Scalp acupuncture for neurological disorders:
a systematic review of randomized clinical trials

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Abstract

**Background and aim:** Scalp acupuncture (SA) is a type of micro-system acupuncture that has been widely used to treat neurological disorders (NDs), mainly in East-Asian countries. The aim of this systematic review is to assess the current clinical evidence of SA in treatment of NDs.

**Methods:** Systematic searches were conducted on 13 electronic databases up to August 2010. All randomized clinical trials (RCTs) which compared SA treatment of NDs with sham acupuncture, standard therapies (STs) or no treatment were included. Methodological quality was assessed using the Cochrane risk of bias.

**Results:** In total, 29 RCTs were included. All of them compared the effectiveness of SA with STs for ND subjects. The Cochrane risk of bias tool indicated that the methodological quality of these studies was generally low. For stroke, SA showed a more favorable response rate when compared to STs. For Parkinson disease (PD), vascular dementia and cerebral palsy, there was no difference between SA and STs in terms of effectiveness.

**Conclusion:** Our systematic review and meta-analysis suggested that there is limited evidence that SA can be used effectively as a substitute or adjuvant treatment for stroke and PD. To confirm the effectiveness of SA, sham-controlled, high quality trials are warranted in the future.
**Background**

Neurological disorders (NDs) are a leading cause of morbidity [1]. Diseases in this category are easily recurrent, have a relatively high prevalence ratio (30.5% between 2001 and 2003) [2] and tend to be chronic and debilitating, resulting in inconveniences for daily life [3]. The burden of NDs is very large; they affect more than 1.5 billion people globally, and their prevalence rate has increased as life expectancies have lengthened [4].

The general intervention for NDs involves various medications that regulate the level and function of neurotransmitters [5]. Rehabilitation and even surgery are also conventional treatments. However, no interventions have been proven to be clearly effective for NDs.

Scalp acupuncture (SA) is defined as a modern acupuncture technique penetrating specific scalp areas or lines of the cerebral cortex based on a specific theory [6]. SA differs from classic acupuncture in that it has its own theoretical basis, and its acupoints are quite different from classic acupoints. In East Asian countries, SA is often used for NDs, psychiatric disorders, pain control and some kinds of neurogenic visceral dysfunctions [7-8]. Clinical evidence has suggested that SA improves nervous function [9-11]. Additionally, SA has been reported to alleviate the gradual damage of neurons by suppressing the cytokine-mediated inflammatory reaction [12-13].

As of this report, several reviews have investigated the effectiveness of classic acupuncture for NDs including stroke [14], Parkinson disease (PD) [15], vascular dementia [16], insomnia [17], depression [18] and headache [19]. Their results suggested that there was at least some limited evidence for the effectiveness of classic acupuncture as a treatment for NDs.

In the case of SA for NDs, there has been no systematic review that demonstrates the therapeutic evidence of SA for NDs. The aim of this systematic review is to summarize the current clinical evidence and to evaluate the effectiveness of SA for NDs according to
PRISMA guideline [20].
Methods

Data sources

Two reviewers (SJL, BCS) searched the following 13 electronic databases from their inceptions up to August 2010: Medline, The Cochrane Library 2010 (Issue 8), EMBASE, CINAHL, Chinese Medical Database (China Academic Journal, www.cnki.net), 7 Korean Medical Databases (Korean Traditional Knowledge Portal, National Discovery of Science Leaders, Korean Medical Database, DBPIA, Korean Studies Information, Korea Knowledge Portal, Korean Library Information System Network) and the Japanese Medical Database (Nii Scholarly and Academic Information Navigator, ci.nii.ac.jp).

Searches

NDs with high prevalence were included as searching keywords. Searching keywords were [“nervous system diseases” OR “neurologic disorder” OR “cerebral palsy” OR “Parkinson disease” OR “vascular dementia” OR “stroke” OR “epilepsy” OR “multiple sclerosis” OR “delirium” OR “headache” OR “Alzheimer disease”] AND [“scalp acupuncture” OR “head acupuncture” OR “cranial acupuncture” OR “skull acupuncture”], and we included research in English, Chinese, Korean and Japanese. Furthermore, the references in all located articles were manually searched for further relevant articles. No restriction was imposed on language or publication form. Therefore, we also included dissertations and abstracts.

Study selection

Types of studies

This review included both parallel and cross-over randomized clinical trials (RCTs) that focused on the effect of penetrating SA with or without electrical stimulation on NDs in
human patients. We included RCTs that compared the effectiveness of SA with relevant control interventions. We also included studies in which co-interventions were given equally in both groups in addition to SA.

**Types of participants**

Human patients with NDs were included regardless of age, sex, race or the phase of disease. The term ND is defined as a disorder of the body’s nervous system and encompasses a wide range of disabling conditions, including stroke, cerebral palsy (CP), autism, PD, multiple sclerosis and dementia [4].

**Types of interventions**

We included four types of SA: SA based on Proposed Standard International Acupuncture Nomenclature (PSIAN) theory [21], Dr. Jiao’s SA (SA developed by Professor Zhu Mingqing) [6], Yamamoto New SA (YNSA) [22] and SA based on the anatomical structure [23-24]. Because non-penetrating techniques or needling without a theoretical basis was not acknowledged as SA, we excluded RCTs that involved needling on the scalp exclusive from the fixed SA lines or points that did not coincide with SA theory. We also excluded trials with mixed interventions and those that used different acupuncture methods in combination with SA because we could not evaluate the effectiveness of SA by itself.

**Types of controls**

We included controls of no treatment, sham (or placebo) (scalp) acupuncture or relevant standard therapies (STs), such as medication or rehabilitation. Studies that compared 2 different kinds of acupuncture methods and studies with unconfirmed control groups (such as herbal medicine) were excluded.
**Types of outcome measures**

The main outcome measures were any scales that measured response rate, activities of daily living (ADL), motor function, severity of dementia or cognitive function for ND patients.

**Analysis**

**Data extraction and quality assessment**

Two independent reviewers (SJL, BCS) read every hard copy of the included RCTs, and data from the articles were validated and extracted according to the assessment criteria defined in this review. Any disagreements were resolved by consensus, and if needed, we obtained an opinion from the third author (MSL). The quality of the included studies was assessed using the Cochrane risk of bias [25]. The Cochrane risk of bias is composed of 6 domains: sequence generation, allocation concealment, blinding of participants, personnel and outcome assessors, incomplete outcome data, selective outcome reporting and other sources of bias. The judging criteria were as follows: ‘Yes’ for low risk of bias, ‘No’ for high risk of bias and ‘Unclear’ for uncertain risk of bias.

