Male/ 55 | Indirect, uninformed | 1×/ d<br>Total 39×/ 1 mo |
| Jo (2012) [8] | Male/ 29 Female/ 32 | Indirect, uninformed | 1×/ d / 69 d |
| Du (2008) [30] | Males/ 13 Females/ 11 | Indirect, 3-5/ points | 1×/d / 2y 3 mo |
| Yang (2007) [21] | Female/ 61 | Direct, uninformed | 1× every 2 d / 25 d |
| Han (2009) [31] | Female/ 54 | Indirect, 3/ points | 1×/d / 20 d |
| Yang (2014) [21] | Males/ 29 Females/ 16 | Indirect, uninformed | 1×/d / 2 mo |

RCT, randomized controlled trial.

Table 5. Summary of 11 Case Reports Concerning Patients Treated with Pharmacopuncture.

| Author (y) | Gender/ Sample size | Type/ Amount | Frequency/ Treatment period |
|---|---|---|---|
| Choi (2004) [13] | Male/ 24 | Xinyang-hu injection 0.4cc + BV 0.2cc | 1×/ d/ 2 mo |
| Kim (2011) [18] | Female/ 16 | Oogong injection 0.5cc | Uninformed |
| Yu (2017) [22] | Male/ 45 | Placenta 1cc | 1×/ d<br>Total 1 ×/ 20 d |
| Kim (2014) [14] | Male/ 24 | BV 5% 0.6cc | 1×/ d / 12 d |
| Jang (2009) [25] | Male/ 50 | Placenta 0.5cc | Uninformed |
| Kim (2015) [15] | Female/ 73 | BV, Hwanglyeonhaedok injection | BV 25 Time, Hwanglyeonhaedok 21×/ 1 mo |
| Kim (2016) [27] | Male/ 55 | BV 10% | 3×/ wk/18 d |
| Byun (2014) [28] | Female/ 26 | Shinbaro injection 1cc | 5×/ wk/ 2 mo |
| Kim (2012) [19] | Female/ 16<br>Male/ 53<br>Female/ 23 | Oogong injection 0.5cc | Uninformed/ 5~11 d |
| Jo (2012) [8] | Male/ 29<br>Female/ 32 | Placenta 0.9cc | 1× in 2 d/ 69 d |
| Yang (2007) [21] | Female/ 61 | BV 1:3000 0.2cc | 1×/ day/ 25 d |

### *Assessment tools*

There were 18 studies which evaluated the ROM of the ankle joint, 17 case studies and 1 RCT. Dorsiflexion, eversion, and inversion were evaluated in ROM.

To assess the subjective symptoms of patients in 10 studies, Visual Analogue Scale and Visual Numeric Rating Scale were used. The Manual Muscle Test was used in 7 studies to evaluate muscle movement. In addition, DITI, which measures the temperature of the lower extremities, was used in 6 studies. Gait disturbance was measured in 4 studies to evaluate improvement in gait status. In addition, Tinel sign was used in 1 study and Ankle-Hind-foot Scale was used in 2 studies. In 1 national study, the satisfaction rating was evaluated before and after treatment using Takakura's rating scale. Among the 3 studies with more than 20 cases, 2 studies used the 4-step classification method - Excellent, Very Good, Good, and Poor, and 1 study used the 3-step classification method - Excellent, Good and Poor.

### *Reports on adverse reactions or side effects*

Of the 20 studies, none reported adverse reactions or side effects. However, there are no studies that clearly stated measurement or reporting of adverse reactions. Therefore, it is difficult to know for sure whether the investigator has overlooked the adverse reactions and side effects of the acupuncture treatment, or the adverse reactions and side effects did not actually occur.

### *Synthesis of research trends*

As a result of summarizing the research without limiting the search period and the language, 20 studies satisfied the inclusion criteria. From the 20 studies included in the analysis, 17 were published in Korean in Korea, which was the highest number, and 3 were published in Chinese from China. Despite peroneal nerve palsy and foot drop being common diseases, there have only been a few studies on the application of acupuncture treatment

Table 6. Summary of 13 Case Reports & RCT Concerning Patients Treated with Electroacupuncture.

