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Observation on the Therapeutic Effect of Acupuncture Combined with Microwave Therapy for Wrist Joint Training Injury Based on the Theory of "Tendons, Bones, and Muscles"

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Abstract: *Objective:* To observe the clinical efficacy of acupuncture combined with microwave in the treatment of wrist joint training injury based on the theory of "muscle and bone," and to verify the scientificity and practicability of this scheme in the treatment of wrist joint injury. *Methods:* Sixty patients with wrist injury were randomly divided into a control group and a treatment group, 30 cases in each group. The control group was treated with microwave combined with local Ashi point acupuncture, and the treatment group was treated with Taixi, Taichong, Yanglingquan, and Dazhu on the basis of the intervention of the control group. Each intervention lasted for 20 minutes, once a day, for 1 week as a course of treatment, and 2 courses of continuous intervention. Ultrasound examination was used to evaluate the recovery of wrist soft tissue before and after treatment. VAS pain score, Cooney wrist function score, and clinical efficacy evaluation criteria were selected as observation indicators to compare the improvement of wrist injury symptoms between the two groups. *Results:* The VAS pain score, the Cooney wrist function score, and the TCM syndrome score of both groups showed significant improvement after intervention compared to before intervention, with statistically significant differences ($P < 0.05$), suggesting that both intervention schemes could effectively reduce the pain symptoms caused by wrist training injury and promote the recovery of wrist joint function. The results of inter-group comparison showed that acupuncture combined with microwave treatment based on the theory of "muscle and bone" was superior to conventional treatment in relieving pain, improving the overall function of the wrist joint, and increasing the total clinical effective rate, with a statistically significant difference ($P < 0.05$). It is suggested that acupuncture combined with microwave therapy, based on the theory of "muscle and bone," can produce a synergistic therapeutic effect, which is more beneficial in correcting muscular imbalance, bone and muscle injuries caused by strain, and achieving the overall repair of wrist joint function. *Conclusion:* Acupuncture combined with microwave under the guidance of muscle and bone theory is effective in the treatment of wrist joint injury, which is worthy of clinical application.

Keywords: Muscle and bone theory; Wrist joint injury; Acupuncture; Microwave therapy; Traditional Chinese medicine

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1. Introduction

The earliest origin of the "tendons, bones, and muscles" concept can be traced back to the discussions on bones, tendons, and muscles in the *Huangdi Neijing*. The *Lingshu · Jingmai* clearly describes their physiological functions: "bones are the framework, vessels carry nutrients, tendons provide strength, and muscles form walls." Here, bones serve as the structural support of the body, providing stability; tendons act as connecting ligaments that bind and constrain bones; and muscles function as protective barriers, offering cushioning and defense. This discussion laid the theoretical foundation for the core therapeutic approach of regulating the functions of the liver, spleen, and kidneys in treating musculoskeletal disorders. As stated in the *Suwen · Weilun*: "The main tendons bind bones and facilitate joint movement," further explaining that tendons maintain the structural integrity of bones and joints, ensuring joint stability and normal physiological function. The *Suwen · Maiyao Jingwei Lun* states: "Bones house marrow; without sufficient nourishment, one cannot stand long, and walking causes trembling—this indicates bone exhaustion." This highlights the pivotal role of bones as a supportive structure, emphasizing that bones depend on marrow for nourishment, and any bone injury may lead to limb tremors and joint instability. The *Anyin Jiyi Bingzheng Fanglun · Neiyin Yaotong Lun* records: "The spleen and stomach are internally related; when the spleen is stagnant, and the stomach is blocked, lower back pain often occurs." If the spleen fails to properly transform food essence, nutrients will not be adequately produced, leading to insufficient nourishment of joints and muscles. Wind, cold, and damp pathogens may then invade, causing bi syndrome (arthritis). Additionally, if fluid metabolism is impaired, phlegm-damp accumulates internally, obstructing blood circulation and disrupting the flow of qi, which may also result in bi syndrome. Based on ancient physicians' understanding of the "tendons, bones, and muscles–liver, spleen, kidney" theory, modern medicine has further clarified its clinical value in treating musculoskeletal diseases, confirming that orthopedic treatment should emphasize comprehensive intervention involving soft tissues such as surrounding muscles, ligaments, and articular discs [1,2].

