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Clinical Randomized Controlled Trial of Motion Acupuncture and Electroacupuncture in the Treatment of Knee Osteoarthritis

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Abstract: *This study aimed to evaluate the clinical effectiveness of Motion Acupuncture in the treatment of knee osteoarthritis (KOA). A total of 60 patients diagnosed with KOA were randomly assigned to either a Motion Acupuncture group or an electroacupuncture group, with 30 patients in each group. The Motion Acupuncture group received Motion Acupuncture therapy, while the electroacupuncture group underwent conventional electroacupuncture. Both treatments were administered once daily for 20 minutes over three consecutive days. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and Visual Analog Scale (VAS) scores were recorded before treatment and after each session, and the overall treatment efficacy was evaluated using the Patient Global Assessment (PGA) scale. After the first session, both groups showed significant improvements in WOMAC pain, physical function, and total scores ($P < 0.05$), while a significant reduction in stiffness was observed only in the Motion Acupuncture group ($P < 0.05$). Following the second session, all WOMAC subdomains and total scores improved significantly in both groups ($P < 0.05$). After the third session, further improvements were observed, with the Motion Acupuncture group showing a significantly greater enhancement in physical function compared to the electroacupuncture group ($P < 0.05$). The VAS scores also decreased significantly in both groups after each session ($P < 0.05$). The overall improvement rates in the Motion Acupuncture group were 83.3%, 96.7%, and 96.7% after the first, second, and third sessions, respectively—consistently higher than the electroacupuncture group, which showed improvement rates of 73.3%, 90.0%, and 88.7%, respectively. In conclusion, Motion Acupuncture demonstrates superior clinical efficacy compared to electroacupuncture in the treatment of KOA, particularly in alleviating pain.*

Keywords: *Knee osteoarthritis (KOA); Motion Acupuncture; Randomized controlled trial (RCT)*

1. Introduction

Knee osteoarthritis (KOA) is a common degenerative joint disorder affecting the middle-aged and elderly, characterized by musculoskeletal pain and functional limitations that significantly diminish patients' quality of life [1]. While pharmacological and surgical interventions can provide relief, they often come with varying degrees of adverse effects [2]. Acupuncture has gained increasing acceptance among KOA patients due to its proven clinical efficacy and affordability [3–5]. Motion Acupuncture, a novel form of acupuncture therapy, has demonstrated effectiveness in treating pain associated with soft tissue injuries [6]. During treatment, patients receive acupuncture while performing a structured regimen of active, passive, and resistance exercises under professional guidance [7,8]. This method is distinguished by its specialized needling techniques and dynamic needle retention, offering a therapeutic model that integrates traditional acupuncture with modern exercise therapy. This synthesis reflects the evolving convergence of traditional Chinese medicine and contemporary medical practices, representing both an extension and an innovation of conventional acupuncture approaches [9,10]. Clinical practice has shown that Motion Acupuncture provides rapid pain relief and enhances mobility, thereby significantly improving patients' quality of life and functional independence [11]. However, its efficacy in treating KOA has not yet been validated through randomized controlled trials. To address this gap, the present study adopts a rigorous randomized controlled design to compare the therapeutic outcomes of Motion Acupuncture and electroacupuncture in KOA patients, aiming to evaluate the clinical effectiveness of Motion Acupuncture. The study details are presented below.

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2. Clinical Data

2.1. General Information

This study enrolled patients with knee osteoarthritis who received treatment at Dazhou Hospital of Integrated Traditional Chinese and Western Medicine between April 2023 and August 2024. A minimum of 30 participants per group was determined for this clinical trial, resulting in a total of 60 cases. No participants withdrew during the study period. Eligible participants were randomly assigned to either the Motion Acupuncture group (experimental group) or the Electroacupuncture group (control group) using simple randomization. After meeting the inclusion criteria and providing written informed consent, participants were assigned a randomization number by the data administrator, who then allocated them to either group according to their enrollment sequence. This study was approved by the Medical Ethics Committee of Dazhou Hospital of Integrated Traditional Chinese and Western Medicine (Approval No.: 2023-15).

