Review Article

Acupotomy Therapy for Knee Osteoarthritis Pain: Systematic Review and Meta-Analysis

Jigao Sun,1,2 Yan Zhao,2 Ruizheng Zhu,1 Qianglong Chen,3 Mengge Song,2 Zhipeng Xue,1 Rongtian Wang,1 and Weiheng Chen1

1The Third Affiliated Hospital of Beijing University of Chinese Medicine, Beijing, China
2Wangjing Hospital, China Academy of Chinese Medical Sciences, Beijing, China
3Guizhou University of Traditional Chinese Medicine, Guiyang, Guizhou, China

Correspondence should be addressed to Weiheng Chen; chenweiheng@yeah.net

Received 29 July 2020; Revised 8 October 2020; Accepted 14 October 2020; Published 31 October 2020

Academic Editor: Arham Shabbir

Copyright © 2020 Jigao Sun et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Background and Purpose. Knee osteoarthritis (OA) is a major public health problem, and currently, few effective medical treatments exist. Chinese acupotomy therapy has been widely used for the treatment of knee OA in China. We conducted this systematic review and meta-analysis to evaluate the efficacy of Chinese acupotomy in treating knee OA to inform clinical practice.

Methods. We performed a comprehensive search on PubMed, the Cochrane Library, EMBASE, and four Chinese databases for articles published prior to June 2020. We included only randomized controlled trials (RCTs) that used acupotomy therapy as the major intervention in adults with knee OA, were published in either Chinese and English, included more than 20 subjects in each group, and included pain and function in the outcome measures. Knee OA was defined by the American College of Rheumatology or Chinese Orthopedic Association criteria in all studies. We extracted the visual analogue scale (VAS) pain score, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) pain score, the total effectiveness rate, the modified Japanese Orthopedic Association (JOA) activities of daily living score, and Lysholm’s score. We calculated the mean difference (MD) or risk ratio (RR) for all relevant outcomes. Meta-analyses were conducted using random-effects models when appropriate. Results. We identified 1317 potentially relevant studies, thirty-two of which met the eligibility criteria and were conducted in China between 2007 and 2020. A total of 3021 knee OA patients (62.96% female, median age: 57 years, and median disease duration: 33 months) were included. The treatment duration ranged from 1 week to 5 weeks (median: 3 weeks). The typical acupotomy treatment involved releasing soft tissue adhesions and was performed once a week for 1–5 weeks until the pain was relieved. The control group treatments included acupuncture (8 studies), electroacupuncture (10 studies), sodium hyaluronate (8 studies), radiofrequency electrotherapy (1 study), and nonsteroidal anti-inflammatory drugs (NSAIDs, 5 studies). The results from the meta-analysis showed that acupotomy led to superior improvements in the VAS pain score (MD = −1.11; 95% confidence interval (CI), −1.51 to −0.71; p < 0.00001) and WOMAC pain score (MD = −2.32; 95% CI, −2.94 to −1.69; p < 0.00001), a higher total effectiveness rate (RR = 1.15; 95% CI, 1.09–1.21; p < 0.00001), and superior improvements in the JOA score (MD = 6.39; 95% CI, 4.11–9.76; p < 0.00001) and Lysholm’s score (MD = 12.75; 95% CI, 2.61–22.89; p = 0.01) for overall pain and function. No serious adverse events were reported. Conclusion. Chinese acupotomy therapy may relieve pain and improve function in patients with knee OA. Furthermore, rigorously designed and well-controlled RCTs are warranted.

1. Introduction

Symptomatic osteoarthritis (OA) is the most frequent cause of dependency in lower limb tasks among ageing populations and is associated with substantial physical and psychosocial disability, a reduced quality of life, and substantial healthcare costs [1]. At present, knee OA is considered a common health problem worldwide; in the United States, nearly 40% of adults over the age of 60 suffer from this disease [2]. Currently, no effective disease-modifying remedies are available to treat knee OA [3]. In the absence of effective disease-modifying treatments,
Evidence-Based Complementary and Alternative Medicine

2. Methods

2.1. Search Strategy. We performed a comprehensive search in PubMed, the Cochrane Library, EMBASE and four Chinese databases (CNKI, Wan Fang, CBMdisc, and VIP) for articles published through June 2020. We included only RCTs that used acupotomy therapy as the main treatment for adults with knee OA. The Chinese and English search terms included acupotomy, acupotomies, acupuncture treatment, acupotomology, acupotome, needle-knife, needle scalpel, stiletto needle, sword-like needle, miniscalpel, small needle-knife, xiao zhen dao, pharmaocupuncture, knee osteoarthritis, osteoarthritis of knee, osteoarthritis of the knee, pain, randomized controlled trial, and clinical trial.

2.2. Eligibility Criteria. Acupotomy was defined as a new type of minimally invasive surgical treatment for knee OA based on the traditional medical theory and modern surgery. We included RCTs that compared acupotomy therapy with acupuncture, electroacupuncture, or standard western treatment in adults with knee OA. Trials were eligible if the intervention included at least 1 acupotomy intervention, more than 20 subjects in each group, and original data. Studies that used the American College of Rheumatology (ACR) diagnostic criteria in 1990 were eligible [25]. We also considered studies that used the Chinese Orthopedic Association (COA) criteria of 2007 or 2018 [26, 27]. To evaluate the independent effects of the acupotomy intervention, we excluded treatment groups that received other major treatments, and we also excluded reviews, theoretical studies, case reports, and animal studies. There were no language restrictions in the literature search.

2.3. Study Selection. Two authors (QLC and RZZ) independently screened all the potentially eligible studies. The titles and abstracts were first screened to exclude irrelevant citations. The full texts of all the articles with potentially relevant abstracts were retrieved and screened according to the study eligibility criteria. Disagreements were resolved by consensus or discussion with a third author (YZ).

Pain intensity was measured using the visual analogue scale (VAS) or the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). The VAS pain score and WOMAC pain score were the prespecified primary outcomes in this study. The total effectiveness rate was used to assess overall pain, physical performance, and wellness. The total effectiveness rate (%) was defined as the quotient of the number of patients who were clinically cured, exhibited significant improvement, or exhibited improvement divided by the total number of patients. The total effectiveness rate was assessed based on the number of patients in each of the following categories: “clinically cured” (the pain and swelling in the joints had disappeared, and the active functional state had returned to normal); “significant improvement” (the pain and swelling in the joints were alleviated, and the active functional state had improved significantly); “improvement” (the pain and swelling in the joints were partially alleviated, and the active functional state...
had improved); and "not cured" (the pain and swelling in the joints remained unchanged, and there was no improvement in active function) [28]. The modified Japanese Orthopedic Association (JOA) activities of the daily living (ADL) score was used to assess pain when walking and pain when going up and down stairs. Lysholm’s score was used to assess overall pain and joint function. The total effectiveness rate, JOA score, and Lysholm’s score were also measured.

2.4. Data Extraction. One author (RZZ) extracted data from the selected studies using a predesigned data extraction table, which included publication information, the origin of study, the study setting, the time frame of the study, patient age, patient sex, the author's definition of knee OA, detailed information on the interventions and controls, outcome measures, a summary of the results, the main conclusion, and adverse reactions (Table 1). The accuracy of the data extracted was verified by another author (ZPX).

2.5. Quality Assessment. Study quality was assessed in RevMan V5.3 (the Nordic Cochrane Centre, Cochrane Collaboration) using the Cochrane risk of bias tool [29]. The risk of bias for each of the following domains was assessed for each study: (1) random sequence generation, (2) allocation concealment, (3) blinding of the participants and personnel, (4) blinding of the outcome assessments, (5) incomplete outcome data, (6) selective reporting, and (7) other bias. Each study included was rated as having a high, low, or unclear risk of bias. Two authors (YZ and MES) evaluated all the data extracted and quality ratings for consistency and resolved disagreements. Disagreements were resolved by discussion with a third author (RTW).