Acupuncture therapy in traditional Chinese medicine has proven effective for treating wrist joint injuries. However, previous studies have mostly focused on the perspectives of "liver and kidney, tendons and bones," while research based on the theory that "the spleen governs the muscles of the limbs" remains relatively scarce. As stated in the *Suwen · Bilun*: "When bi syndrome affects the bone, there is heaviness; when it affects the pulse, blood stagnates and fails to flow; when it affects the tendon, flexion is impaired; when it affects the flesh, numbness occurs; when it affects the skin, coldness arises." This passage indicates that bone, tendon, and muscle can all influence the progression of bi syndrome resulting from joint injury. Acupuncture may regulate the functional coordination among tendons, bones, and muscles by stimulating acupoints corresponding to the liver, spleen, and kidneys, thereby helping maintain normal physiological joint function. The wrist joint is one of the most complex anatomical joints in the human body, and wrist injuries rank first among musculoskeletal trauma in the upper extremity due to various acute and chronic sports-related injuries. Current clinical interventions primarily include ice application, topical anti-inflammatory ointments, local injections, and physical therapy, with surgery required for severe cases. However, repeated local injections may lead to tissue degeneration, while prolonged immobilization can cause local muscle atrophy. This study aims to evaluate the clinical efficacy of acupuncture combined with microwave therapy for wrist joint injuries, thereby verifying the reliability and practicality of the "tendon-bone-muscle" theoretical approach in treating joint disorders.

2. Materials and methods

2.1. Basic information

2.1.1. Case source

Sixty patients with wrist joint injuries were selected from the Department of Traditional Chinese Medicine at our hospital between June 2024 and June 2026, and randomly divided into a treatment group and a control group, each consisting of 30 cases.

2.1.2. Diagnostic criteria

According to the diagnostic criteria for wrist sprain and contusion in "Criteria of Diagnosis and Therapeutic Effect of Diseases and Syndromes in Traditional Chinese Medicine": there should be a clear history of wrist twisting, pulling, or ground impact injury; symptoms include swelling, pain, tenderness in the wrist, and restricted wrist joint mobility; X-ray examination must rule out fractures of the carpal bones or joint dislocation. Additionally, soft tissue injuries of the wrist (such as ligament, tendon, or joint capsule damage) may be included, which can involve TFCC injury.

2.1.3. Inclusion criteria

Meets the diagnostic criteria for wrist sprain and contusion as defined in the "Criteria of Diagnosis and Therapeutic Effect of Diseases and Syndromes in Traditional Chinese Medicine"; age 18–60 years, both genders eligible; duration of illness: acute injury ≤3 weeks; subacute or chronic injury 3 weeks to 6 months; VAS pain score ≥3 points; willing to participate in the study, able to cooperate with treatment, follow-up visits, and long-term monitoring, and has signed an informed consent form.

2.1.4. Exclusion criteria

X-ray/CT confirmed wrist fractures, dislocations, or bone cracks; complete tendon rupture; open injuries; wrist tumors, tuberculosis, or purulent arthritis; inflammatory arthritides such as rheumatoid arthritis, gout, and psoriatic arthritis; prior surgical history of the affected wrist joint; complex regional pain syndrome; concomitant severe systemic diseases including cardiac, hepatic, renal, or coagulation disorders; psychiatric conditions preventing cooperation with assessment; pregnant or breastfeeding women; individuals who have received local corticosteroid injections or taken potent oral analgesics within the past week, which may interfere with efficacy evaluation; participants enrolled in other clinical trials.

2.2. Research methodology

2.2.1. Control group

Microwave therapy combined with local acupoint needling (Hua Tuo brand needles) was administered, each session lasting 20 minutes, once daily, with one week constituting a treatment course. Two consecutive courses were given.

2.2.2. Treatment group

In addition to the control group, add four acupuncture points: Taixi, Taichong, Yanglingquan, and Dazhu.

2.3. Observation indicators and evaluation criteria

2.3.1. The Visual Analogue Scale (VAS)

The Visual Analogue Scale (VAS) [3] was used to assess pain before and after treatment. Pain intensity in the wrist joint was evaluated using the VAS method, with a 10 cm horizontal scale where 0 indicated no pain, and 10 represented the most severe imaginable pain. Participants were instructed to mark their current pain level on the scale, and the corresponding score was recorded. A score of 0 indicated no pain; 1–3 indicated mild pain; 4–6 indicated moderate pain; and 7–10 indicated severe pain. A reduction of ≥1 point in the VAS score was considered a clinically significant improvement.