| Author (y) | Gender/ Sample size | V (voltage), mA (electric current), Hz (frequency) | Frequency/ Treatment period | Time (m) |
|---|---|---|---|---|
| Choi (2004) [13] | Male/ 24 | Constant, 9V, 1.3-20Hz | 1×/ d/ 2 mo | 15 |
| Chu (2007) [9] | Male/ 26<br>Male/ 20<br>Female/ 61 | DC 12V, 850mV, 50Hz | 1×/ d/ 8~40 d | 20 |
| Yu (2017) [22] | Male/ 45 | Mixed 2-4Hz | Mon-Fri: 1×/ d<br>Sat,Sun: 2×/ d<br>Total 24×/ 20 d | 15 |
| Lee (2006) [23] | Male/ 21 | DC 12V, 850mA, Mixed 2Hz&120Hz | 1×/ d/1 mo | 20 |
| Kim (2015) [15] | Female/ 73 | 2-4Hz | 1×/ d<br>Total 33×/ 1 mo | 15 |
| Hwang (2005) [26] | Female/ 45<br>Female/ 71 | 9V, 280mA, 2-4Hz | 1× in 2 days/ 1 mo | 20 |
| Kim (2016) [27] | Male/ 55 | 2-4Hz | 1×/ d<br>Total 39×/ 18 d | 15 |
| Byun (2014) [28] | Female/ 26 | 10V, 1mmA | 5×/ wk/ 2 mo | 15 |
| Jo (2012) [8] | Male/ 29<br>Female/ 32 | Constant, 60Hz | 1×/ d/ 69 d | 15 |
| Kim (2000) [29] | Female/ 30 | Uninformed | 1×/ d<br>Total 28×/ 28 d | Uninformed |
| Yang (2007) [21] | Female/ 61 | Mixed 3Hz | 1×/ d/ 25 d | 20 |
| Han (2009) [31] | Female/ 54 | 80V, 9mA, 60Hz | 1×/ d/ 20 d | 20 |
| Wu (2009) [20] | Male/ 32 (uninformed)<br>Female/ 36-48 (uninformed) | 100Hz | 1×/ d / Uninformed | 20 |

RCT, randomized controlled trial.

Table 7. Summary of 3 Case Reports & RCT Concerning Patients Treated with Acupotomy.

| Author (y) | Gender/ Sample size | Acupoint/ Method | Frequency/ Treatment period |
|---|---|---|---|
| Kim (2011) [18] | Female/ 16 | GB34/ 3-4 needle a time, depth 0.5-0.7cm | 2×/ 10 d |
| Kim (2012) [19] | Female/ 16<br>Male/ 53<br>Female/ 23 | GB34/ 3-4 needle a time, depth 0.5-0.7cm | 2-6 ×/ 5~11 d |
| Wu (2009) [20] | Male/ 32 (uninformed)<br>Female/ 36-48 (uninformed) | KI1 | 3 ×/ uninformed |

RCT, randomized controlled trial.

for these conditions. Nevertheless, acupuncture treatment used for this disease was consistent, and since the first case report was made in 2000, there has been approximately 1 to 3 cases reported annually from 2000 to 2017, excluding 2001, 2002, 2003, and 2013. Amongst the 20 studies, 11 studies were published before 2010, and 9 studies were published after 2010. Searching the treatment methods by year, amongst the total 19 studies involving acupuncture treatment, 10 studies (52.63%) were published before 2010 and 9 studies (47.36%) after 2010. In the 10 moxibustion therapy studies, 6 (60%) were published before 2010, and 4 (40%) after 2010. In the 14 electroacupuncture treatments, 7 (50%) were published before 2010, and 7 (50%) after 2010. In the 11 studies involving treatment of BV and pharmacopuncture, 3 (27.27%) were published before 2010, and 8 (72.72%) after 2010. In the 3 acupotomy treatments, 1 (33.33%) was published before 2010 and 2 (66.67%) after 2010. Since 2010, research on the acupuncture and electroacupuncture treatment of peroneal nerve palsy has been consistently performed. Research on moxibustion treatment has been gradually declining, while BV and pharmacopuncture research studies have increased. The study of acupotomy treatment has not been conducted since 2012.

Only 1 RCT used a single treatment, whilst the other 19 studies used various treatments. The most common treatment method was acupuncture treatment (19), followed by electroacupuncture (14), BV and pharmacopuncture (11), moxibustion (10), and acupotomy (3).

The most common acupuncture point was ST36, which was used in 17 studies excluding 2 studies that did not mention the acupoints. The second most frequently used acupoints were GB34, ST41, GB39, ST40, LR3 and ST37 (Table 8).

## Discussion

Clinical causes of peroneal nerve palsy are diverse and can occur after a stroke, lumbar neuropathy or diabetes. In this case, treatment is aimed at treating the disease [11]. On the other hand, when a foot drop occurs due to an external factor in the peroneal nerve, non-surgical treatment such as rest and exercise is the first line of treatment. Surgical therapy may be considered if the patient does not respond to 3 months of conservative treatment [12].

In this current study, a total of 20 articles were analyzed. Treatment with acupuncture was consistently used in all studies.