2.6. Data Synthesis and Statistical Analysis. We qualitatively synthesized all the included studies (Table 1). The included studies on pain were synthesized based on the VAS pain score and the WOMAC pain score separately. The VAS score ranged from 0 points (no pain) to 10 points (worst possible pain). The WOMAC pain score ranged from 0 points to 20 points, with a lower score representing a better outcome. Lysholm’s score ranged from 0 points to 100 points, and the modified JOA score ranged from 0 points to 55 points, with a higher score representing a better outcome.

All analyses were conducted using RevMan V5.3. For the meta-analysis of the VAS pain score, WOMAC pain score, JOA score, and Lysholm’s score, we combined studies using the mean difference (MD); a positive MD indicated that the effect of acupotomy therapy was favourable compared with the control therapy. For the total effectiveness rate, we combined studies using the risk ratio (RR) in the meta-analysis, and an RR of the total effectiveness rate greater than 1 indicated that acupotomy was more effective than the control therapy. We evaluated heterogeneity using the $I^2$ statistic. $p$ values < 0.05 were considered to indicate statistical significance in all the results.

3. Results

3.1. Results of the Literature Search and Selection Processes. We screened a total of 1317 studies that were retrieved from 3 English databases and 4 Chinese databases. After initially screening 348 potentially relevant abstracts, we excluded 279 because they did not meet the inclusion criteria. Thirty-seven articles were excluded due to lack of randomization or the absence of a control group and insufficient data for the meta-analysis. Finally, 32 RCTs [19, 30–60], which included 3021 patients (62.96% female) and were published between 2007 and 2020, met our inclusion criteria. The details of the study selection process are summarized in Figure 1.

3.2. Included Studies. Table 1 describes the studies and patient characteristics of the included studies. All 32 RCTs [19, 30–60] were conducted in China, and the total sample size of the included RCTs ranged from 41 to 324 (median: 74). The mean age ranged from 47 to 66 years (median: 57 years), and the percentage of females ranged from 42.57% to 87.5% (median: 60%). The disease duration ranged from 4 to 152 months (median: 33 months).

The typical acupotomy therapy involved releasing soft tissue adhesions and was performed once a week for 1–5 weeks until the pain was relieved. Additional massage therapy after acupotomy was included in 2 studies, and functional training was included in 1 study. The control group treatments included acupuncture (8 studies), electroacupuncture (10 studies), sodium hyaluronate (8 studies), radiofrequency electrotherapy (1 study), and NSAIDs (5 studies). The NSAIDs used included oral NSAIDs (3 celecoxib and 1 diclofenac sodium) and topical NSAIDs (1 votalin emulsion). The treatment duration ranged from 1 to 5 weeks (median: 3 weeks).

The quality (risk of bias) of the trials was assessed using the Cochrane Collaboration tool, with modifications. Figure 2 describes the study quality, and Figure 3 describes the overall risk of bias distribution among the studies included. The overall bias quality for the trials was modest. The randomization process was adequate in 17 trials (53.13%), unclear in 14 trials (43.75%), and indicated a high risk of bias in 1 trial (3.13%). One trial (3.13%) reported appropriate allocation concealment methods, but 31 trials (96.88%) were at high risk of bias. Blinding of the participants and personnel occurred in 1 trial (3.13%), but 31 trials were considered to have a high risk of bias (96.88%). Blinding of the outcomes occurred in 1 trial (3.13%), but whether blinding was performed was unclear in 31 trials (96.88%). All studies reported the similarity of the study groups at baseline (100%).