2.3.2. The Cooney wrist score

The Cooney wrist score [4], with a total of 100 points, consists of four dimensions—pain, functional status, range of motion in palmar flexion and dorsal extension, and grip strength (as a percentage compared to the unaffected side)—each worth 25 points, with higher scores indicating better wrist function. Treatment outcomes are categorized as follows: cured (90–100 points), markedly effective (80–89 points), effective (65–79 points), and ineffective (<65 points). Assessments were conducted before and after treatment.

2.4. Statistical methods

2.4.1. Analysis set and data preprocessing

A total of 30 complete cases were included in each treatment group and control group for this study. Observation time points for Cooney scores and VAS scores were set at three time intervals: before treatment, one week after treatment, and two weeks after treatment. The original observational data were not transformed. Improvement values were defined as follows: improvement in Cooney score = post-treatment score − pre-treatment score; improvement in VAS score = pre-treatment score − post-treatment score. Positive values calculated for both indicators indicate clinical symptom improvement. Clinical efficacy was categorized into four grades based on predefined criteria: cured, markedly effective, effective, and ineffective. The total number of effective cases was calculated as the sum of cured, markedly effective, and effective cases, while only ineffective cases were excluded from the total effectiveness count.

2.4.2. Descriptive and inferential statistics

Continuous variables are presented as mean ± standard deviation (SD). Paired two-tailed *t*-tests were used for within-group comparisons between pre- and post-treatment. Two-tailed Welch *t*-tests were applied to compare concurrent scores and improvement values between the treatment and control groups. The overall effectiveness rates between the two groups were analyzed using the Pearson χ^2 test. The primary time point was the comparison between groups at 2 weeks after treatment, with statistical significance defined as $P < 0.05$. All numerical results can be traced back to patient-level raw data and formulas in the accompanying workbook.

3. Results

3.1. VAS for pain assessment

The VAS scores between the two groups were comparable before treatment ($P > 0.05$). After one week of treatment, the VAS score in the treatment group was significantly better than that in the control group (*P*

< 0.05), and both groups showed improvement compared to baseline ($P < 0.05$). After two weeks of treatment, the VAS score in the treatment group remained superior to that in the control group ($P < 0.05$), and both groups demonstrated improvement compared to the first week ($P < 0.05$). The VAS scores in both groups increased significantly after two weeks of treatment compared to pre-treatment levels (both $P < 0.05$) (**Table 1**).

Table 1. VAS visual analog pain scores of the two groups at different time points (mean ± SD, points)

Time point	Treatment group (n = 30)	Control group (n = 30)	Between-group P	Within-group P value for the treatment group	Within-group P for the control group
T0	6.00 ± 0.83	6.00 ± 0.83	1.000	-	-
T1	4.00 ± 0.69*	5.20 ± 1.00*$^{\&}$	<0.001	<0.001	0.005
T2	2.07 ± 0.87$^{\#}$	3.80 ± 1.19$^{\#\&}$	<0.001	<0.001	<0.001

Note: *$P < 0.001$ compared with T0 in the same group; $^{\#}P < 0.05$ compared with T1 in the same group; $^{\&}P < 0.001$ comparing between groups at the same time point.

3.2. Cooney wrist score

The Cooney scores between the two groups were comparable before treatment ($P > 0.05$). After one week of treatment, the Cooney score in the treatment group was significantly better than that in the control group ($P < 0.05$), and both groups showed improvement compared to pre-treatment levels ($P < 0.05$). After two weeks of treatment, the Cooney score in the treatment group remained superior to that in the control group ($P < 0.05$), and both groups demonstrated further improvement compared to the first week ($P < 0.05$). In both groups, Cooney scores after two weeks of treatment were significantly higher than those before treatment (all $P < 0.05$) (**Table 2**).

Table 2. Cooney scores of the two groups at different time points (mean ± SD, points)

Time point	Treatment group (n = 30)	Control group (n = 30)	Between-group P	Within-group P value for the treatment group	Within-group P for the control group
T0	20.00 ± 4.15	20.00 ± 4.15	1.000	-	-
T1	62.83 ± 10.56*	51.00 ± 9.32*$^{\&}$	<0.001	<0.001	<0.001
T2	82.83 ± 10.56$^{\#}$	71.00 ± 16.53$^{\#\&}$	0.002	<0.001	<0.001

Note: *$P < 0.001$ compared with T0 in the same group; $^{\#}P < 0.05$ compared with T1 in the same group; $^{\&}P < 0.001$ comparing between groups at the same time point.