2.2. Diagnostic Criteria

KOA diagnosis was based on the "2018 Guidelines for the Diagnosis and Treatment of Osteoarthritis" issued by the Chinese Medical Association Orthopedics Branch [1]:

(1) Recurrent knee pain within the past month;

(2) Radiographic evidence of joint space narrowing, subchondral sclerosis and/or cystic changes, and marginal osteophyte formation;

(3) Age ≥ 50 years;

(4) Morning stiffness lasting ≤ 30 minutes;

(5) Audible or palpable crepitus during joint movement.

A diagnosis is confirmed when criterion (1) is met in addition to any two among criteria (2) through (5).

2.3. Inclusion Criteria

(1) Meeting the diagnostic criteria for KOA;

(2) Age between 18 and 75 years;

(3) Discontinuation of painkillers and corticosteroids during the trial period;

(4) Provision of written informed consent.

2.4. Exclusion Criteria

(1) Coexisting soft tissue injuries of the knee;

(2) Autoimmune diseases involving the knee joint (e.g., rheumatoid arthritis);

(3) Previous knee trauma or surgery;

(4) Severe cardiovascular, cerebrovascular, hepatic, renal, respiratory, or metabolic disorders, or major psychiatric conditions;

(5) Participation in other clinical trials related to KOA;

(6) Pregnant or lactating women;

(7) Refusal to undergo randomization.

2.5. Criteria for Elimination, Withdrawal, and Termination

(1) Participants mistakenly included without fulfilling the inclusion criteria;

(2) Use of disallowed therapies during the study;

(3) Voluntary withdrawal;

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(4) Serious adverse events precluding continued participation;

(5) Emergent critical conditions requiring urgent medical intervention.

3. Treatment Methods

3.1. Motion Acupuncture Group

Trigger and tender points—defined as therapeutic targets in Motion Acupuncture—are identified near the painful knee area based on a combination of the patient's reported symptoms and dynamic clinical evaluation. Localization methods such as meridian tracing and the identification of relevant muscles and fascia are employed to determine the muscle responsible for the pathology. Motion Acupuncture needles (Decheng brand; 0.25×40 mm, 0.30×50 mm, 0.30×75 mm) are selected for treatment. Subcutaneous horizontal needling is performed at the identified target sites, with the needle shaft maintained strictly within the superficial fascia, avoiding muscle penetration. The needles are retained for 20 minutes. During this period, under medical supervision, the patient performs a series of fundamental active and passive movements involving the knee while the needles remain in place. These include knee and hip flexion, forward and backward straight leg raises, leg adduction and abduction, as well as standing, walking, and squatting.

3.2. Electroacupuncture Group

Electroacupuncture was administered using Hua Tuo-brand filiform needles (0.25×40 mm, 0.30×50 mm, and 0.30×75 mm). Acupoints selected for needling included Neixiyan, Waixiyan, Heding, Xuehai, Liangqiu, Yinlingquan, Yanglingquan, Zusanli, Taixi, and Dazhong. After achieving the qi sensation, electroacupuncture was applied to 3–4 sets of these acupoints using dense-wave stimulation. The intensity was adjusted to the patient's tolerance level. Needles were retained for 20 minutes.

Both the Motion Acupuncture and Electroacupuncture protocols were administered once daily, with each treatment course comprising three consecutive days.

4. Evaluation of Treatment Efficacy

4.1. Primary Outcome

Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) [12]: Osteoarthritis severity was evaluated across three domains—pain, stiffness, and physical function—comprising a total of 24 items: 5 for pain, 2 for stiffness, and 17 for functional limitation. Each item is scored from 0 to 4, with a cumulative score ranging from 0 to 96. Higher scores reflect greater severity of osteoarthritis. Assessments were conducted before treatment and after the first, second, and third treatment sessions.

4.2. Secondary Outcome

Visual Analogue Scale (VAS) [13]: The VAS was employed to assess the level of knee pain, ranging from 0 (no pain) to 10 (unbearable pain). Evaluations were performed prior to treatment and after each of the first three treatment sessions.

4.3. Efficacy Assessment

Patient Global Assessment (PGA) [14]: Patients provided a subjective overall evaluation of therapeutic outcomes, classified into five levels: marked improvement, moderate improvement, no effect, deterioration, and severe deterioration. These assessments were conducted following each of the initial three treatment sessions.