3.3. Meta-Analysis. Among the thirty-two eligible RCTs, twenty-two trials [30–34, 36, 37, 39, 40, 42–47, 49, 50, 53, 55, 58–60] reported the VAS pain score for the individuals who underwent acupotomy therapy and controls. Nine trials [19, 35, 38, 41, 46, 48, 50, 52, 60] reported the WOMAC pain score. Furthermore, twenty-three trials [19, 30–42, 44–46, 48, 52, 55, 58–60] evaluated overall pain,
| Author (y) | Diagnostic criteria | N (female, %) | Age (%) | Disease duration (months) | Duration (wks) | Acupotomy therapy | Controls | Main outcomes | Results (treatment vs. control) | P value |
|-----------|---------------------|---------------|---------|--------------------------|----------------|-------------------|----------|---------------|--------------------------------|---------|
| Li X. (2015) | COA criteria (2007) | 324 (57.41%) | 64 | 61 | 3 | Release soft tissue adhesion, once/wk, 3 times | Acupuncture, 30 min, 6 times/wk, 3 wks | VAS pain Lysholm's score Total effectiveness rate | 2.83 vs. 3.94 | <0.05 |
| Li S. (2015) | ACR knee OA criteria (1995) | 67 (43.28%) | 55 | Not mentioned | 2 | Release soft tissue adhesion, once/wk, 2 times | Electroacupuncture, 20 min, once/day, 10 times | VAS pain Total effectiveness rate | 1.58 vs. 2.69 | <0.05 |
| Sun (2019) | Not mentioned | 60 (71.67%) | 59 | 152 | 4 | Release soft tissue adhesion, once/wk, 4 times | Sodium hyaluronate, 2 ml, once/wk, 4 wks | VAS pain Total effectiveness rate | 3.41 vs. 5.48 | <0.01 |
| Shi (2019) | COA criteria (2018) | 120 (67.5%) | 58 | 21 | 4 | Release soft tissue adhesion, once/wk, 4 times | Sodium hyaluronate, 2.5 mg, once/6 days, 5 times | VAS pain Total effectiveness rate | 3.01 vs. 4.81 | <0.05 |
| Hong (2019) | COA criteria (2007) | 61 (67.21%) | 58 | 15 | 3 | Release soft tissue adhesion, once/wk, 3 times | Acupuncture, 5 times/wk, 3 wks | VAS pain Total effectiveness rate | 1.81 vs. 2.7 | <0.05 |
| Wang (2016) | COA criteria (2007) | 230 (63.91%) | 52 | 14 | 2 | Release soft tissue adhesion, once | Acupuncture, 20 min, 1-2 times/wk, 2 wks | WOMAC pain Total effectiveness rate | 86.09 vs. 86.96 | <0.05 |
| Jin (2020) | ACR knee OA criteria | 60 (58.33%) | 57 | 89 | 4 | Release soft tissue adhesion, twice/wk, 8 times | Celecoxib capsules, 200 mg, twice/day, 4 wks | VAS pain Total effectiveness rate | 3.23 vs. 3.67 | <0.05 |
| Xiu (2017) | COA criteria (2007) | 80 (56.25%) | 53 | 73 | 2 | Release soft tissue adhesion, once/wk, 4 times; Massage therapy, once every other day, 7 times; massage therapy, once/2 days, 14 times | Acupuncture, 30 min, once every other day, 7 times; massage therapy, once/2 days, 14 times | VAS pain Lysholm's score Total effectiveness rate | 2.51 vs. 3.52 | <0.05 |
| Dai (2018) | COA criteria (2007) | 200 (58.5%) | 53 | 17 | 2 | Release soft tissue adhesion, once | Acupuncture, 20 min, 1-2 times/wk, 2 wks | WOMAC Pain Total effectiveness rate | 8.52 vs. 10.81 | <0.05 |
| Jia (2017) | COA criteria (2007) | 148 (42.57%) | 59 | 77 | 5 | Release soft tissue adhesion, once/wk, 5 times | Sodium hyaluronate, 25 mg, once/wk, 5 times | VAS pain Total effectiveness rate | 2.19 vs. 3.88 | <0.05 |
| Author (y) | Diagnostic criteria | N (female, %) | Age (%) | Disease duration (months) | Duration (wks) | Acupotomy therapy | Controls | Main outcomes | Results (treatment vs. control) | p value |
|-----------|---------------------|--------------|---------|--------------------------|---------------|-------------------|----------|--------------|-------------------------------|---------|
| Quan (2016) [40] | COA criteria (2007) | 50 (72%) | 56 | 78 | 2 | Release soft tissue adhesion, once/wk, 2 times | Electroacupuncture, 30 min, once/2 days, 7 times | VAS pain Total effectiveness rate | 1.28 vs. 3.71 | <0.01 | <0.05 |
| Sun (2016) [41] | COA criteria (2007) | 73 (71.23%) | 56 | 11 | 4 | Release soft tissue adhesion, once/wk, 4 times | Acupuncture, 30 min, 5 times/wk, 4 wks | WOMAC Pain Total effectiveness rate | 3.95 vs. 7.46 | <0.05 | <0.05 |
| Cheng (2015) [42] | COA criteria (2007) | 56 (44.64%) | 57 | 32 | 5 | Release soft tissue adhesion, once/wk, 4 times | Sodium hyaluronate, 2 ml, once/wk, 5 wks | VAS pain JOA assessment Total effectiveness rate | 2.15 vs. 3.52 | <0.05 | <0.05 |
| Zhou (2015) [43] | COA criteria (2007) | 100 (64%) | 58 | 12 | 4 | Release soft tissue adhesion, once/wk, 4 times | Sodium hyaluronate, 2 ml, once/wk, 4 wks | VAS pain | 1.52 vs. 1.49 | >0.05 |
| Sun (2012) [44] | COA criteria (2007) | 90 (73.33%) | 59 | 13 | 4 | Release soft tissue adhesion, once/wk, 1–4 times, until pain relieves | Diclofenac sodium, 75 mg, once/day, 20 days, oral pill | VAS pain Total effectiveness rate | 2.76 vs. 3.84 | <0.05 | <0.05 |
| Chen (2011) [45] | ACR knee OA criteria (1995) | 120 (69.17%) | 60 | 45 | 2 | Release soft tissue adhesion, once/wk, 2 times; Massage therapy, once/2 days, 14 times | Electroacupuncture, 30 min, once every other day, 7 times; massage therapy, once/2 days, 14 times | VAS pain Total effectiveness rate | 1.27 vs. 3.64 | <0.01 | <0.05 |
| Xiong (2020) [46] | COA criteria (2007) | 60 (56.67%) | 54 | 69 | 3 | Release soft tissue adhesion, once/wk, 3 times | Celecoxib capsules, 200 mg, once/day, 3 wks | VAS pain WOMAC pain Total effectiveness rate | 5.77 vs. 4.57 | <0.05 | <0.05 |
| Hu (2009) [47] | ACR knee OA criteria (1995) | 80 (50%) | 66 | 67 | 4 | Release soft tissue adhesion, once/wk, 4 times | Electroacupuncture, 30 min, once/day, 4 wks | VAS pain | 3.52 vs. 5.26 | <0.05 |
| Wang (2009) [48] | ACR knee OA criteria (1995) | 60 (66.67%) | 49 | 61 | 5 | Release soft tissue adhesion, 1 time | Sodium hyaluronate, 2 ml, once/wk, 5 wks | WOMAC pain Total effectiveness rate | 1.8 vs. 5.33 | <0.01 | <0.05 |
| Author (y) | Diagnostic criteria | N (female, %) | Age (%) | Disease duration (months) | Duration (wks) | Acupotomy therapy | Controls | Main outcomes | Results (treatment vs. control) | P value |
|------------|---------------------|---------------|---------|---------------------------|----------------|-------------------|----------|---------------|-------------------------------|---------|
| Zeng (2009) [49] ACR knee OA criteria (1995) | 41 (68.29%) | Not mentioned | Not mentioned | 3 | Release soft tissue adhesion, once/wk, 1–3 times, until pain relieves | Electroacupuncture, 30 min, 3 times/wk, 3 wks | VAS pain | | 1.49 vs. 2.85 | <0.01 |
| Zhang (2018) [50] COA criteria (2007) | 80 (60%) | 58 | 59 | 1 | Release soft tissue adhesion, 2 times | Celecoxib, 400 mg, once/day, 1 wk Omeprazole, 20 mg, once/day, 1 wk | VAS pain WOMAC pain | | 2.54 vs. 3.56 | 7.3 vs. 8.93 | <0.05 <0.05 |
| Xu (2018) [51] ACR knee OA criteria | 82 (56.10%) | 58 | 34 | 3 | Release soft tissue adhesion, once/wk, 1–3 times | Electroacupuncture, 3 times/wk, 10 times | JOA assessment | | 48.9 vs. 43.2 | <0.05 |
| Meng (2017) [52] COA criteria (2007) | 69 (44.93%) | 56 | 54 | 4 | Release soft tissue adhesion, once/wk, 4 times | Sodium hyaluronate, 2 ml, once/wk, 4 wks | WOMAC pain Total effectiveness rate | | 15.36 vs. 17.55 | 91.67 vs. 78.79 | <0.05 <0.05 |
| Gu (2016) [53] ACR knee OA criteria (1995) | 75 (69.33%) | 57 | 28 | 2 | Release soft tissue adhesion, once/wk, 2 times | Votalin emulsion, 3 times/day, 2 wks | VAS pain | | 2.06 vs. 2.64 | <0.05 |
| Liang (2015) [54] ACR knee OA criteria (1995) | 60 (73.33%) | 59 | 10 | 3 | Release soft tissue adhesion, once/wk, 1–3 times; functional training, 3 wks | Electroacupuncture, 3 times/wk, 10 times; functional training, 3 wks | JOA assessment | | 48.26 vs. 43.94 | <0.05 |
| Liu (2012) [55] COA criteria (2007) | 60 (51.67%) | 63 | 38 | 4 | Release soft tissue adhesion, once/wk, 1 month | Acupuncture and moxibustion, once/day, 1 month | VAS pain Lysholm’s score Total effectiveness rate | | 2.01 vs. 3.32 | 23.3 vs. 48.35 | 80 vs. 60 | <0.05 <0.05 <0.05 |
| Guo (2012) [56] ACR knee OA criteria (1995) | 180 (65.56%) | 60 | 62 | 3 | Release soft tissue adhesion, once/wk, 3 wks | Electroacupuncture, 3 times/wk, 3 wks | JOA assessment | | 43.66 vs. 39.27 | <0.01 |
Table 1: Continued.