**Data synthesis**

To evaluate the effects of SA on each outcome, we summarized the original data by calculating relative risk (RR) values with 95% confidence intervals (CIs) if they were dichotomous in nature. For continuous data, we summarized the standardized mean difference (SMD) with 95% CIs. Weighted mean differences (WMDs), RRs and SMDs were calculated using the Cochrane Collaboration software [Review Manager 5 (RevMan) version 5.0.25 for Windows. Copenhagen: The Nordic Cochrane Centre].
The variance of change was determined by a correlation factor of 0.5 as suggested by the Cochrane Collaboration [26]. We then pooled data across studies using random effect models because clinical heterogeneity was expected. The chi-square test and the Higgins $I^2$ test were used to assess statistical heterogeneity.

**Subgroup analysis and sensitivity analysis**

Using the Cochrane software, we conducted a subgroup analysis to evaluate the robustness of the overall effects in subgroups by response rate because of the possibility of clinical heterogeneity, which could have resulted from the study design, sample size, publication year or SA methods. For the study design, we divided all included RCTs according to whether the STs were adjunctive with SA or not (SA+ST versus ST or SA versus ST). The mean sample size of the included RCTs was 86, so we divided the studies into 2 subgroups: over or under 86 participants. The median publication year was 2000, so the subgroups were further divided according to publication before or after 2000. We also divided the 29 included RCTs according to the 4 SA theories. Finally, we conducted a sensitivity analysis to evaluate the overall effects according to study quality, as assessed by the risk of bias. RCTs that clearly described sequence generation and patient blinding and that were also free of selective reporting were evaluated as high quality studies, while the others were regarded as low quality ones.

**Publication bias**

Publication bias was assessed by a funnel plot using the response rate with the Cochrane software.
Results

Study Description

We found 698 potentially relevant studies, of which 669 trials were excluded. In total, 29 publications fit the criteria for inclusion (Figure 1). Of them, 21 used a two-parallel-arm group design [9, 11, 24, 27-45]; 6 used a three-parallel-arm group design [10, 46-50]; and 2 used a four-parallel-arm group design [23, 51]. The 29 RCTs included 2504 ND patients in total (Table 1).

All the trials originated from China [9-11, 23-24, 27-51]. Of the 29 included RCTs, 17 RCTs investigated stroke [23-24, 27, 34-36, 38, 40-41, 43-50]; 4, PD [29-31, 33]; 4, vascular dementia [9, 11, 28, 37, 51]; 2, cerebral palsy [10, 32]; 1, multiple tics-coprolalia syndrome [39]; and 1, aphemia [42]. The key data from the included RCTs are described in Table 1.

One rigorous sham-controlled study was published in 2010. However, it was excluded because healthy subjects were included for control group [52].

Outcomes

I. Stroke

Seventeen RCTs investigated the effect of SA compared with that of STs for 1693 stroke patients [23-24, 27, 34-36, 38, 40-41, 43-50].

Response rate

Seven RCTs reported the response rate as the main outcome [23, 38, 40, 43, 46-47, 49]. Three of these studies were designed as SA versus STs [23, 38, 43], while 4 were SA+STs versus STs [40, 46-47, 49]. Four indicated that SA treatment was more effective than STs.
[23, 38, 40, 43]. A meta-analysis showed a favorable effect of SA in terms of response rate regardless of the study design (n=711; RR, 1.23; 95% CI, 1.12 to 1.34, P<0.00001; heterogeneity: $\chi^2=7.92$, $P=0.24$, $I^2=24\%$, Figure 2A).

**Activities of daily living (ADL)**

Five of the included RCTs evaluated ADL as the main outcome [23, 34, 47-48, 50]. Two studies were designed as SA versus STs [23, 48], while three were SA+STs versus STs studies [34, 47, 50]. Each showed that SA had a therapeutic effect that was similar to that of general STs (table 1). In the aggregate, the pooled meta-analysis of these RCTs showed a superior therapeutic effect for SA relative to STs with high heterogeneity ($I^2=94\%$, Figure 2B).

**Motor function**

Four studies assessed the improvement of motor function by means of the Fugel-Meyer assessment (FMA) [23, 34, 46, 48]. Two were designed as SA versus STs [23, 48], while 2 were SA+STs versus STs [34, 46]. SA combined with STs had more favorable effects than did STs alone (n=100; WMD, -10.98; 95% CI, -13.68 to -8.28, P<0.00001; heterogeneity: $\chi^2=0.06$, $P=0.80$, $I^2=0\%$), but SA treatment alone gave less favorable effects (Figure 2C). In total, the results of the meta-analysis indicated that SA had more favorable effects when compared to STs with high heterogeneity ($I^2=91\%$, Figure 2C).

**Nervous function**

Eight studies assessed the ability of SA to improve the nervous function of stroke patients [24, 27, 36, 40-41, 46-47, 50], and all were designed as SA+STs versus STs. In 3 RCTs, SA showed therapeutic effects that were no different than those of current STs [24, 41, 47].
The others reported more favorable effects for SA in improving nervous function compared with STs [27, 36, 40, 46, 50]. A meta-analysis of these trials showed a positive effect for SA when compared with STs with high heterogeneity ($I^2=86\%$, Figure 2D).

**II. Parkinson disease**

Four RCTs investigated the effect of SA compared with STs for 80 PD patients [29-31, 33]. The improvement of motor function, as assessed by the Unified PD Rating Scale (UPDRS), was the only main outcome considered in 2 RCTs [31, 33]. The others used brain imaging to measure the changes in specific neurotransmitters or their transporters [29-30]. A meta-analysis of the former 2 trials showed no difference in the effects between SA and STs (n=60; WMD, -0.82; 95% CI, -3.18 to 1.53, P=0.49; heterogeneity: $\chi^2=0.63$, P=0.43, $I^2=0\%$, Figure 3).

**III. Vascular dementia**

Vascular dementia was the target disease in 4 RCTs [9, 11, 28, 37, 51]. Three RCTs were designed as SA versus STs [11, 37, 51], and the other one was SA+STs versus STs [9, 28]. In these studies, response rate, ADL and cognitive function were compared between subjects treated with SA and those treated with STs. SA was slightly superior to STs for response rate, but the 2 therapies had similar effects in terms of ADL and cognitive function.

**IV. Cerebral palsy**

Two RCTs investigated the effect of SA compared to STs for 170 CP patients [10, 32]. One was SA versus STs [10], and the other one was SA+STs versus STs [32]. Response rate, ADL and motor function were used as the main outcomes. Only ADL was evaluated in
both RCTs, and there was no difference between SA and STs for this criterion.

