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Original Article

EFFECTIVENESS OF THREAD EMBEDDING COMBINED WITH THERAPEUTIC ULTRASOUND IN PATIENTS WITH PRIMARY KNEE OSTEOARTHRITIS

Tran Thi Hoang Oanh[1,*], Vo Tam[2], Nguyen Thi Xuan Mai[2], Tran Huu Tuan[3]

1. Level II specialist trainee, University of Medicine and Pharmacy, Hue University, Vietnam
2. University of Medicine and Pharmacy, Hue University, Vietnam
3. Phu Yen Hospital of Traditional Medicine, Vietnam

**Corresponding author: Tran Thi Hoang Oanh ✉ bsoanh193@gmail.com*

ABSTRACT: According to the Global Burden of Disease Study 2021, the burden of musculoskeletal disorders increased rapidly between 1990 and 2020, with the knee being one of the most commonly affected sites of osteoarthritis. The disease is characterized by pain and restricted mobility and is more prevalent among older adults and women. Treatment is often prolonged and requires a multimodal approach. Currently, traditional medicine combined with modern medicine is widely applied, and thread embedding acupuncture and therapeutic ultrasound are among the treatment modalities of interest for knee osteoarthritis. To evaluate the therapeutic effectiveness of thread embedding therapy combined with therapeutic ultrasound in patients with primary knee osteoarthritis. The study included 62 patients diagnosed with primary knee osteoarthritis who were treated at Phu Yen Hospital of Traditional Medicine with a combination of thread embedding therapy and therapeutic ultrasound. A clinical interventional study with a before-and-after treatment design and no control group was conducted. Patients aged ≥60 years accounted for the majority of the study population, and the proportion of female patients was higher than that of male patients. After 21 days of treatment, the mean VAS score decreased from 72.63 ± 5.90 mm to 20.71 ± 9.99 mm, while the median decreased from 72 mm to 21 mm. The mean reduction in the Lequesne index and the mean increase in knee joint range of motion were 8.61 ± 1.34 points and 30.16 ± 7.20°, respectively. The mean heel-to-buttock distance decreased from 25.95 ± 8.49 cm to 9.84 ± 5.72 cm, with the median decreasing from 25 cm to 10.0 cm ($p < 0.001$). **T**he combination of thread embedding acupuncture and therapeutic ultrasound may improve pain and physical function; however, further controlled studies with longer follow-up periods are needed to evaluate its efficacy and safety.

Keywords: Primary knee osteoarthritis; thread embedding therapy; therapeutic ultrasound

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1. INTRODUCTION

Primary knee osteoarthritis (OA) is a common chronic disease in older adults and women, presenting with pain, limited mobility, and impaired joint function [1], [2], [3]. The burden of musculoskeletal disease is rising, and the knee is the most common site of OA [4]. The main treatment goals remain pain relief, functional improvement, and slowing disease progression [5]. Besides drug therapy, non-pharmacological methods such as therapeutic ultrasound are receiving growing attention because they relieve pain and improve joint function [6]. In traditional medicine (TM), knee OA falls under Bi syndrome or Hac tat phong (crane's knee wind). Thread embedding is a method of acupoint stimulation that has been used to treat chronic diseases and has shown effectiveness in knee OA [7]. Combining thread embedding with therapeutic ultrasound may have complementary effects on symptom control and joint function. However, few studies have evaluated the effectiveness of this combination. We therefore evaluated the effectiveness of thread embedding combined with therapeutic ultrasound in patients with primary knee OA, with the following objectives:

1. To describe selected clinical and paraclinical characteristics of patients with primary knee osteoarthritis at Phu Yen Hospital of Traditional Medicine.

2. To evaluate the effectiveness of thread embedding combined with therapeutic ultrasound in patients with primary knee osteoarthritis

2. SUBJECTS AND METHODS

2.1. Study subjects

All outpatients diagnosed with primary knee OA at Phu Yen Hospital of Traditional Medicine from April 2025 to June 2026.

2.1.1. Inclusion criteria

Inclusion criteria according to modern medicine

- Patients diagnosed with primary OA according to the American College of Rheumatology (ACR) criteria, using the clinical and radiographic criteria set [8]:

Knee pain

Marginal osteophytes on X-ray

Degenerative synovial fluid

Age ≥40 years

Joint stiffness lasting less than 30 minutes

Crepitus on joint movement

The diagnosis is confirmed when factors 1 and 2 are present

- X-ray findings: patients with knee OA of Kellgren and Lawrence (1957) grade I, II, or III [9]

Inclusion criteria according to TM:

Patients diagnosed with Hac tat phong of the following patterns were selected: wind-cold-dampness; wind-cold-dampness with liver-kidney deficiency [2].

2.1.2. Exclusion criteria

Secondary OA; comorbidities or health conditions that could affect the study; infection or skin lesions in the treatment area; use of drugs (morphine, corticosteroids, etc.) that could affect the study results; allergy to catgut; refusal to participate or nonadherence to treatment.

2.1.3. Sample size

- Sampling method: all outpatients who met the inclusion criteria, had none of the exclusion criteria, and were enrolled during the study period were included.

- Sample size: 62 patients

2.2. Methods

2.2.1. Study design*:*

Clinical interventional study with a before-and-after treatment comparison and no control group

2.2.2. Study procedures

Clinical examination using a case record form; assessment of pain on the VAS, impairment of knee motor function on the Lequesne index, knee range of motion, and heel-to-buttock distance; improvement in TM symptoms; adverse effects; and patient satisfaction after treatment.

Practitioners: trained in the study procedures, including examination, assessment, and the steps of each procedure, with a scope of practice consistent with

professional regulations.