| Author (y) | Diagnostic criteria   | N (female, %) | Age (%) | Disease duration (months) | Duration (wks) | Acupotomy therapy | Controls | Main outcomes | Results (treatment vs. control) | P value |
|------------|-----------------------|---------------|---------|----------------------------|----------------|-------------------|----------|---------------|----------------------------------|---------|
| Zhang (2011) [57] | ACR knee OA criteria (1995) | 58 (53.45%) | 53 | 20 | 3 | Release soft tissue adhesion, once/wk, 1–3 times, until pain relieves | Electroacupuncture, 3 times/wk, 3wks | JOA assessment | 41.33 vs. 31.79 | <0.01 |
| Zhang (2007) [19] | ACR knee OA criteria (1995) | 48 (87.50%) | 61 | 31 | 3 | Release soft tissue adhesion, once/wk, 1–3 times, until pain relieves | Electroacupuncture, twice/wk, 3wks | WOMAC pain Total effectivenss rate | 3 vs. 4.13 | <0.01 |
| Liu (2017) [58] | Not mentioned | 88 (54.55%) | 63 | 77 | 5 | Release soft tissue adhesion, once/wk, 4 times | Sodium hyaluronate 20–30 mg, once/wk, 5 times | VAS pain Total effectivenss rate | 1.5 vs. 1.9 | <0.05 |
| An (2018) [59] | Not mentioned | 80 (53.75%) | 47 | 30 | 3 | Release soft tissue adhesion, once/wk, 3 times | Acupuncture, 20 min, once/wk, 3wks | VAS pain Total effectivenss rate | 2.67 vs. 4.18 | <0.05 |
| Zhu (2019) [60] | COA criteria (2007) | 60 (60%) | 53 | 4 | 2 | Release soft tissue adhesion, once/wk, 2 times | Medium frequency electrotherapy, 6 times/wk, 2wks | VAS pain WOMAC pain Total effectivenss rate | 2.47 vs. 2.78 | <0.05 |

*ACR, American College of Rheumatology; COA, Chinese Orthopedic Association; y, year; N, number of patients included; VAS, visual analogue scale; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index; JOA, Japanese Orthopedic Association.

(1) VAS pain score: 0–10; lower score = better outcome. (2) WOMAC pain score: 0–20; it was assessed with the following five items: pain during walking, stair climbing, resting, weight bearing, and pain at night. Each subscale used the following descriptors: none (0 points), mild (1 point), moderate (2 points), severe (3 points), and extreme (4 points); lower score = better outcome. (3) The total effectiveness rate (%) was defined as the quotient of the number of patients who were clinically cured, exhibited significant improvement, and exhibited improvement divided by the total number of patients. It assesses overall pain, physical function, and wellness; a higher score = better outcome. (4) Lysholm’s score: 0–100, 100 points indicated no symptoms, 80–99 indicated “excellent,” 70–79 indicated “good,” 60–69 indicated “medium,” and less than 60 indicated “poor”; higher score = better outcome. (5) Modified JOA score [57]: 0–55, including pain when walking (30 points) and pain when going up and down stairs (25 points); higher score = better outcome.
physical performance, and wellness using the total effectiveness rate. Three trials [30, 37, 55] used Lysholm’s score and five trials [42, 51, 54, 56, 57] used the JOA score to evaluate overall pain and function.

3.3.1. VAS Pain Score. Twenty-two trials [30–34, 36, 37, 39, 40, 42–47, 49, 50, 53, 55, 58–60] involving 1969 patients were included in the meta-analysis of pain using the VAS pain score. The results of the random-effects meta-analysis indicated that the patients in the acupotomy groups had significantly lower pain scores than did those in the sodium hyaluronate, celecoxib, acupuncture, and electrotherapy control groups (MD = −2.32; 95% CI, −2.94 to −1.69; p < 0.00001) after 1–5 weeks of treatment. The level of heterogeneity (I²) of the VAS pain score was 96% (Figure 4).

The subgroup analysis exploring the improvement in the VAS pain score among different control groups showed that acupotomy therapy had a larger effect than did acupuncture or electroacupuncture (MD = group analysis exploring the impro 0.0006), intraarticular sodium hyaluronate injection (MD = −1.21; 95% CI, −2.06 to −0.36; p = 0.005), NSAIDs (MD = −0.68; 95% CI, −0.99 to −0.37; p < 0.0001), and medium frequency electrotherapy (MD = −1.11; 95% CI, −1.51 to −0.71; p = 0.01) (Figure 4).

3.3.2. WOMAC Pain Score. Nine trials [19, 35, 38, 41, 46, 48, 50, 52, 60] involving 880 patients were included in the meta-analysis of pain using the WOMAC pain score. The results of the random-effects meta-analysis indicated that the patients in the acupotomy groups had significantly lower pain scores than did those in the sodium hyaluronate, celecoxib, acupuncture, and electrotherapy control groups (MD = −2.32; 95% CI, −2.94 to −1.69; p < 0.00001) after 1–5 weeks of treatment. The level of heterogeneity (I²) of the WOMAC pain score was 61% (Figure 5).

The subgroup analysis exploring the improvement in the WOMAC pain score among different control groups showed that acupotomy therapy had a larger effect than did acupuncture or electroacupuncture (MD = −2.44; 95% CI, −3.27 to −1.62; p < 0.00001), intraarticular sodium hyaluronate injection (MD = −2.57; 95% CI, −4.44 to −0.70; p = 0.007), NSAIDs (MD = −2.07; 95% CI, −4.62 to −0.48; p = 0.11), and medium frequency electrotherapy (MD = −2.10; 95% CI, −3.57 to −0.63; p = 0.005) (Figure 5).

3.3.3. The Total Effectiveness Rate. Twenty-three trials [19, 30–42, 44–46, 48, 52, 55, 58–60] involving 2276 patients were included in the meta-analysis of the total effectiveness rate of acupotomy compared to those of acupuncture, electroacupuncture, diclofenac sodium, intraarticular hyaluronate injection, and electrotherapy. The results from our meta-analysis with a random-effects model showed that acupotomy improved the clinical effectiveness rate by 15% (RR = 1.15; 95% CI, 1.09–1.21; p < 0.00001), with a moderate degree of heterogeneity (I² = 54%). Our meta-analysis showed that 2–5 weeks of acupotomy can improve clinical symptoms such as overall pain, physical performance, and wellness in patients with knee OA (Figure 6).
Figure 2: Risk of bias summary.
### Figure 3: Risk of bias distribution graph.