V. Others

Multiple-tics coprolalia [39] and aphemia [42] were the target diseases in 1 study each. The response rate was reported in each study, and neither demonstrated any difference between SA (plus STs or not) and STs.

Risk of bias across the studies

The quality of the 29 included RCTs is summarized in Table 1. Twelve trials (40%) used proper sequence generation methods in randomization [9-11, 24, 28, 34, 39, 42, 44, 47-48, 50-51]. None of the included trials conducted allocation concealment. Four RCTs were single-blinded without detailed information [45, 47-48, 50]. No RCT adopted assessor blinding. Only 1 trial provided sufficient details about dropouts and withdrawals [33].

Methods of SA treatment

Three different kinds of SA based on different theories were used, and detailed descriptions are provided in Table 2. Seventeen trials implemented PSIAN theory [9, 11, 28-31, 33, 36-37, 39, 41, 46-51]; 9 trials, Dr. Jiao’s SA [10, 27, 32, 35, 38, 40, 43-45]; 3 trials, SA based on the anatomical structure [23-24, 42]; and 1 trial, treatment using both PSIAN and Dr. Jiao’s theory [34]. The duration of SA treatment was from 10 to 75 days (mean: 34.4 days).

Subgroup analysis and sensitivity analysis

On the basis of study design, sample size, publication year and SA methods that could affect the overall result of these meta-analyses through clinical heterogeneity, subgroup
analyses were performed. There were no significant statistical differences in the odds ratios of the response rates among the subgroups (data not shown). The reinforcement of the results from the subgroup analyses suggested that the results of the meta-analysis were robust.

For sensitivity analyses, the odds ratio of response rate was not affected by study quality (data not shown).

**Publication bias**

The possibility of publication bias was examined with a funnel plot. The results showed that the included studies had a publication bias due to the asymmetry in response rate and ADL (Figure 4).

**Adverse events**

Four RCTs described possible adverse events related to SA, all of which were mild to moderate. Three reported no adverse effects [40, 50-51], and 1 reported dull pain and gastro-intestinal upset [33]. There were no serious adverse events (Table 2).
Discussion

Our article is the first systematic review and meta-analysis to evaluate the effectiveness of SA on NDs. Twenty-nine RCTs, dealing with stroke, PD, vascular dementia, CP, mutiple-tics coprolalia and aphemia subjects, were included. For stroke, we could suggest that SA showed a more positive response rate than did existing STs. Additionally, there was limited evidence that SA improved ADL, motor function and nervous function in stroke patients. For PD, there was weak evidence that the therapeutic effect of SA did not differ from that of existing STs for the improvement of somatic function in PD patients. For other conditions, we failed to draw any firm conclusions because there were not enough RCTs to analyze.

On the whole, we could suggest that there was weak evidence affirming the ability of SA to treat NDs. However, because of the low quality of the included RCTs, we could not be confident of these results. Most of the included trials had high risks of bias. Inappropriate sequence generation for randomization and the lack of allocation concealment could have exaggerated the effectiveness of interventions and caused selection or study quality bias [53]. Only 4 trials clearly mentioned participant blinding [45, 47-48, 50]. Due to the nature of acupuncture trials, double-blinding of the trial was impossible. Details about dropouts and withdrawals were reported only by one trial [11]. Thus, we cannot rule out the possibility of attrition or exclusion bias [54]. Low methodological quality and irregular sample sizes paired with an absence of power calculations suggested that there is only limited evidence for the effectiveness of SA in the treatment of NDs.

All included RCTs were conducted in China. Trials conducted in China and East Asian countries are known to produce more positive results than those conducted in other countries [55-56]. Sometimes we had difficulty comparing the data because accurate outcome scales were not mentioned in some RCTs or because some of the indices analyzed
were not official ones.

Although SA has been used for neurologic and psychiatric disorders for a long time, mainly in East Asian countries, the therapeutic mechanisms of SA for those conditions have not been clearly reported. However, several possible mechanisms could be suggested. First, SA might attenuate the gradual damage of neurons induced by neuronal injury by suppressing the cytokine-mediated inflammatory reaction [12-13]. Second, SA treatment has been shown to significantly increase serum vascular endothelial growth factor (VEGF) in patients with acute cerebral infarction [57]. Third, stimulation by SA on the cerebral cortex can rapidly remove the factors that inhibit action potential propagation and cause gradual damage to the neurons [12].

For the reasons above, SA is being explored as a possible alternative for the treatment of NDs. Additionally, SA is a relatively safe treatment with a low prevalence of adverse events. For the included RCTs, all reported adverse events were mild to negligible.

Although there is promising evidence that SA can be used as an optional treatment for NDs, more systematically collected data are needed to confirm the effectiveness of SA. On the basis of our systematic review, we offer the following suggestions to improve the quality of future studies. First, we recommend that trials evaluating the effectiveness of SA incorporate a sham-controlled study design because of the high methodological quality of such studies [58], even though sham-controlled trials are difficult to design in practice [59-60]. Second, more standardized therapeutic methods need to be established. Here, the treatment periods, frequency, area of SA, needle retention time and treatment methods that corresponded to various symptoms were too variable. To evaluate the effect of SA, more rigorous guidelines standardizing this approach should be prepared. Third, appropriate sequence generation, allocation concealment, patient blinding and detailed reporting about dropouts are needed to prevent bias. Forth, appropriate sample size calculations, including
power calculations, need to be reported.

**Conclusion**

In conclusion, the result of our systematic review and meta-analysis suggested that there is weak evidence for the effectiveness of SA as an alternative therapy for stroke and PD patients. Additional standardized, randomized, sham-controlled studies with rigorous methodologies are required to confirm the effectiveness of SA for NDs.
Conflicts of interest

The authors declare that they have no competing interests.

Author’s contributions

SJL and BCS searched and analyzed the data and drafted the manuscript. BCS have designed this study and given the final approval of the version to be published. MSL and JIK assisted with analyzing the data, interpreting the results and writing the manuscript.

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References

15. Lee MS, Shin BC, Kong JC, Ernst E: Effectiveness of acupuncture for Parkinson's disease:


**Figure legends**

**Figure 1:** Flow chart of trial selection process.

SA: scalp acupuncture; NDs: neurological disorders; UCT: uncontrolled clinical trial; NRCT: non-randomized controlled clinical trial; RCT: randomized clinical trial

**Figure 2:** Scalp acupuncture for stroke. **A:** Response rate. **B:** Activities of daily living (ADL). **C:** Motor function (FMA). **D:** Nervous function.