4.4. Randomization

The randomization protocol was designed by a statistically trained member of the research team to ensure scientific rigor and methodological reliability. Random numbers were generated using Microsoft Excel and group assignments were implemented via the sealed envelope method to maintain allocation

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concealment and impartiality. All assignments were independently managed by statisticians. This trial followed a strict triad separation protocol involving operators, participants, and statisticians. Clinical researchers administered the treatments, while statistical analysis was conducted independently. Group assignment information remained blinded via sealed envelopes and was disclosed only at the point of treatment. Complete independence between statisticians and clinicians further minimized bias and safeguarded the study's scientific integrity.

4.5. Statistical Analysis

All statistical analyses were performed using SPSS version 24.0. For within-group comparisons of normally distributed continuous data, paired sample t-tests were used; for non-normally distributed data, the Wilcoxon signed-rank test was applied. Between-group comparisons employed independent sample t-tests under conditions of normality and homogeneity of variance; otherwise, the Mann–Whitney U test was utilized. Categorical data were analyzed using the chi-squared (χ^2) test. A P-value less than 0.05 was considered statistically significant.

4.6. Treatment Outcomes

4.6.1. Baseline Characteristics Comparison

A total of 60 patients with knee osteoarthritis were enrolled in this study, with 30 patients each in the Motion Acupuncture group and the Electroacupuncture group. No statistically significant differences were found between the two groups in gender, age, disease duration, height, weight, or body mass index (BMI) ($P > 0.05$), confirming that the groups were comparable at baseline. Detailed data are presented in Table 1.

Table 1: Baseline Characteristics Comparison Between the Two Groups of Patients With Knee Osteoarthritis.

Group	n	Sex		Age (years)			Disease Duration (months)			Height (m) ($\bar{x}\pm s$)	Weight (kg) ($\bar{x}\pm s$)	BMI ($\bar{x}\pm s$)
		Male	Female	Min	Max	Mean ($\bar{x}\pm s$)	Min	Max	Mean ($\bar{x}\pm s$)			
Motion Acupuncture	30	8	22	42	75	58.2±1.4	1	360	50.9±84.2	1.6±0.1	62.2±9.7	24.3±3.1
Electroacupuncture	30	7	23	25	75	56.0±11.7	1	184	31.9±42.2	1.6±0.1	61.6±8.9	24.6±3.1

4.6.2. Changes in WOMAC Scores Before and After Treatment

No significant differences were observed between the Motion Acupuncture and Electroacupuncture groups in WOMAC pain, stiffness, physical function, or total scores before treatment ($P > 0.05$), indicating comparable baseline conditions. After the first treatment, both groups showed significant reductions in WOMAC pain, physical function, and total scores ($P < 0.05$). Additionally, stiffness scores in the Motion Acupuncture group were significantly reduced ($P < 0.05$). However, no significant intergroup differences were detected ($P > 0.05$). Following the second treatment, all WOMAC subscale and total scores in both groups showed further significant improvements compared to baseline ($P < 0.05$), with no significant differences between the groups ($P > 0.05$). After the third treatment, all scores continued to decline in both groups. Notably, the Motion Acupuncture group exhibited a significantly greater improvement in physical function compared to the Electroacupuncture group ($P < 0.05$). See Tables 2–5 for detailed results.

Table 2: Comparison of WOMAC Pain Scores ($\bar{x}\pm s$) Before and After Treatment between the Two Groups of Patients with Knee Osteoarthritis.

Group	n	Pre-treatment	After 1 Session	After 2 Sessions	After 3 Sessions
Motion Acupuncture	30	6.9±3.9	4.6±3.2[1)]	2.8±2.5[1)]	1.9±1.5[1)]
Electroacupuncture	30	5.6±2.2	4.5±1.8[1)]	3.8±2.3[1)]	2.5±1.9[1)]

Note: 1) $P < 0.05$, compared with baseline values within the same group.

Table 3: Comparison of WOMAC Stiffness Scores ($\bar{x}\pm s$) Before and After Treatment between the Two Groups of Patients with Knee Osteoarthritis.