#### Table 1: Effect of acupotomy therapy on the VAS pain score.

| Study or subgroup       | Experimental | Control | Mean difference | Mean difference |
|-------------------------|--------------|---------|-----------------|-----------------|
|                         | Mean (SD)    | Mean (SD) | IV, random, 95% CI | IV, random, 95% CI |
| Acupotomy vs. acupuncture |             |         |                 |                 |
| An, 2018                | -3.6 (1.99)  | 40      | -2.45 (2.58) 40 | -1.15 [-2.16, -0.14] |
| Chen, 2011              | -6.4 (0.81)  | 60      | -3.89 (0.69) 60 | -2.51 [-2.78, -2.24] |
| Hong, 2019              | -2.91 (1.58) | 30      | -2.36 (1.22) 30 | -0.55 [-1.26, -0.16] |
| Hu, 2009                | -3.79 (2.84) | 40      | -2.61 (2.75) 40 | -1.18 [-2.41, -0.05] |
| Li, 2015                | -1.55 (0.12) | 40      | -1.57 (0.63) 40 | 0.02 [-0.18, 0.22]  |
| Li X, 2015              | -3.3 (1.34)  | 162     | -2.04 (1.28) 162 | -1.26 [-1.55, -0.97] |
| Liu, 2012               | -3.2 (1.74)  | 30      | -1.82 (1.26) 30 | -1.38 [-2.15, -0.61] |
| Quan, 2016              | -6.17 (0.66) | 25      | -3.72 (0.56) 25 | -2.45 [-2.79, -2.11] |
| Xiu, 2017               | -3.57 (1.41) | 40      | -2.59 (1.24) 40 | -0.98 [-1.56, -0.40] |
| Zeng, 2009              | -5.57 (1.6)  | 24      | -3.89 (1.28) 17 | -1.68 [-2.56, -0.80] |
| Subtotal (95% CI)        |              |         |                 | -1.32 [-2.07, -0.56] |
| Heterogeneity: tau² = 1.36; chi² = 292.80, df = 9 (P < 0.0001); I² = 97% |
| Test for overall effect: Z = 3.42 (P = 0.0006) |
| Acupotomy vs. sodium hyaluronate |         |         |                 |                 |
| Cheng, 2015             | -5.11 (1.39) | 28      | -3.82 (1.4) 28  | -1.29 [-2.02, -0.56] |
| Jia, 2017               | -4.29 (1.66) | 74      | -2.54 (1.76) 74 | -1.75 [-2.30, -1.20] |
| Liu, 2017               | -3.2 (0.35)  | 44      | -2.9 (0.36) 44  | -0.30 [-0.45, -0.15] |
| Shi, 2019               | -5.32 (1.1)  | 66      | -3.45 (1.14) 54 | -1.87 [-2.27, -1.47] |
| Sun, 2019               | -4.1 (0.55)  | 30      | -2.1 (0.44) 30  | -2.00 [-2.25, -1.75] |
| Sun, 2019               | -3.66 (2.13) | 50      | -3.76 (2.62) 50 | 0.40 [0.10, 0.70]   |
| Subtotal (95% CI)        | 292          | 280     | 27.8 [-1.21 [-2.06, -0.36] |
| Heterogeneity: tau² = 1.05; chi² = 172.67, df = 5 (P < 0.0001); I² = 97% |
| Test for overall effect: Z = 2.79 (P = 0.005) |
| Acupotomy vs. NSAIDs     |             |         |                 |                 |
| Gu, 2016                | -2.22 (0.77) | 36      | -1.72 (0.79) 36 | -0.50 [-0.86, -0.14] |
| Jin, 2020               | -3.44 (1.06) | 30      | -3.16 (0.88) 30 | -0.28 [-0.77, 0.21] |
| Sun, 2012               | -4.71 (1.79) | 45      | -3.65 (2.23) 45 | -1.06 [-1.90, -0.22] |
| Xiong, 2020             | -4.1 (1.46)  | 30      | -3.37 (1.46) 30 | -0.73 [-1.47, 0.01] |
| Zhang, 2018             | -2.36 (0.73) | 40      | -1.13 (1.08) 40 | -1.03 [-1.43, -0.63] |
| Subtotal (95% CI)        | 181          | 181     | 22.9 [-0.68 [-0.99, -0.37] |
| Heterogeneity: tau² = 0.05; chi² = 7.17, df = 4 (P = 0.13); I² = 44% |
| Test for overall effect: Z = 4.30 (P < 0.0001) |
| Acupotomy vs. medium frequency electrotherapy |         |         |                 |                 |
| Zhu, 2019               | -4.03 (0.69) | 30      | -3.56 (0.78) 30 | -0.47 [-0.84, -0.10] |
| Subtotal (95% CI)        | 30           | 30      | 4.9 [-0.47 [-0.84, -0.10] |
| Heterogeneity: not applicable |
| Test for the overall effect: Z = 2.47 (P = 0.01) |
| Total (95% CI)           | 994          | 975     | 100.0 [-1.11 [-1.51, -0.71] |
| Heterogeneity: tau² = 0.83; chi² = 499.56, df = 21 (P < 0.0001); I² = 96% |
| Test for overall effect: Z = 5.42 (P < 0.00001) |
| Test for subgroup differences: chi² = 5.43, df = 3 (P = 0.14), I² = 44.8% |

#### Figure 4: Effect of acupotomy therapy on the VAS pain score.
The subgroup analysis exploring the improvement in the total effectiveness rate among different control groups showed that acupotomy therapy had a larger effect than did acupuncture or electroacupuncture (RR = 1.15; 95% CI, 1.07–1.24; \( p = 0.0002 \)), intraarticular sodium hyaluronate injection (RR = 1.18; 95% CI, 1.10–1.26; \( p < 0.00001 \)), NSAIDs (RR = 1.06; 95% CI, 0.94–1.21; \( p = 0.34 \)), and medium frequency electrotherapy (RR = 1.13; 95% CI, 0.89–1.44; \( p = 0.32 \)) (Figure 6).

### 3.3.4. Lysholm’s Score

Three trials [30, 37, 55] involving 464 patients were included in the meta-analysis of the joint function outcomes using Lysholm’s score. The results of the random-effects meta-analysis indicated that the patients in the acupotomy groups had significantly better joint function than did those in the acupuncture control groups (MD = 12.75; 95% CI, 2.61–22.89; \( p = 0.01 \)) after 2–4 weeks of treatment. The level of heterogeneity (\( I^2 \)) in Lysholm’s score was 98% (Figure 7).

### 3.3.5. JOA Score

Five trials [42, 51, 54, 56, 57] involving 436 patients were included in the meta-analysis of the pain outcomes using the JOA score. The results of the random-effects meta-analysis indicated that the patients in the acupotomy groups had significantly lower pain scores than did those in the sodium hyaluronate and acupuncture control groups (MD = 6.39; 95% CI, 4.11–9.76; \( p < 0.00001 \)) after 3–5 weeks of treatment. The level of heterogeneity (\( I^2 \)) in the JOA score was 78% (Figure 8).

The subgroup analysis exploring the improvement in the JOA score among different control groups showed that acupotomy therapy had a larger effect than did acupuncture or electroacupuncture (MD = 7.09; 95% CI, 3.89–10.29; \( p < 0.0001 \)) and intraarticular sodium hyaluronate injection (RR = 5.82; 95% CI, 0.31–11.33; \( p = 0.04 \)) (Figure 8).

### 4. Discussion

This systematic review and meta-analysis of 32 RCTs including 3021 individuals indicated that acupotomy therapy has larger beneficial effects than do standard Western medication, Chinese acupuncture, and electroacupuncture for knee OA. In addition, many studies have shown that acupuncture and electroacupuncture are beneficial for knee OA in alleviating pain and improving physical function [61–64]. Overall, acupotomy therapy appears to be a safe method for alleviating pain in people with knee OA.

Our findings are supported by the existing evidence. Zhao et al. [65] reported that according to 7 trials using acupotomy combined with sodium hyaluronate for 5 weeks, this combination therapy is more effective than sodium hyaluronate alone in treating knee OA. Another review of 12 RCTs by Fu et al. [66] suggested that acupotomy combined

### Figure 5: Effect of acupotomy therapy on the WOMAC pain score.

The subgroup analysis exploring the improvement in the total effectiveness rate among different control groups showed that acupotomy therapy had a larger effect than did acupuncture or electroacupuncture (RR = 1.15; 95% CI, 1.07–1.24; \( p = 0.0002 \)), intraarticular sodium hyaluronate injection (RR = 1.18; 95% CI, 1.10–1.26; \( p < 0.00001 \)), NSAIDs (RR = 1.06; 95% CI, 0.94–1.21; \( p = 0.34 \)), and medium frequency electrotherapy (RR = 1.13; 95% CI, 0.89–1.44; \( p = 0.32 \)) (Figure 6).
| Study or subgroup | Experimental Events | Control Events | Total (95% CI) | Risk ratio M-H, random, 95% CI |
|------------------|--------------------|----------------|----------------|--------------------------------|
| **Acupotomy vs. acupuncture** | | | | |
| An, 2018         | 37                 | 40             | 27             | 1.37 [1.09, 1.73]             |
| Chen, 2011       | 58                 | 60             | 54             | 1.07 [0.98, 1.18]             |
| Dai, 2018        | 98                 | 100            | 78             | 1.26 [1.13, 1.40]             |
| Hong, 2019       | 29                 | 30             | 22             | 1.32 [1.05, 1.65]             |
| Li S, 2015       | 39                 | 40             | 25             | 1.56 [1.22, 1.99]             |
| Li X, 2015       | 142                | 162            | 139            | 1.02 [0.94, 1.11]             |
| Liu, 2012        | 24                 | 30             | 18             | 1.26 [1.00, 1.60]             |
| Quan, 2016       | 24                 | 25             | 19             | 1.26 [1.00, 1.60]             |
| Sun, 2016        | 34                 | 36             | 34             | 1.03 [0.91, 1.16]             |
| Wang, 2016       | 99                 | 115            | 100            | 0.99 [0.89, 1.10]             |
| Xu, 2017         | 38                 | 40             | 32             | 1.19 [1.00, 1.41]             |
| Zhang, 2007      | 23                 | 24             | 22             | 1.05 [0.90, 1.21]             |
| **Subtotal (95% CI)** | 702                | 703            | 703            | 1.15 [1.07, 1.24]             |
| **Total events** | 645                | 570            |                |                                |