SA: scalp acupuncture; ST: standard therapy; FMA: Fugel-Meyer Assessment

**Figure 3:** Scalp acupuncture for Parkinson disease (motor function_UPDRS).

SA: scalp acupuncture; ST: standard therapy; UPDRS: Unified Parkinson disease Rating Scale

**Figure 4:** Funnel plot of included studies. **A:** Response rate. **B:** Activities of daily living (ADL).

SE: standard error; SA: scalp acupuncture; ST: standard therapy; RR: relative risk; SMD: standard mean difference
<table>
<thead>
<tr>
<th>First author (year)</th>
<th>Sample size</th>
<th>Intervention group</th>
<th>Control group</th>
<th>Main outcomes</th>
<th>Intergroup differences</th>
<th>Risk of Bias*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stroke</strong></td>
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<tr>
<td>Li [48] (2009) China</td>
<td>135</td>
<td>(A) SA (n=45)</td>
<td>(C) rehabilitation (n=45)</td>
<td>1) ADL(BI) 2) motor function (FMA)</td>
<td>A vs. C 1) P=0.15, MD, -0.31 [0.72, 0.63] 2) P=0.31, MD, 0.22 [0.20, 0.63]</td>
<td>Y, N, Y, Y, U</td>
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<td>(B) SA+ rehabilitation (n=45)</td>
<td></td>
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<td></td>
<td>B vs. C 1) P=0.00001, MD, 2.32 [1.78, 2.86] 2) P=0.00001, MD, 1.11 [0.66, 1.55]</td>
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<td>Xu [38] (2006) China</td>
<td>261</td>
<td>(A) ESA (n=131)</td>
<td>(B) medication (n=130)</td>
<td>1) total efficacy rate (%)</td>
<td>1) P&lt;0.00001, RR, 1.30 [1.17, 1.45]</td>
<td>U, N, Y, Y, N</td>
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<td>(2001) China</td>
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<td>2) P&lt;0.00001, RR, 1.11 [0.66, 1.55]</td>
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<td>Tang [23] (2001) China</td>
<td>120</td>
<td>(A) SA (n=30)</td>
<td>(B) SA + rehabilitation (n=30)</td>
<td>1) total efficacy rate (%) 2) ADL(BI) 3) motor function (FMA)</td>
<td>A vs. D 1) P=0.04, RR, 1.37 [1.01, 1.86] 2) P=0.0033, MD, 1.00 [0.46, 1.53] 3) P=0.0003, MD, 1.00 [0.46, 1.53]</td>
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<td>(D) medication (n=30)</td>
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<td>B vs. C 1) P=0.31, RR, 1.07 [0.94, 1.23] 2) P=0.15, MD, 0.37 [0.14, 0.88] 3) P=0.25, MD, -0.30 [0.21, 0.81]</td>
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<td>Zhang [43] (1995) China</td>
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<td>(B) medication (n=40)</td>
<td>1) total efficacy rate (%)</td>
<td>1) P=0.01, RR, 2.09 [1.18, 3.69]</td>
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<td>Yang [40] (2009) China</td>
<td>120</td>
<td>(A) SA + medication (n=60)</td>
<td>(B) medication (n=60)</td>
<td>1) total efficacy rate (%)</td>
<td>1) P=0.03, RR, 1.20 [1.02, 1.40]</td>
<td>U, N, Y, Y, U</td>
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<td>Jiao [34] (2009) China</td>
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<td>(A) SA + (B) (n=20)</td>
<td>(B) rehabilitation (CIMT) (n=20)</td>
<td>2) improvement of motor function (FMA)</td>
<td>1) P=0.00001, MD, 1.61 [0.89, 2.34] 2) P=0.00001, MD, 2.36 [1.54, 3.19]</td>
<td>Y, N, Y, Y, U</td>
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<td>Heang [47] (2008) China</td>
<td>90</td>
<td>(A) SA + medication (n=30) (B) (A)+(C) (n=30)</td>
<td>(C) rehabilitation + medication (n=30)</td>
<td>1) total efficacy rate (%) 2) ADL(BI) 3) improvement of motor function</td>
<td>A vs. C 1) P=0.77, RR, 1.05 [0.78, 1.40] 2) P=0.38, MD, 0.23 [0.28, 0.74] 3) P=0.20, MD, -0.33 [0.84, 0.18]</td>
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<td>(2001) China</td>
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<td>B vs. C 1) P=0.10, RR, 1.23 [0.96, 1.57] 2) P=0.00001, MD, 1.61 [1.02, 2.19] 3) P=0.00001, MD, -0.97 [1.51, -0.43]</td>
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<td>Shi [50] (2007) China</td>
<td>93</td>
<td>(A) SA + medication (drawing method) (n=33)</td>
<td>(C) medication(n=31)</td>
<td>1) ADL(BI) 2) improvement of motor function (ESSS)</td>
<td>1) P=0.00001, MD, 3.06 [2.31, 3.80] 2) P=0.00001, MD, -1.99 [2.60, -1.37]</td>
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<td>(A) ESA + rehabilitation (n=60)</td>
<td>(B) rehabilitation (n=60)</td>
<td>1) ADL(BI) 2) improvement of upper and lower limb function (Brunnstrom's stage)</td>
<td>1) P=0.0001, RR, 4.00 [2.01, 7.95] 2) P=0.0088, RR, 2.40 [1.26, 4.57]</td>
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<td>100</td>
<td>(A) SA + medication (lifting, thrusting, retaining method) (n=30)</td>
<td>(C) medication (n=40)</td>
<td>1) total efficacy rate (%)</td>
<td>1) P=0.26, RR, 1.11 [0.92, 1.33]</td>
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<td>(B) SA + medication (quick twisting method) (n=30)</td>
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<td>2) P=0.00001, MD, 1.61 [1.02, 2.19] 3) P=0.00001, MD, -0.97 [1.51, -0.43]</td>
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<td>Han [46] (2008) China</td>
<td>90</td>
<td>(A) SA + medication (n=30) (B) (A) + blood pricking (n=30)</td>
<td>(C) medication(n=30)</td>
<td>1) total efficacy rate (%) 2) ADL(BI) 3) motor function (FMA) 4) improvement of motor function</td>
<td>1) P=0.20, RR, 1.18 [0.91, 1.53] 2) P=0.05, RR, 1.89 [1.01, 3.55] 3) P=0.02, MD, 0.80 [0.08, 1.11] 4) P=0.05, MD, -0.53 [-1.04, -0.01]</td>
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<td>(B) medication (n=43)</td>
<td>1) improvement of nervous function</td>
<td>1) P=0.0099, RR, 3.19 [1.34, 7.56]</td>
<td>N, N, Y, Y, U</td>
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<tr>
<td>Zhou [45] (2002) China</td>
<td>62</td>
<td>(A) ESA + medication (n=32)</td>
<td>(B) medication(n=30)</td>
<td>1) improvement of upper and lower limb function</td>
<td>1) P=0.08, RR, 1.50 [0.96, 2.35] 2) P=0.16, MD, -0.36 [-0.87, 0.15]</td>
<td>U, Y, Y, Y, U</td>
</tr>
<tr>
<td>Yu [41] (2003) China</td>
<td>60</td>
<td>(A) SA + medication (n=30)</td>
<td>(B) medication (n=30)</td>
<td>1) ADL(BI) 2) improvement of nervous function</td>
<td>1) P=0.08, RR, 1.50 [0.96, 2.35] 2) P=0.16, MD, -0.36 [-0.87, 0.15]</td>
<td>N, N, Y, Y, U</td>
</tr>
</tbody>
</table>