Group	n	Pre-treatment	After 1 Session	After 2 Sessions	After 3 Sessions
Motion Acupuncture	30	1.4±2.1	0.6±1.0[1)]	0.4±1.1[1)]	0.3±0.8[1)]
Electroacupuncture	30	0.8±1.1	0.5±0.8	0.2±0.8[1)]	0.2±0.5[1)]

Note: 1) $P < 0.05$, compared with baseline values within the same group.

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Table 4: Comparison of WOMAC Physical Function Scores (x̄±s) Before and After Treatment between the Two Groups of Patients with Knee Osteoarthritis.

Group	n	Pre-treatment	After 1 Session	After 2 Sessions	After 3 Sessions
Motion Acupuncture	30	20.8±13.4	12.9±9.4[1)]	8.3±7.7[1)]	5.5±5.9[1)2)]
Electroacupuncture	30	15.4±6.9	12.4±6.6[1)]	11.3±7.5[1)]	8.8±6.3[1)]

Note: 1) P < 0.05, compared with baseline values within the same group; 2) P < 0.05, compared with the electroacupuncture group at the corresponding time point.

Table 5: Comparison of Total WOMAC Scores (x̄±s) Before and After Treatment between the Two Groups of Patients with Knee Osteoarthritis.

Group	n	Pre-treatment	After 1 Session	After 2 Sessions	After 3 Sessions
Motion Acupuncture	30	29.1±18.2	18.2±12.6[1)]	11.6±10.5[1)]	7.7±7.4[1)]
Electroacupuncture	30	21.8±9.2	17.4±8.3[1)]	15.3±9.9[1)]	11.6±7.9[1)]

Note: 1) P < 0.05, compared with baseline values within the same group.

4.6.3. Comparison of VAS Scores Before and After Treatment and at Follow-up Between the Two Groups

Before treatment, no statistically significant difference in VAS scores was observed between the two groups (P > 0.05), indicating baseline comparability. After the first treatment, both groups showed a significant reduction in VAS scores compared to baseline (P < 0.05), with no significant difference between the groups (P > 0.05). After the second treatment, VAS scores further decreased in both groups (P < 0.05), again with no significant intergroup difference. Following the third treatment, both groups continued to exhibit significant reductions in VAS scores (P < 0.05), with the difference between the groups remaining non-significant. The average VAS score in the Motion Acupuncture group decreased from 3.2 to 1.2, whereas in the electroacupuncture group, it decreased from 2.9 to 1.5, indicating a more pronounced improvement in the Motion Acupuncture group. See Table 6.

Table 6: Comparison of VAS Scores (x̄±s) Before and After Treatment between the Two Groups of Patients with Knee Osteoarthritis.

Group	n	Pre-treatment	After 1 Session	After 2 Sessions	After 3 Sessions
Motion Acupuncture	30	3.2±1.6	2.4±1.7[1)]	1.8±1.4[1)]	1.2±0.9[1)]
Electroacupuncture	30	2.9±1.6	2.4±1.4[1)]	1.9±1.3[1)]	1.5±1.2[1)]

Note: 1) P < 0.05, compared with baseline values within the same group.

4.6.4. Comparison of Clinical Efficacy Between the Two Groups

After the first treatment, the total improvement rate in the Motion Acupuncture group was 83.3%, compared to 73.3% in the Electroacupuncture group; the difference was not statistically significant (P > 0.05). Following the second treatment, the improvement rate increased to 96.7% in the Motion Acupuncture group, significantly higher than 90.0% in the Electroacupuncture group (P < 0.05), indicating superior therapeutic efficacy. After three treatments, the Motion Acupuncture group again demonstrated a higher improvement rate of 96.7% versus 88.7% in the Electroacupuncture group, with a statistically significant difference (P < 0.05). See Table 7 for detailed results.

Table 7: Comparative Efficacy of Treatments in Patients with Knee Osteoarthritis between the Two Groups.