Heterogeneity: tau² = 0.01; ch² = 33.48, df = 11 (P = 0.00004); I² = 67%
Test for overall effect: Z = 3.67 (P = 0.0002)

| **Acupotomy vs. sodium hyaluronate** | | | | |
| Cheng, 2015 | 22 | 28 | 14 | 1.57 [1.03, 2.39] |
| Jia, 2017   | 68 | 74 | 60 | 1.13 [1.00, 1.29] |
| Liu, 2017   | 43 | 44 | 38 | 1.13 [1.00, 1.28] |
| Meng, 2017  | 33 | 36 | 26 | 1.16 [0.95, 1.42] |
| Shi, 2017   | 60 | 66 | 42 | 1.17 [0.99, 1.37] |
| Sun, 2019   | 29 | 30 | 20 | 1.45 [1.12, 1.88] |
| Wang, 2009  | 28 | 30 | 22 | 1.27 [1.01, 1.61] |
| **Subtotal (95% CI)** | 308 | 293 | 272 | 1.18 [1.10, 1.26] |
| **Total events** | 283 | 222 | | |

Heterogeneity: tau² = 0.00; ch² = 5.99, df = 6 (P = 0.42); I² = 0%
Test for overall effect: Z = 4.89 (P < 0.00001)

| **Acupotomy vs. NSAIDs** | | | | |
| Jin, 2020 | 26 | 30 | 24 | 1.08 [0.86, 1.36] |
| Sun, 2012 | 42 | 45 | 42 | 1.00 [0.90, 1.12] |
| Xiong, 2020 | 27 | 30 | 22 | 1.23 [0.96, 1.57] |
| **Subtotal (95% CI)** | 105 | 105 | 125 | 1.06 [0.94, 1.21] |
| **Total events** | 95 | 88 | | |

Heterogeneity: tau² = 0.00; ch² = 2.89, df = 2 (P = 0.24); I² = 31%
Test for overall effect: Z = 0.95 (P = 0.34)

| **Acupotomy vs. medium frequency electrotherapy** | | | | |
| Zhu, 2019 | 26 | 30 | 23 | 1.13 [0.89, 1.44] |
| **Subtotal (95% CI)** | 30 | 30 | 30 | 1.13 [0.89, 1.44] |
| **Total events** | 26 | 23 | | |

Heterogeneity: not applicable
Test for overall effect: Z = 0.99 (P = 0.32)

| **Total (95% CI)** | 1145 | 1131 | 100.0 | 1.15 [1.09, 1.21] |
| **Total events** | 1049 | 903 | | |

Heterogeneity: tau² = 0.01; ch² = 48.24, df = 22 (P = 0.001); I² = 54%
Test for overall effect: Z = 5.39 (P < 0.00001)
Test for subgroup differences: ch² = 2.14, df = 3 (P = 0.54); I² = 0%

**Figure 6:** Effect of acupotomy therapy on the total effectiveness rate.
contractures in muscles and fasciae, relieve pain, and improve the function of the knee joint by releasing adhesive tissue [69]. The growing body of evidence is beginning to shed light on the potential mechanisms by which acupotomy therapy relieves the symptoms of knee OA. One study [70] showed that acupotomy may significantly reduce the magnitude of knee effusion and synovial thickness in patients with knee OA, as assessed by musculoskeletal ultrasound. One study [71] indicated that the centre of gravity is closer to the original point, and weight bearing is improved after acupotomy treatment. One animal study [72] showed that acupotomy can significantly change the behaviour and morphology and significantly improve the mechanical properties of the quadriceps femoris tendon. Recent studies [73–75] have suggested that acupotomy therapy can promote the repair of cartilage cells by activating the FAK-P13K signalling pathway, promote cartilage cell metabolism, and regulate the PERK-eIF2α-CHOP signalling pathway. Several studies [76,77] have already shown an association between increases in the expression levels of the integrin β1, col-II, and aggrecan proteins and decreases in the expression of BAX, caspase-3, and MMP-3 proteins. In addition, acupotomy may also have an anti-inflammatory effect by suppressing the expression of inflammatory cytokines such as interleukin (IL)-1β, IL-6, and TNF-α [20]. Overall, the mechanisms by which acupotomy relieves the symptoms of knee OA are still not clear, and there is accumulating evidence suggesting that acupotomy alters biomechanics, inhibits chondrocyte apoptosis, reduces inflammatory factors and anti-inflammation, inhibits pain signal transduction, and alleviates pain [78–80].

Our study has limitations. First, the overall methodological quality of the RCTs was moderate. Many of the included RCTs had a high risk of bias. Only one study reported double blinding and allocation concealment, and there were no placebo-controlled studies. Second, these studies were short-term, and their treatment did not exceed 6 weeks; therefore, a longer duration of follow-up is needed in future research. Third, the reporting of adverse events was insufficient. Only 1 trial [43] reported three cases of redness and swelling in a control group treated with sodium hyaluronate, and one trial [46] reported 3 cases of subcutaneous bruising after the acupotomy intervention and 2 cases of a stomach ache in the control group receiving a celecoxib capsule.

![Figure 7: Effect of acupotomy therapy on Lysholm's score.](image1)

![Figure 8: Effect of acupotomy therapy on the JOA score.](image2)
Three trials reported no adverse events, but 27 trials did not mention adverse events. Acupotomy therapy appears to be a safe method with no severe side effects, but it is important to assess adverse events in future studies. Fourth, despite the statistically significant and beneficial effects of acupotomy on pain and function in patients with knee OA, the clinically important benefits of acupotomy remain to be determined. Many challenges remain, and the potential benefits of acupotomy therapy for knee OA need to be further evaluated through clinical trials that employ more rigorous methodologies.

5. Conclusions

In summary, acupotomy therapy may be effective in reducing pain and improving the physical function of individuals with knee OA. Despite the limited quality of the trials included in this review, our study provides new and valuable information. Chinese acupotomy therapy may be effective in treating knee OA. More rigorous randomized controlled trial designs are needed in the future.

Disclosure

Jigao Sun and Yan Zhao are co-first authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors’ Contributions

Weiheng Chen was involved in funding acquisition. Weiheng Chen and Jigao Sun were involved in conceptualization, review, and revision. Jigao Sun and Yan Zhao were involved in preparing original draft and in analyses. Ruizheng Zhu, Qianglong Chen, and Zhipeng Xue were involved in data extraction. Yan Zhao, Rongtian Wang, and Mengge Song were involved in quality assessment.

Acknowledgments

This study was supported by the National Science and Technology Support of China (2015BAI04B03), the China Association of Traditional Chinese Medicine (SATCM-2015-BZ402), and the Beijing Municipal Natural Science Foundation (No. 7182186).