* Risk of Bias: Y = Yes, N = No, U = Unclear
<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Type 1</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
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<th>Outcome 2</th>
<th>Outcome 3</th>
<th>Outcome 4</th>
<th>Outcome 5</th>
<th>Outcome 6</th>
<th>Outcome 7</th>
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<tbody>
<tr>
<td>Cai</td>
<td>2002</td>
<td>76</td>
<td>SA + medication</td>
<td>35</td>
<td>Medication</td>
<td>41</td>
<td>Improvement of nervous function</td>
<td>P=0.0002, MD, 0.92 [0.44, 1.39]</td>
<td>(U, N, Y, U, U)</td>
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<tr>
<td>Mu</td>
<td>2002</td>
<td>120</td>
<td>ESA + rehabilitation</td>
<td>60</td>
<td>Rehabilitation</td>
<td>60</td>
<td>1) ADL/BP</td>
<td>P=0.0001, RR, 1.66 [1.35, 2.04]</td>
<td>(U, N, Y, U, U)</td>
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<tr>
<td>Zhao</td>
<td>2018</td>
<td>43</td>
<td>SA + medication</td>
<td>21</td>
<td>Medication</td>
<td>22</td>
<td>Improvement of nervous function</td>
<td>P=0.0005, RR, 1.80 [1.19, 2.72]</td>
<td>(U, N, Y, U, U)</td>
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<tr>
<td>Huang</td>
<td>2002</td>
<td>120</td>
<td>ESA + rehabilitation</td>
<td>60</td>
<td>Rehabilitation</td>
<td>60</td>
<td>Improvement of upper and lower limb function (Brunnstrom's stage)</td>
<td>P=0.28, MD, -0.33 [-0.93, 0.27]</td>
<td>(Y, N, Y, U, U)</td>
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<tr>
<td>Mu</td>
<td>2006</td>
<td>10</td>
<td>ESA</td>
<td>5</td>
<td>Medication</td>
<td>5</td>
<td>Improvement of nervous function</td>
<td>P&lt;0.00001, RR, 1.66 [1.35, 2.04]</td>
<td>(U, N, Y, U, U)</td>
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<tr>
<td>Zhao</td>
<td>2008</td>
<td>43</td>
<td>SA + medication</td>
<td>21</td>
<td>Medication</td>
<td>22</td>
<td>Improvement of nervous function</td>
<td>P=0.28, MD, -0.33 [-0.93, 0.27]</td>
<td>(Y, N, Y, U, U)</td>
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<tr>
<td>Huang</td>
<td>2009</td>
<td>10</td>
<td>ESA</td>
<td>5</td>
<td>Medication</td>
<td>5</td>
<td>Cerebral glucose metabolism (PET)</td>
<td>P&lt;0.00001, RR, 1.66 [1.35, 2.04]</td>
<td>(Y, N, Y, U, U)</td>
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<tr>
<td>Liu</td>
<td>2008</td>
<td>108</td>
<td>ESA + medication</td>
<td>54</td>
<td>Medication</td>
<td>54</td>
<td>1) Total efficacy rate</td>
<td>P=0.002, MD, 1.26 [0.47, 2.06]</td>
<td>(U, N, Y, U, U)</td>
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<tr>
<td>Liu</td>
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<td>SA + medication</td>
<td>33</td>
<td>Medication</td>
<td>32</td>
<td>1) Total efficacy rate</td>
<td>P=0.37, MD, -0.33 [-1.05, 0.39]</td>
<td>(U, N, Y, U, U)</td>
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<tr>
<td>Liu</td>
<td>1998</td>
<td>180</td>
<td>ESA + rehabilitation</td>
<td>60</td>
<td>Rehabilitation</td>
<td>60</td>
<td>1) Total efficacy rate</td>
<td>P=0.65, RR, 0.00 [0.87, 1.15]</td>
<td>(Y, N, N, U, U)</td>
<td></td>
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<td>Chu</td>
<td>2008</td>
<td>80</td>
<td>SA + rehabilitation</td>
<td>40</td>
<td>Medication</td>
<td>40</td>
<td>1) Total efficacy rate</td>
<td>P=0.04, RR, 1.34 [1.01, 1.77]</td>
<td>(Y, N, Y, U, U)</td>
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<td>Deng</td>
<td>2005</td>
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<td>SA</td>
<td>30</td>
<td>Medication</td>
<td>30</td>
<td>1) ADL</td>
<td>P=0.04, RR, 1.34 [1.01, 1.77]</td>
<td>(Y, N, Y, U, U)</td>
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<tr>
<td>Ji</td>
<td>2008</td>
<td>80</td>
<td>SA + rehabilitation</td>
<td>40</td>
<td>Medication</td>
<td>40</td>
<td>1) Total efficacy rate</td>
<td>P=0.02, RR, 1.28 [1.03, 1.57]</td>
<td>(N, N, Y, U, U)</td>
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<tr>
<td>Xu</td>
<td>2009</td>
<td>60</td>
<td>ESA</td>
<td>30</td>
<td>Medication</td>
<td>30</td>
<td>1) Total efficacy rate</td>
<td>P=0.28, RR, 1.22 [0.85, 1.76]</td>
<td>(Y, N, Y, U, U)</td>
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<tr>
<td>Zhang</td>
<td>2007</td>
<td>56</td>
<td>SA + rehabilitation</td>
<td>20</td>
<td>Medication</td>
<td>19</td>
<td>1) Total efficacy rate</td>
<td>P=0.72, MD, 0.09 [0.41, 1.60]</td>
<td>(Y, N, Y, U, U)</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Parkinson disease**