Table 8. Acupoints Usage Among 19 Studies for the Treatment of Peroneal Nerve Palsy (Foot Drop).

| Number of studies | Acupoints |
|---|---|
| 17 | ST36 |
| 14 | GB34 |
| 7 | ST41 |
| 6 | GB39, ST40, LR3, ST37 |
| 5 | KI3 |
| 4 | GB40 |
| 3 | ST38, BL60 |
| 2 | GB41, ST39, ST44, GV3, GB30, ST35, BL62, LI4, LI11, PC6, TE5, BL25, LU8, KI7, SP3 |
| 1 | LR4, BL23, GB31, SP5, LU9, BL52, GB43, KI1, LI5, BL26, KI10 |

Moxibustion treatment was mostly used before 2010 and its use has been gradually declining. Acupotomy was used in 2009, 2011 and 2012, with research studies using BV and pharmacopuncture increasing.

BV was used in studies by Choi [13], Kim [14], Kim [15], Yang [16] and Kim [17]. BV was the only treatment used in studies by Kim [14], Yang [16] and Kim [17] In the remaining studies, BV and other pharmacopuncture treatments were used together. Choi [13] used BV and Xinyang-hu injection, and Kim [15] used BV and Hwanglyeonhaedok injection. It is difficult to accurately compare the treatment effect of single BV and the mixed treatment of BV and pharmacoacupuncture because all 5 studies used various treatments besides BV and pharmacoacupuncture and their evaluation index was not the same.

Acupotomy was used for treatment of peroneal nerve palsy in studies performed by Kim [18] and Kim [19]. The treatment was practiced 3 times a week at GB34 using 3 or 4 disposable needles at each treatment. The depth of penetration was measured using ultrasonic waves for each acupoint, usually within a range of 0.5 to 1 cm. The needles were removed immediately after stimulation by a practitioner who had 21 years of clinical experience.

Recently, treatment diversity has been observed with various treatments, in addition to conventional traditional acupuncture such as BV, pharmacopuncture and acupotomy. In the study using acupotomy, moxibustion and herbal medicine were used in combination, but acupotomy was used as the main treatment method.

There were 2 RCTs investigating oriental medicine treatment of peroneal nerve palsy. In a study where peroneal nerve palsy was treated using acupotomy at KI1 [20], the treatment was performed alone with a treatment rate of 90.6%, which was higher than 68.9% in the control group using electroacupuncture ($p < 0.05$). In an experimental group treated using oriental medicine such as electroacupuncture and moxibustion, the treatment rate was 97.8%, whereas the control group treated with western medication such as vitamin supplements and mecobalamine, the treatment rate was lower at 82.2% ($p < 0.01$) [21].

Although there seem to be very few reported side effects of oriental medicine treatment, we should not overlook the fact that side effects or adverse reactions may occur so these need to be monitored and reported to validate acupuncture treatment in peroneal nerve palsy.

In addition, it is regrettable that the domestic studies meeting the search criteria are all based on case reports. It is also worth pointing out that despite the fact that peroneal nerve palsy is not a very rare disease, all 17 studies in Korea have been reported in less than 3 cases. In the future, we will be able to establish an objective basis for the efficacy of oriental medicine treatment if a case-control study or a large-scale randomized control study is performed for peroneal nerve palsy using various oriental medical treatments.

Finally, there are limitations in that there are no unified evaluation indicators, as various evaluation indicators have been used to measure clinical symptoms of peroneal nerve palsy. In all studies, indicators for pain, muscle strength, and temperature were used, and ideally, 1 index should be developed to cover them all. Even if the case reports are sporadic, it would be much easier to compare related studies if the same index was used.

This study has limitations as it is not a systematic review of literature, and includes all domestic and overseas studies on acupuncture treatment of peroneal nerve palsy without limiting the quality of papers in the selection of studies. Therefore, more active research is needed to provide a scientific basis for the treatment of peroneal nerve palsy.

## Conclusion

A total of 20 clinical trials were selected based on the research method set out in this study. Among them, 18 case studies and 2 RCT's were selected. The results of the analysis are as follows.

1. Conservative therapy in the treatment of peroneal nerve palsy (foot drop) can be used as a positive basis for preferential treatment of acupuncture, moxibustion, BV, pharmacopuncture, electroacupuncture and acupotomy.
2. The most commonly used acupoint was ST36, followed by GB34, ST41, GB39, ST40, LR3, and ST37. The most common sites of acupoint were ST, GB and LR.
3. Most of the treatment methods were used in combination, with the main intervention used being acupuncture, followed by electroacupuncture, pharmacopuncture, moxibustion, and acupotomy. Research on acupuncture continues to be performed, whereas moxibustion treatment is on the decline, whilst BV and pharmacopuncture treatment have been gradually increasing. Research on acupotomy has been performed in 2009, 2011 and 2012, with a detailed presentation of the studies performed, and has been shown to be an effective method of treatment for peroneal nerve palsy.