Supplementary Materials

Additional file 1: VAS pain score funnel plot; additional file 2: WOMAC pain score funnel plot; additional file 3: the total effectiveness rate funnel plot; additional file 4: Lysholm’s score funnel plot; additional file 5: JOA score funnel plot; additional file 6: image of acupotomy therapy, 0.8 mm × 80 mm (Huayou Medical Co., China). (Supplementary Materials)

References

[1] D. T. Felson, “Clinical practice, osteoarthritis of the knee,” New England Journal of Medicine, vol. 354, no. 8, pp. 841–848, 2006.
[2] C. F. Dillon, E. K. Rasz, Q. Gu, and R. Hirsch, “Prevalence of knee osteoarthritis in the United States: arthritis data from the third national health and nutrition examination survey 1991–94,” Journal of Rheumatology, vol. 33, no. 11, pp. 2271, 2006.
[3] Z. Jatanovic, R. Mihelic, B. Setas, and Z. Dembic, “Emerging pathways and promising agents with possible disease modifying effect in osteoarthritis treatment,” Current Drug Targets, vol. 15, no. 16, pp. 635–661, 2014.
[4] R. R. Bannuru, M. C. Osani, F. Al-Eid, and C. Wang, “Efficacy of curcumin and boswellia for knee osteoarthritis: systematic review and meta-analysis,” Seminars in Arthritis and Rheumatism, vol. 48, no. 3, pp. 416–429, 2018.
[5] M. C. Osani, E. E. Vaysbrot, M. Zhou, T. E. McAlindon, and R. R. Bannuru, “Duration of symptom relief and early trajectory of adverse events for oral NSAIDs in knee osteoarthritis: a systematic review and meta-analysis,” Arthritis Care & Research, vol. 72, no. 5, pp. 641–651, 2019.
[6] M. Bally, N. Dedukuri, B. Rich et al., “Risk of acute myocardial infarction with NSAIDs in real world use: bayesian meta-analysis of individual patient data,” British Medical Journal, vol. 357, Article ID j1909, 2017.
[7] N. Bhala, J. Emberson, A. Merhi, S. Abramson, N. Arber, J. A. Baron et al., “Vascular and upper gastrointestinal effects of non-steroidal anti-inflammatory drugs: meta-analyses of individual participant data from randomised trials,” Lancet (London, England), vol. 382, no. 9894, pp. 769–779, 2013.
[8] C. Scarpignato, A. Lasans, C. Blandizzi, W. F. Lems, M. Hermann, and R. H. Hunt, “Safe prescribing of non-steroidal anti-inflammatory drugs in patients with osteoarthritis—an expert consensus addressing benefits as well as gastrointestinal and cardiovascular risks,” BMC Medicine, vol. 13, p. 55, 2015.
[9] C. Zeng, J. Wei, M. S. M. Persson et al., “Relative efficacy and safety of topical non-steroidal anti-inflammatory drugs for osteoarthritis: a systematic review and network meta-analysis of randomised controlled trials and observational studies,” British Journal of Sports Medicine, vol. 52, no. 10, pp. 642–650, 2018.
[10] R. R. Bannuru, M. C. Osani, E. E. Vaysbrot et al., “OARSI guidelines for the non-surgical management of knee, hip, and polyarticular osteoarthritis,” Osteoarthritis and Cartilage, vol. 27, no. 11, pp. 1578–1589, 2019.
[11] B. Chen, H. Zhan, J. Marszalek et al., “Traditional Chinese medications for knee osteoarthritis pain: a meta-analysis of randomized controlled trials,” The American Journal of Chinese Medicine, vol. 44, no. 04, pp. 677–703, 2016.
[12] B. Wang, D. Xing, S. J. Dong, R. Tie, and X. Wei, “Prevalence and disease burden of knee osteoarthritis in China: a systematic review,” Chinese Journal of Evidence-Based Medicine, vol. 18, no. 2, pp. 134–142, 2018, in Chinese.
[13] S. L. Kolasinski, T. Neogi, M. C. Hochberg et al., “2019 American College of rheumatology/arthritis foundation guideline for the management of osteoarthritis of the hand, hip, and knee,” Arthritis & Rheumatology, vol. 72, no. 2, pp. 220–233, 2020.
[14] W.-h. Callahan, X. X. Liu, X.-x. Liu, P.-j. Tong, and H.-s. Zhan, “Diagnosis and management of knee osteoarthritis: Chinese medicine expert consensus (2015),” Chinese
osteoarthrosis,” *Chinese Journal of Orthopedics and Traumatology*, vol. 28, no. 2, pp. 19–23, 2020, in Chinese.

[47] S. R. Hu, L. H. Yin, and W. Y. Li, “Clinical study on the improvement of Knee osteoarthrosis by acupotomy surgery,” *Jiangai Medical Journal*, vol. 44, no. 11, pp. 1093–1095, 200, in Chinese.

[48] L. K. Wang and J. L. Qiao, "A randomized controlled clinical study of acupotomy and sodium hyaluronate injection in the treatment of knee osteoarthrosis-Annex: a report of 60 cases," *Journal of Chengdu University of Traditional Chinese*, vol. 32, no. 1, pp. 22–25, 2009, in Chinese.

[49] G. G. Zeng, X. F. Zhang, W. C. Quan, Y. B. Wang, T. J. Chen, and Y. Q. Liu, “Effects of needle knife relaxing therapy on stress stimulation and clinical symptoms of knee osteoarthrosis,” *Chinese Archives of Traditional Chinese Medicine*, vol. 27, no. 1, pp. 66–68, 2009, in Chinese.

[50] Z. Q. Zhang, B. Q. Zhang, J. W. Liu, and D. Guo Clinical, "Effects of injection needle scalpel therapy on knee osteoarthris at early stage," *Modern Hospital*, vol. 18, no. 7, pp. 1052–1054, 2018, in Chinese.

[51] X. Xu, “Effect of acupotomy on the early pain of knee osteoarthrosis,” *Shenzhen Journal of Integrated Traditional Chinese and Western Medicine*, vol. 28, no. 6, pp. 60–62, 2018, in Chinese.

[52] F. Meng, Y. Yin, T. F. Wang, and L. Feng, “Therapeutic effects of small needle knife on knee osteoarthrosis and its effects on the expression levels of TNF-α, MMPs in joint synovial fluid of patients,” *Hebei Medical Journal*, vol. 39, no. 2, pp. 168–172, 2017, in Chinese.

[53] L. J. Gu, W. H. Li, B. Zhang, Y. Tang, W. K. Qin, and F. H. Dong, “Observation on the short- term clinical curative effect of release with stiletto needle versus knife needle for treatment of early-middle knee osteoarthrosis,” *The Journal of Traditional Chinese Orthopedics and Traumatology*, vol. 28, no. 9, pp. 30–34, 2016, in Chinese.

[54] C. Liang, J. Y. Cai, L. Yan et al., “Evaluation of the curative effect of needle-knife therapy for relieving knee pain in patients with early knee osteoarthrosis,” *The Journal of Traditional Chinese Orthopedics and Traumatology*, vol. 27, no. 9, pp. 9–14, 2015, in Chinese.

[55] M. R. Liu, L. Li, and Z. W. He, “Efficacy observation on osteoarthrosis of the knee treated with the ultrastructural acupotomy therapy at the counter-Ashi points,” *Chinese Acupuncture & Moxibustion*, vol. 32, no. 7, pp. 621–624, 2012, in Chinese.

[56] C. Q. Guo, T. Si, J. M. Wen et al., “Effects of acupotomy therapy on the pain symptoms in patients with knee osteoarthrosis: a randomized controlled clinical trial,” *Tianjin Journal of Traditional Chinese Medicine*, vol. 29, no. 1, pp. 35–38, 2012, in Chinese.