- Huang [29] (2009) China: ESA + medication (n=35) vs. Medication (n=41)
  1. Improvement of nervous function: P=0.0002, MD, 0.92 [0.44, 1.39]
  2. Activity of dopamine transporter by ratio of BG/OL: P<0.00001, RR, 1.66 [1.35, 2.04]

- Huang [31] (2009) China: ESA + medication (n=15) vs. Medication (n=15)
  1. UPDRS: P=0.002, MD, 1.26 [0.47, 2.06]
  2. Webster scale: P=0.64, MD, -0.17 [-0.89, 0.54]

**Vascular dementia**

- Xiong [37] (2009) China: SA (n=46) vs. Medication (n=46)
  1. NS: P=0.65, RR, 0.96 [0.79, 1.15]
  2. MRI: P=0.98, MD, -0.00 [-0.41, 0.40]
  3. P=0.97, MD, -0.01 [-0.42, 0.40]
  4. P=0.79, MD, -0.06 [-0.35, 0.47]
  5. P=0.02, RR, 2.93 [1.50, 5.73]
  6. P=0.0001, MD, 2.23 [2.22, 3.43]
  7. P=0.0001, MD, 1.25 [1.61, 2.70]
  8. P=0.002, RR, 1.34 [1.01, 1.77]
  9. P=0.10, MD, -0.42 [-0.91, 0.07]
  10. P=0.002, MD, 0.57 [0.08, 1.07]
  11. P=0.015, MD, 0.36 [-0.13, 0.85]

**Cerebral palsy**

  1. Motor function: A vs. C: P=0.37, MD, -0.00 [-0.41, 0.40]
  2. P=0.02, RR, 1.34 [1.01, 1.77]

  1. WeeFIM score: P=0.06, RR, 0.96 [0.79, 1.15]
  2. GMFM: P=0.0001, MD, 2.83 [2.22, 3.43]

**Others**

  1. Total efficacy rate: P=0.37, MD, -0.00 [-0.41, 0.40]
  2. P=0.64, MD, -0.17 [-0.89, 0.54]

- Others: SA + Rehabilitation (n=20) vs. Medication (n=19)
  1. Total efficacy rate: P=0.28, RR, 1.22 [0.85, 1.76]
  2. YGTSS: P=0.72, MD, 0.09 [0.41, 1.60]
  3. P=0.63, RR, 1.08 [0.80, 1.45]

**Risks of bias**

- Risk of bias (sequence generation, allocation concealment, patient blinding, incomplete outcome data addressed, free of selective reporting, free of other bias), Yes (Y): low risk of bias; No (N): high risk of bias; Unclear (U)