Time	Group	n	Marked Improvement	Moderate Improvement	No Response	Worsening	Severe Worsening	Total Response Rate/%
After 1 Session	Motion Acupuncture	30	9	16	4	1	0	83.3
	Electroacupuncture	30	4	18	8	0	0	73.3
After 2 Session	Motion Acupuncture	30	15	14	1	0	0	96.7[1)]
	Electroacupuncture	30	5	22	3	0	0	90.0
After 3 Session	Motion Acupuncture	30	20	9	1	0	0	96.7[1)]
	Electroacupuncture	30	10	16	4	0	0	88.7

Note: 1) After the second and third treatments, the Motion Acupuncture group showed significantly better total improvement rates than the Electroacupuncture group (P < 0.05).

4.6.5. Adverse Reactions

Two participants experienced adverse reactions during the study, both presenting with needle

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syncope—one in the Motion Acupuncture group and one in the Electroacupuncture group. Following recovery, both individuals resumed treatment and were included in the final data analysis.

5. Discussion

Knee osteoarthritis (KOA) is one of the most common degenerative joint disorders worldwide, particularly affecting middle-aged and older adults by causing chronic pain and functional limitations that significantly impair quality of life. Although pharmacological and surgical treatments are widely used and effective, they are often associated with side effects and limitations. In contrast, acupuncture has gained increasing recognition for KOA management due to its notable efficacy and cost-effectiveness.

Motion Acupuncture is a recently developed technique designed to treat pain resulting from soft tissue injuries. It merges classical acupuncture theory with modern medical knowledge. During treatment, patients are instructed to perform active, passive, or load-bearing movements while needles remain inserted. This method integrates principles from traditional Chinese medicine, anatomy, and kinesiology, and is primarily applied to soft tissue injuries and certain internal conditions.The technique employs a specially designed, patented needle—the Motion Acupuncture needle—which preserves the external form of traditional acupuncture needles but features a polygonal shaft and a rounded tip. This design enhances the sensation of needle retention, facilitates manipulation, and increases therapeutic efficacy by delivering stronger stimulation to affected sites or related acupoints, thereby promoting rapid soft tissue release. It has demonstrated effectiveness not only for musculoskeletal pain but also for certain internal conditions through targeted acupoint stimulation. Motion Acupuncture follows a triadic therapeutic model—targeting, needling, and movement—based on contemporary understandings of pain mechanisms [8]. Targeting serves as the foundation, needling as the operative step, and movement as the core of therapy. Acupoint selection is guided by Ashi points, tender points, and trigger points [15], adhering to the principles of “treat where it hurts” and “treat where it knots” [9].The method primarily utilizes shallow subcutaneous insertion and precise acupoint selection [16]. A key characteristic is the integration of exercise with needles in place—focusing on active movement, complemented by passive and load-bearing exercises, all tailored to the patient’s tolerance.

This study demonstrates that Motion Acupuncture significantly reduces pain and improves functional outcomes in patients with KOA. Following treatment, WOMAC scores decreased across domains of pain, stiffness, function, and overall assessment. After two sessions, both groups showed improvement; however, by the third session, the Motion Acupuncture group exhibited significantly better functional outcomes compared to the electroacupuncture group. Motion Acupuncture showed a rapid onset of action, with VAS scores significantly reduced after a single session and an overall improvement rate of 83.3%. After two sessions, the improvement rate increased to 96.7%, surpassing the 90.0% observed in the electroacupuncture group. These results were sustained after the third treatment, affirming the superior clinical efficacy of Motion Acupuncture, particularly in pain management. Given its simplicity, safety, effectiveness, and rapid onset, Motion Acupuncture is well-suited for clinical application. Nevertheless, this study is limited by its small sample size, short treatment duration, and lack of long-term follow-up. Future studies should include larger, multicenter trials with extended follow-up periods to validate these findings further.

6. Conclusion

Motion Acupuncture represents an innovative acupuncture modality that integrates traditional Chinese meridian theory with modern medical insights and multidisciplinary principles. It is easy to implement, highly safe, and exhibits robust clinical effectiveness. The findings of this study demonstrate that Motion Acupuncture provides significant analgesic benefits for patients with knee osteoarthritis, effectively reducing pain, enhancing knee function, and improving overall quality of life. Its clinical performance surpasses that of conventional electroacupuncture, supporting its wider adoption and application in clinical practice.

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