[57] X. F. Zhang, W. C. Quan, S. Peng, Y. B. Wang, T. J. Chen, and L. H. Li, “Effects of acupotomy on the footplate pressure and X ray manifestations in the treatment of knee osteoarthrosis,” *Medical Journal of the Chinese People’s Armed Police Forces*, vol. 109, no. 44, pp. 21028–21039, 2011, in Chinese.

[58] Z. L. Liu, “Research on pathogenesis of knee joint osteoarthritis and study on curative effect of needle knife therapy,” *China & Foreign Medical Treatment*, vol. 36, no. 20, pp. 33–37, 2017, in Chinese.

[59] J. H. An, Q. H. Hua, and H. D. Wang, “Effect of acupotomy on pain relief and joint function improvement in patients with knee joint disease,” *Internal Medicine*, vol. 13, no. 4, pp. 565–567, 2018, in Chinese.

[60] F. F. Zhu, B. Dong, P. W. Yuan et al., “Clinical study on treatment of early knee osteoarthrosis with small needle knife therapy Modern,” *Journal of Integrated Traditional Chinese and Western Medicine*, vol. 28, no. 31, pp. 3421–3425, 2019, in Chinese.

[61] M. S. Corbett, S. J. C. Rice, V. Madurasinghe et al., “Acupuncture and other physical treatments for the relief of pain due to osteoarthrosis of the knee: network meta-analysis,” *Osteoarthritis and Cartilage*, vol. 21, no. 9, pp. 1290–1298, 2013.

[62] Q. Zhang, J. Yue, B. Golián, Z. Sun, and Y. Lu, “Updated systematic review and meta-analysis of acupuncture for chronic knee pain,” *Acupuncture in Medicine*, vol. 35, no. 6, pp. 392–403, 2017.

[63] H. MacPherson, E. Vertosick, G. Lewith et al., “Influence of control group on effect size in trials of acupuncture for chronic pain: a secondary analysis of an individual patient data meta-analysis,” *PloS One*, vol. 9, no. 4, Article ID e93739, 2014.

[64] N. Chen, J. Wang, A. Mucelli, X. Zhang, and C. Wang, “Electro-acupuncture is beneficial for knee osteoarthrosis: the evidence from meta-analysis of randomized controlled trials,” *The American Journal of Chinese Medicine*, vol. 45, no. 5, pp. 965–985, 2017.

[65] J. Zhao, Q. F. Wang, Y. F. Ma et al., “Meta-analysis on efficacy of acupotomy combined with sodium hyaluronate versus sodium hyaluronate in treating knee osteoarthrosis,” *Chinese Journal of Traditional Medical Traumatology & Orthopedics*, vol. 22, no. 2, pp. 15–20, 2014, in Chinese.

[66] F. Y. Fu, H. L. Ye, Z. X. Jia, M. G. Song, and W. H. Chen, “Meta-analysis of efficacy of acupotomy combined with ozone in treatment of knee osteoarthrosis,” *Journal of Hainan Medical University*, vol. 25, no. 23, pp. 1811–1817, 2019, in Chinese.

[67] S. F. Chen, K. Q. Wang, and H. M. Zhang, “Clinical study of articular cavity injection combined with needle knife for the knee osteoarthrosis,” *Guiding Journal of Traditional Chinese Medicine & Pharmacy*, vol. 23, no. 23, pp. 87–90, 2017, in Chinese.

[68] Y. Cheng, K. Wu, Z. Cheng et al., “Randomized controlled study on the treatment of knee osteoarthrosis with different acupuncture methods at different stages,” *Zhongguo Zhen Jiu*, vol. 33, no. 6, pp. 508–512, 2013, in Chinese.

[69] G. Li, R. Zhu, X. Li, and X. Chen, “Acupotomy therapy’s effect and mechanism in knee osteoarthrosis,” *World Chinese Medicine*, vol. 11, no. 6, pp. 1077–1081, 2016, in Chinese.

[70] J. Y. Li, “Objective to investigate the soft tissue changes of knee osteoarthrosis treated by acupotomy with musculoskeletal ultrasound,” *Hubei Journal of Traditional Chinese Medicine*, vol. 37, no. 8, pp. 51–52, 2015, in Chinese.

[71] L. J. Gu, B. Zhang, W. H. Li, Y. Tang, and F. H. Dong, “Stiletto needle and needle-knife for influence of gravity index in treating knee osteoarthrosis,” *Zhongguo Gu Shang*, vol. 30, no. 12, pp. 1091–1096, 2017.

[72] L. J. Wang, X. W. Shi, W. Zhang, T. Wang, S. Zhou, and C. Q. Guo, “Effect of needle-knife intervention on tensile mechanics of femoral quadriiceps tendon in rabbits with knee osteoarthrosis,” *Zhongguo Gu Shang*, vol. 32, no. 5, pp. 462–468, 2019.

[73] S. N. Ma, Z. G. Xie, Y. Guo et al., “Effect of acupotomy on FAK-Pi3K signaling pathways in KOA rabbit articular cartilages,” *Evidence-Based Complementary and Alternative Medicine*, vol. 2017, Article ID 4535326, 11 pages, 2017.
[74] N. G. Liu, J. N. Yu, B. Hu, Y. Guo, and C. Q. Guo, “Phosphorylated focal adhesion kinase, phosphoinositides 3 kinase and aggrecan genes and proteins in cartilage cells are probably involved in needle knife intervention induced improvement of knee osteoarthritis in rabbits,” Zhen Ci Yan Jiu, vol. 43, no. 4, pp. 221–225, 2018.

[75] Y.-h. Yang, T.-h. Liu, L.-d. Zhang, Z.-y. Chen, and X.-s. Huang, "Role of the PERK-eIF2α-CHOP signaling pathway in the effect of needle knife therapy on knee joint chondrocyte apoptosis," Evidence-Based Complementary and Alternative Medicine, vol. 2019, Article ID 7164916, 7 pages, 2019.

[76] C. X. Liang, Y. Guo, L. Tao et al., “Effects of acupotomy intervention on regional pathological changes and expression of cartilage-mechanics related proteins in rabbits with knee osteoarthritis,” Zhen Ci Yan Jiu, vol. 40, no. 2, pp. 119–124, 2015.

[77] Y. R. Huang, Y. L. Jin, N. Li et al., “Effects of acupotomy, electroacupuncture or round-sharp acupuncture needle interventions on expression of Bcl-2, Bax, Caspase-3 proteins of rectus femoris in rabbits with knee osteoarthritis,” Zhen Ci Yan Jiu, vol. 39, no. 2, pp. 100–105, 2014.

[78] M. L. Zhao, Y. H. Bai, Y. Zhang, and W. M. Shi, “Advances in the treatment of knee osteoarthritis with small needle knife,” Hebei Journal of Traditional Chinese Medicine, vol. 39, no. 12, pp. 1908–1912, 2017, in Chinese.

[79] Z. J. Niu, W. Shen, and L. M. Xie, “Parallel control study of needle-knife combined with traditional Chinese medicine hot compress and simple needle knife in the treatment of knee osteoarthritis with cold-damp blocking syndrome,” Journal of Clinical and Experimental Medicine, vol. 18, no. 12, pp. 1297–1301, 2019, in Chinese.

[80] A. C. Niu, J. M. Wu, and N. Li Research, "Progress of the effect and mechanisms of needle-knife on knee osteoarthritis," Asia-Pacific Traditional Medicine, vol. 12, no. 7, pp. 76–78, 2016, in Chinese.