**Other abbreviations**

- ADL: Activities of Daily Living
- AC: Acupuncture
- BDS: Blessed Dementia Scale
- BMI: Body Mass Index
- CGM: Constraint-induced movement therapy
- E: ESA, electro-scalp acupuncture
- ES: Edinburgh-Scandinavia stroke scale
- FMA: Fugl-Meyer Assessment
- GMFM: Gross Motor Function Measure
- HDS: Hasegawa Dementia Scale
- MBI: Modified Barthel Index
- MMSE: Mini Mental State Examination
- OL: Occipital Lobe
- SA: Scalp acupuncture
- TCD: Transcranial Doppler Sonography
- UPDRS: Unified Parkinson's Disease Rating Scale
- Webster scale
- YGTSS: Yale Global Tic Severity Scale
<table>
<thead>
<tr>
<th>First author</th>
<th>SA method</th>
<th>Treatment method for 1 session (Hz for ESA)</th>
<th>Total treatment Times (session)</th>
<th>Acupuncture points</th>
<th>Adverse events*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke</td>
<td></td>
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<tr>
<td>Li [48]</td>
<td>PSIAN</td>
<td>once a day, 45-60 min/d, 5 times per week, for 1 week</td>
<td>30(6 session)</td>
<td>MS 5, 6, 7</td>
<td>n.r.</td>
</tr>
<tr>
<td>Xu [38]</td>
<td>Dr. Jiao’s SA</td>
<td>once daily, 6-8 hrs/d, 30 times (100-200 Hz)</td>
<td>30(1 session)</td>
<td>MA</td>
<td>n.r.</td>
</tr>
<tr>
<td>Tang [23]</td>
<td>anatomical structure</td>
<td>once daily, 6 hrs/d, for 4 weeks</td>
<td>28(1 session)</td>
<td>MA, Pre-MA</td>
<td>n.r.</td>
</tr>
<tr>
<td>Zhang [43]</td>
<td>Dr. Jiao’s SA</td>
<td>once a day, 30 min, 10 times (240-260 Hz)</td>
<td>20(2 session)</td>
<td>MA, SA</td>
<td>n.r.</td>
</tr>
<tr>
<td>Yang [40]</td>
<td>Dr. Jiao’s SA</td>
<td>once daily, 15 times</td>
<td>30(2 session)</td>
<td>MA, LMSA, SA</td>
<td>None</td>
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<tr>
<td>Jiao [34]</td>
<td>PSIAN + Dr. Jiao’s SA</td>
<td>once daily, 1 hr/d, for 3 weeks</td>
<td>21(1 session)</td>
<td>MS6, SA</td>
<td>n.r.</td>
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<tr>
<td>Huang [47]</td>
<td>PSIAN</td>
<td>once a day, 30 min, 6 times per week, for 1 week</td>
<td>24(4 session)</td>
<td>MS 6.7 (healthy side)</td>
<td>n.r.</td>
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<tr>
<td>Shi [30]</td>
<td>PSIAN</td>
<td>once every other day, 2 hrs/d, 3 times per week, for 4 weeks</td>
<td>12(1 session)</td>
<td>MS 5.6</td>
<td>None</td>
</tr>
<tr>
<td>Zhao [44]</td>
<td>Dr. Jiao’s SA</td>
<td>once daily, 25-30 min, for 3 months (100 Hz)</td>
<td>3 months</td>
<td>MA, BA, LMSA</td>
<td>n.r.</td>
</tr>
<tr>
<td>Ren [49]</td>
<td>PSIAN</td>
<td>once daily, 30 min, 10 times</td>
<td>10(1 session)</td>
<td>Dyskinesia: MS6, 5, 8 Sensory disturbance: MS7, 5, 8 (both MS6, 7, 5, 8 BVDCA)</td>
<td>n.r.</td>
</tr>
<tr>
<td>Han [46]</td>
<td>PSIAN</td>
<td>once daily, 40 min, for 10 days</td>
<td>10(1 session)</td>
<td>MS 6.7</td>
<td>n.r.</td>
</tr>
<tr>
<td>Sun [36]</td>
<td>PSIAN</td>
<td>once daily, 30 min, 12 times</td>
<td>12(1 session)</td>
<td>MS 7</td>
<td>n.r.</td>
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<tr>
<td>Zhou [45]</td>
<td>Dr. Jiao’s SA</td>
<td>once daily, 30 min, 15 times (15 Hz)</td>
<td>15(1 session)</td>
<td>MA</td>
<td>n.r.</td>
</tr>
<tr>
<td>Yu [41]</td>
<td>PSIAN</td>
<td>once daily, 30 min, 10 times</td>
<td>10(1 session)</td>
<td>MS 5.6 (opposite side)</td>
<td>n.r.</td>
</tr>
<tr>
<td>Cai [27]</td>
<td>Dr. Jiao’s SA</td>
<td>once daily, 40 min, for 2 weeks</td>
<td>14(1 session)</td>
<td>MS 5.6</td>
<td>n.r.</td>
</tr>
<tr>
<td>Mu [35]</td>
<td>Dr. Jiao’s SA</td>
<td>once a day, 45-60 min/d, 15 times, 2-3 days rest between sessions (18-24 Hz)</td>
<td>3 months</td>
<td>MS 5.6</td>
<td>n.r.</td>
</tr>
<tr>
<td>Zhao [24]</td>
<td>along the suture line</td>
<td>once daily, 30 min, for 10 days</td>
<td>10(1 session)</td>
<td>MS 5.6</td>
<td>n.r.</td>
</tr>
<tr>
<td>Parkinson disease</td>
<td></td>
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</tr>
<tr>
<td>Huang [29]</td>
<td>PSIAN</td>
<td>once a day, 30 min, 6 times per week, for 5 weeks (50 Hz)</td>
<td>30(1 session)</td>
<td>MS 6, 4, 8, 9, 14</td>
<td>n.r.</td>
</tr>
<tr>
<td>Huang [30]</td>
<td>PSIAN</td>
<td>once a day, 30 min, 5 times per week, for 6 weeks (100 Hz)</td>
<td>30(1 session)</td>
<td>MS 4, 6, 8, 9, 14</td>
<td>n.r.</td>
</tr>
<tr>
<td>Huang [31]</td>
<td>PSIAN</td>
<td>once a day, 30 min, 6 times per week, for 5 weeks (50 Hz)</td>
<td>30(1 session)</td>
<td>MS 6, 4, 8, 9, 14</td>
<td>n.r.</td>
</tr>
<tr>
<td>Jiang [33]</td>
<td>PSIAN</td>
<td>once a day, 30 min, 5 times per week, for 6 weeks (100 Hz)</td>
<td>30(1 session)</td>
<td>MS 4, 6, 8, 9, 14</td>
<td>n.r.</td>
</tr>
<tr>
<td>Vascular dementia</td>
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<td></td>
</tr>
<tr>
<td>Xiong [37]</td>
<td>PSIAN</td>
<td>once daily, 30 min, for 6 days</td>
<td>30(5 session)</td>
<td>MS 6, 7</td>
<td>n.r.</td>
</tr>
<tr>
<td>Liu [11]</td>
<td>PSIAN</td>
<td>once daily, 30 min, for 6 days</td>
<td>30(5 session)</td>
<td>MS 6, 7</td>
<td>n.r.</td>
</tr>
<tr>
<td>Liu [51]</td>
<td>PSIAN</td>
<td>once daily, 30 min, for 5 days</td>
<td>40(8 session)</td>
<td>MS 5, 1-4, 10, 11 None</td>
<td>n.r.</td>
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<tr>
<td>Chu [9, 28]</td>
<td>PSIAN</td>
<td>once daily, 10 hrs/d, for 5 days</td>
<td>40(8 session)</td>
<td>MS 5, 1, 8</td>
<td>n.r.</td>
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<tr>
<td>Cerebral palsy</td>
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<tr>
<td>Deng [10]</td>
<td>Dr. Jiao’s SA</td>
<td>once a day, 1 hr/d, 6 times per week, for 8 weeks</td>
<td>60(1 session)</td>
<td>LMSA, MA, SPA2, SPA3, Intellectual area</td>
<td>n.r.</td>
</tr>
<tr>
<td>Ji [32]</td>
<td>Dr. Jiao’s SA</td>
<td>once a day, 45 min, 5 times per week, for 4 weeks</td>
<td>75(3 session)</td>
<td>MA, BA, SEA, LMSA, CTCA, SPA2, SPA3</td>
<td>n.r.</td>
</tr>
<tr>
<td>Xu [39]</td>
<td>PSIAN</td>
<td>once daily, 1 hr/d, 3 times per week</td>
<td>36(12 session)</td>
<td>MS 1, 5, 8 + MS 12, 2 or MS 11</td>
<td>n.r.</td>
</tr>
<tr>
<td>Zhang [42]</td>
<td>anatomical structure</td>
<td>once daily, 6 hrs/d, 3 months</td>
<td>3 months</td>
<td>MS 1, 5, 8</td>
<td>n.r.</td>
</tr>
</tbody>
</table>

* Adverse events, n.r.: not reported

BA: balance area; BVDCA: blood vessel dilation and constriction area; CTCA: chorea and tremor control area; ESA: electro-scalp acupuncture; FA: forehead area; LMSA: leg motor and sensory area; MA: motor area; PSIAN: a Proposed Standard International Acupuncture Nomenclature; SEA: sensory area; SPA2: speech area2; SPA3: speech area3; TA: temporal area; VA: vertex area; YNSA: Yamamoto New Scalp Acupuncture
Publications identified (n =699)

Publications excluded after screening the abstract (n =400). Reasons:
- Acupuncture, but not related to SA (n=215)
- Not related to NDs (n=14)
- Not clinical studies (n=77)
  - Introduction article (n=36)
  - Reviews (n=41)
- Case reports (n=52)
- Non human studies (n=42)
  - In vivo studies (n=32)
  - In vitro studies (n=10)

Full text for detailed evaluation (n=299)