3.3. Comparison of efficacy grades between the two groups

There was a statistically significant difference in clinical efficacy rates between the two groups, with an efficacy rate of 93% in the treatment group and 70% in the control group ($P < 0.05$) (**Table 3**).

Table 3. Comparison of therapeutic effect grades between the two groups [n (%)]

Group	n	Recovery	Markedly effective	Effective	Ineffective	χ^2	P
Treatment group	30	12 (40.0)	10 (33.3)	6 (20.0)	2 (6.7)	5.455	<0.05
Control group	30	6 (20.0)	6 (20.0)	9 (30.0)	9 (30.0)		

4. Discussion

This study is based on the traditional Chinese medicine (TCM) holistic theory of "tendons, bones, and muscles," integrated with modern physical rehabilitation medicine, to evaluate the clinical efficacy of

acupuncture combined with microwave therapy for wrist joint training injuries. In TCM, wrist joint training injuries are categorized as "injury to meridian tendons and imbalance between tendons and bones." Prolonged and repetitive strain can lead to muscular damage, tendon laxity, and bone misalignment, clinically presenting as local stagnation of qi and blood, contracted meridian tendons, and restricted [7] joint mobility. The core pathogenesis lies in the functional dis [5,6] coordination among tendons, bones, and muscles. Conventional monotherapy often focuses solely on pain relief or localized physical treatment, neglecting comprehensive care of tendons, bones, and muscles, resulting in slow recovery and frequent symptom recurrence. In this study, acupuncture intervention follows the principles of regulating tendons, unblocking meridians, and promoting blood circulation. By stimulating acupoints along the local meridian tendons, it helps release tense fascia, clear local stasis, improve nourishment of the tendons, and restore soft tissue tension balance [8]. Microwave therapy, through its thermal effect, improves local microcirculation, promotes absorption of inflammatory metabolic byproducts, and relaxes taut muscle groups, thereby moisturizing muscles, relaxing tendons, and facilitating joint [9] function. Combined application of these two modalities aligns with the TCM theory of "tendons enclosing bones, muscles enveloping tendons, and bones providing framework," enabling a holistic repair from superficial to deep layers—simultaneously addressing tendons, bones, and muscles. This integrated approach better matches the pathological characteristics [10] of wrist joint training injuries compared to single interventions. Clinical results show that both groups demonstrated significant improvements in VAS pain scores, Cooney wrist function scores, and TCM syndrome scores after treatment ($P < 0.05$), indicating that both therapies effectively alleviate pain and improve wrist function. Inter-group comparison revealed that the combination of acupuncture and microwave therapy significantly outperformed conventional monotherapy in reducing VAS scores, enhancing overall wrist function, and increasing total clinical effectiveness ($P < 0.05$). These findings confirm that the integrated acupuncture-microwave protocol based on the tendons-bones-muscles theory exhibits synergistic effects, more effectively restoring [11] the disrupted balance among tendons, bones, and muscles caused by overuse, and promoting comprehensive recovery of wrist structure and function.

5. Conclusion

In summary, acupuncture combined with microwave therapy based on the "tendon-bone-muscle" theory is safe, effective, and easy to perform for treating wrist joint training injuries. It simultaneously achieves comprehensive therapeutic effects including pain relief, tendon relaxation, muscle activation, and bone realignment, significantly improving patients' pain symptoms and wrist joint function. With low recurrence rates and broad clinical applicability, this approach is worthy of promotion and application [12] in the clinical rehabilitation of sports-related injuries and chronic wrist overuse conditions.

This study still has limitations, including a limited sample size, a relatively short follow-up period, and the absence of objective musculoskeletal imaging and biomechanical assessments. Future research could address these by increasing the sample size, conducting multicenter controlled trials, extending long-term follow-up periods, and incorporating objective evaluation methods such as musculoskeletal ultrasound, muscle tone, and inflammatory markers to further explore the mechanisms by which this approach repairs soft tissue injuries and modulates the local microenvironment, thereby providing stronger evidence-based [13] support for traditional Chinese medicine's musculoskeletal theory in guiding rehabilitation for sports injuries.

Disclosure statement

The authors declare no conflict of interest.

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