## Conflicts of Interest

The authors have no conflicts of interest to declare.

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Appendix 1. Search Formulas According to Each Database.

A. Results for PubMed.

| Search | Query | Items found |
|---|---|---|
| #1 | Search “Peroneal nerve palsy”[tw] | 454 |
| #2 | Search “Peroneal nerve palsy”[mh] | 571 |
| #3 | Search “Foot drop”[tw] | 1,026 |
| #4 | Search “Acupuncture”[mh] | 21,725 |
| #5 | Search “Acupuncture”[tw] | 24,543 |
| #6 | Search “Moxibustion”[mh] | 1,540 |
| #7 | Search “Moxibustion”[tw] | 2,275 |
| #8 | Search “Electroacupuncture”[mh] | 3,262 |
| #9 | Search “Electroacupuncture”[tw] | 4,549 |
| #10 | Search “Pharmacopuncture”[tw] | 3 |
| #11 | Search “Dry needling”[tw] | 356 |
| #12 | Search “Acupotomy”[mh] | 21,032 |
| #13 | Search “Acupotomy”[tw] | 39 |
| #14 | Search (“Peroneal nerve palsy”[tw]) OR (“Peroneal nerve palsy”[mh]) OR (“Foot drop”[tw]) | 1,799 |
| #15 | Search (Acupuncture[mh] OR Acupuncture[tw]) OR Moxibustion[mh]) OR Moxibustion[tw]) OR Electroacupuncture[mh]) OR Electroacupuncture[tw]) OR Pharmacopuncture[tw]) OR Dry needling[tw]) OR Acupotomy[mh]) OR Acupotomy[tw]) | 27,086 |
| #16 | Search (“Peroneal nerve palsy”[tw]) OR (“Peroneal nerve palsy”[mh]) OR (“Foot drop”[tw]) AND (Acupuncture[mh) OR (Acupuncture[tw]) OR (Moxibustion[mh]) OR (Moxibustion[tw]) OR (Electroacupuncture[mh]) OR (Electroacupuncture[tw]) OR (Pharmacopuncture[tw]) OR (Dry needling[tw]) OR (Acupotomy[mh]) OR (Acupotomy[tw]) | 6 |

B. Results for OASIS Database.

| Search | Query | Items found |
|---|---|---|
| #1 | Search Peroneal nerve palsy | 9 |
| #2 | Search Foot drop | 17 |
| #3 | #1 OR #2 | 22 |
| #4 | Search Acupuncture | 2,874 |
| #5 | Search Moxibustion | 444 |
| #6 | Search Electroacupuncture | 213 |
| #7 | Search Pharmacopuncture | 5 |
| #8 | Search Dry needling | 0 |
| #9 | Search Acupotomy | 40 |
| #10 | #4 OR #5 OR #6 OR #7 OR #8 OR #9 | 3,130 |
| #11 | #3 AND #10 | 23 |

C. Results for Cochrane Library.

| Search | Query | Items found |
|---|---|---|
| #1 | Search Peroneal nerve palsy | 20 |
| #2 | Search Foot drop | 503 |
| #3 | #1 OR #2 | 522 |
| #4 | Search Acupuncture | 12,202 |
| #5 | Search Moxibustion | 4,173 |
| #6 | Search Electroacupuncture | 1,606 |
| #7 | Search Pharmacopuncture | 2 |
| #8 | Search Dry needling | 0 |
| #9 | Search Acupotomy | 24 |
| #10 | #4 OR #5 OR #6 OR #7 OR #8 OR #9 | 12,726 |
| #11 | #3 AND #10 | 54 |

D. Results for NDSL Database

| Search | Query | Items found |
|---|---|---|
| #1 | Search Peroneal nerve palsy | 224 |
| #2 | Search Foot drop | 729 |
| #3 | #1 OR #2 | 942 |
| #4 | Search Acupuncture | 24,467 |
| #5 | Search Moxibustion | 3,011 |
| #6 | Search Electroacupuncture | 4,135 |
| #7 | Search Pharmacopuncture | 7 |
| #8 | Search Dry needling | 261 |
| #9 | Search Acupotomy | 118 |
| #10 | #4 OR #5 OR #6 OR #7 | 30,446 |
| #11 | #3 AND #11 | 16 |

E. Results for CNKI Database.

| Search | Query | Items found |
|---|---|---|
| #1 | SU = (“Peroneal nerve palsy”+”Foot drop”+”腓骨神經麻痺”+”足下垂”) | 962 |
| #2 | SU = (“Acupuncture”+”Moxibustion”+”Electroacupuncture”+”Pharmacopuncture”+”Dry needling”+”Acupotomy”+”针”+”灸”+”電針”+”藥針”+”刀針”) | 151,547 |
| #3 | #1 AND #2 | 26 |