Publications excluded after screening the full text (n =269). Reasons:
- UCTs (n=120)
- NRCTs (n=20)
- RCTs, but excluded (n=128)
  - Not appropriate control group (complex herbal medicine) (n=3)
  - Compare different AT methods (n=49)
  - Mixed treatment (n=73)
  - Duplicated publication (n=3)
  - Insufficient documentation (n=1)
  - Including healthy subjects (n=2)

Included RCTs: n=30
(2 studies were combined as 1 trial because they published twice with different outcomes)
Finally included RCTs: n=29
### A. Response rate

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>SA</th>
<th>ST</th>
<th>Risk Ratio</th>
<th>M-H. Random. 95% CI</th>
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<tr>
<td><strong>1.1.1 Response rate [SA vs. ST]</strong></td>
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<tr>
<td>Tang 2001</td>
<td>26</td>
<td>30</td>
<td>19</td>
<td>30</td>
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<tr>
<td>Xu 2006</td>
<td>126</td>
<td>131</td>
<td>96</td>
<td>130</td>
</tr>
<tr>
<td>Zhang 1995</td>
<td>23</td>
<td>40</td>
<td>11</td>
<td>40</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>291</td>
<td>290</td>
<td>269</td>
<td>329</td>
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<tr>
<td><strong>Total events</strong></td>
<td>175</td>
<td>126</td>
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<tr>
<td><strong>Test for overall effect</strong>: Z = 3.28 (P = 0.001)</td>
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</tbody>
</table>

#### Heterogeneity
- Tau²: 0.01; Chi²: 3.17, df = 2 (P = 0.20); I²: 37%

### B. Activities of daily living (ADL)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>SA</th>
<th>ST</th>
<th>Std. Mean Difference</th>
<th>IV. Random. 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.2.1 Stroke ADL [SA vs. ST]</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Li 2009</td>
<td>-34.4</td>
<td>5.84</td>
<td>45.32</td>
<td>5.72</td>
</tr>
<tr>
<td>Tang 2001</td>
<td>-31.6</td>
<td>19.99</td>
<td>30</td>
<td>-11.63</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>75</td>
<td>40.9%</td>
<td>-0.33 [-1.62, 0.95]</td>
<td></td>
</tr>
<tr>
<td><strong>Heterogeneity</strong>: Tau²: 0.80; Chi²: 14.24, df = 1 (P = 0.0002); I²: 93%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Test for overall effect</strong>: Z = 0.51 (P = 0.61)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Heterogeneity
- Tau²: 0.80; Chi²: 14.24, df = 1 (P = 0.0002); I²: 93%
- Test for overall effect: Z = 0.51 (P = 0.61)

### C. Motor function (FMA)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>SA</th>
<th>ST</th>
<th>Mean Difference</th>
<th>IV. Random. 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.3.1 Stroke motor function [SA vs. ST]</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Li 2009</td>
<td>-35.5</td>
<td>6.56</td>
<td>45</td>
<td>-34.1</td>
</tr>
<tr>
<td>Tang 2001</td>
<td>-39.4</td>
<td>7.68</td>
<td>30</td>
<td>-24.68</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>75</td>
<td>47.7%</td>
<td>13.57 [-32.96, 8.82]</td>
<td></td>
</tr>
<tr>
<td><strong>Heterogeneity</strong>: Tau²: 0.80; Chi²: 24.71, df = 1 (P = 0.0003); I²: 92%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Test for overall effect</strong>: Z = 1.06 (P = 0.29)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Heterogeneity
- Tau²: 0.80; Chi²: 24.71, df = 1 (P = 0.0003); I²: 92%
- Test for overall effect: Z = 1.06 (P = 0.29)

### D. Nervous function

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>SA</th>
<th>ST</th>
<th>Mean Difference</th>
<th>IV. Random. 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.3.3 Stroke nervous function [SA vs. ST]</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cai 2002</td>
<td>-8.4</td>
<td>3.4</td>
<td>35</td>
<td>-5.2</td>
</tr>
<tr>
<td>Han 2006</td>
<td>-12.27</td>
<td>3.88</td>
<td>30</td>
<td>-9.14</td>
</tr>
<tr>
<td>Wang 2006</td>
<td>-4.79</td>
<td>3.57</td>
<td>30</td>
<td>-3.68</td>
</tr>
<tr>
<td>Shi 2007</td>
<td>-6.78</td>
<td>2.82</td>
<td>31</td>
<td>-9.2</td>
</tr>
<tr>
<td>Sun 2006</td>
<td>-14.33</td>
<td>4.52</td>
<td>40</td>
<td>-5.35</td>
</tr>
<tr>
<td>Yang 2009</td>
<td>-3.28</td>
<td>6.06</td>
<td>60</td>
<td>-6.76</td>
</tr>
<tr>
<td>Yu 2003</td>
<td>-9.87</td>
<td>6.2</td>
<td>30</td>
<td>-7.68</td>
</tr>
<tr>
<td>Zhao 2006</td>
<td>-10.29</td>
<td>8.11</td>
<td>21</td>
<td>-7.59</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td>277</td>
<td>287</td>
<td>100.0%</td>
<td>-9.33 [-1.41, -4.45]</td>
</tr>
<tr>
<td><strong>Heterogeneity</strong>: Tau²: 0.41; Chi²: 49.79, df = 7 (P = 0.0001); I²: 95%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Test for overall effect</strong>: Z = 3.91 (P = 0.0001)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Heterogeneity
- Tau²: 0.41; Chi²: 49.79, df = 7 (P = 0.0001); I²: 95%
- Test for overall effect: Z = 3.91 (P = 0.0001)
Figure 3

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Mean</th>
<th>SD</th>
<th>Total</th>
<th>Mean</th>
<th>SD</th>
<th>Total</th>
<th>Weight</th>
<th>IV, Random, 95% CI</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huang 2009</td>
<td>-10.8</td>
<td>13.43</td>
<td>15</td>
<td>-5.9</td>
<td>15.41</td>
<td>15</td>
<td>5.2%</td>
<td>-4.90 [-15.24, 5.44]</td>
<td></td>
</tr>
<tr>
<td>Jiang 2006</td>
<td>-4.4</td>
<td>3.7</td>
<td>15</td>
<td>-3.8</td>
<td>3.03</td>
<td>15</td>
<td>94.8%</td>
<td>-0.60 [-3.02, 1.82]</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>30</td>
<td>30</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.82 [-3.18, 1.53]</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.00; Chi² = 0.63, df = 1 (P = 0.43); I² = 0%
Test for overall effect: Z = 0.68 (P = 0.49)
A. Response rate

B. Activities of daily living (ADL)