Thread embedding was performed according to the Ministry of Health protocol as follows [2]:

Thread embedding session 1 (D0): Dubi (ST35), Xiyan (EX-LE5), and Liangqiu (ST34) on the affected knee; Shenshu (BL23) on both sides was added if the patient was diagnosed with the wind-cold-dampness Bi pattern with liver-kidney deficiency.

Thread embedding session 2 (after 7 days, D7): Yanglingquan (GB34), Yinlingquan (SP9), and Xuehai (SP10) on the affected knee; Ganshu (BL18) on both sides was added if the patient was diagnosed with the wind-cold-dampness Bi pattern with liver-kidney deficiency.

Thread embedding session 3 (after 14 days, D14): Weizhong (BL40), Zusanli (ST36), and Dubi (ST35) on the affected knee

The thread embedding procedure followed aseptic technique: hand washing, sterile gloves, disinfection of the acupoint area, a 20G drawing-up needle, 2.0 chromic catgut, a sterile thread-pushing needle, and sterile cotton. Embedding depth ranged from 1-2 cm depending on the acupoint. Patients were monitored for 15-30 minutes after embedding, and adverse events were recorded, including local pain, bleeding, hematoma, swelling/infection, reaction to the thread, allergy, fainting/needle syncope, and any other events [2].

Therapeutic ultrasound: continuous output mode, intensity 0.8 W/cm^2, frequency 1 MHz. The transducer head was coated with coupling gel and moved slowly and continuously in circles over the area around the treated knee [10]

Treatment course: 3 thread embedding sessions over 21 days and therapeutic ultrasound (15 minutes/session/day × 21 days)

2.2.3. Outcome measures

Treatment outcomes were assessed using the VAS, the Lequesne index, knee range of motion, heel-to-buttock distance, and improvement in TM symptoms, at 7, 14, and 21 days after the start of treatment [11], [12], [13]

2.3. Data analysis:

Data were analyzed with SPSS 20.0. The distribution of quantitative variables was tested with the Shapiro-Wilk test. Variables measured repeatedly at D0, D7, D14, and D21 were compared with the Friedman test; when a difference was found, post hoc comparisons were made with the Wilcoxon signed-rank test with Bonferroni correction for multiple comparisons. Qualitative variables were compared with the chi-square test or Fisher's exact test. All tests were two-sided, and statistical significance was set at $p<0.05$.

2.4. Research ethics:

The study was approved by the Biomedical Research Ethics Committee of the University of Medicine and Pharmacy, Hue University (No. H2025/420, dated 14/5/2025)

3. RESULTS

3.1. Clinical and paraclinical characteristics:

3.1.1. Age: mean 63.74±10.23 years; patients aged ≥ 60 years accounted for 66.1%.

3.1.2. Sex: Females outnumbered males (1.7/1).

3.1.3. Occupation: mainly light work (45.2%), followed by heavy work (37.1%) and moderate work (17.7%)

3.1.4. Treatment before the study: 70.9% of patients had been treated before the study, mainly with modern medicine (54.8%)

3.1.5. BMI: mean 23.34 ±3.03 kg/m^2; 59.7% of patients had a BMI within the normal range

3.1.6. Clinical symptoms: 40.3% of patients had right knee pain; left knee pain alone and bilateral knee pain were less common, at 27.4% and 32.2%, respectively.

Common clinical symptoms were mechanical pain (100%), the gelling phenomenon (100%), limited mobility (100%), knee crepitus (98.4%), and pain occurring frequently during both day and night (75.8%)

3.1.7. Paraclinical findings: On X-ray,

most patients had grade 2 knee OA (67.7%), followed by grade 3 (17.7%) and grade 1 (14.5%).

3.1.8. Distribution of TM patterns: wind-cold-dampness and wind-cold-dampness with liver-kidney deficiency accounted for 24.2% and 75.8%, respectively.

3.2. Treatment outcomes

3.2.1. Improvement in pain on the VAS

3.2.2. Treatment effectiveness by the Lequesne index

Table 1. Change in mean VAS score at each time point

Measure		Time point			
		D0	D7	D14	D21
Mean ± SD		72.63±5.90	55.15±7.31	37.61±9.03	20.71±9.99
Median (min–max)		72.00 (60.00–90.00)	55.00 (40.00–72.00)	38.00 (18.00–55.00)	21.00 (1.00–40.00)
Reduction	**D_7-D_0**	17.48 (4.31)			
	D_{14}-D_7	17.53 (4.49)			
	D_{21}-D_{14}	16.90 (3.68)			
	D_{21}-D_0	51.92 (8.60)			
p*		$p_{(D7-D0)}$ <0.001 ; $p_{(D14-D0)}$ <0.001; $p_{(D21-D0)}$ <0.001			
p**		<0.001			

* Wilcoxon signed-rank test

** Friedman test

Comment: After 21 days, the mean VAS score decreased from 72.63±5.90 mm to 20.71±9.99 mm, and the median decreased from 72 mm to 21 mm

3.2.3. Treatment effectiveness by knee range of motion

Table 2. Mean Lequesne index at each time point

Measure		**Time point**			
		D0	**D7**	**D14**	**D21**
Mean ± SD		13.21±1.61	10.23±1.62	7.37±1.79	5.89±10.37
Median (min–max)		13.00 (9.00–17.00)	10.00 (6.00–13.00)	8.00 (3.00–11.00)	5.00 (1.00–8.00)
Reduction	**D_7-D_0**	2.98±0.80			
	D_{14}-D_7	2.85±0.67			
	D_{21}-D_{14}	2.77±0.61			
	D_{21}-D_0	8.61±1.34			
p*		$p_{(D7-D0)}$ <0.001 ; $p_{(D14-D0)}$ <0.001; $p_{(D21-D0)}$ <0.001			
p**		<0.001			

* Wilcoxon signed-rank test

** Friedman test

Comment: After 21 days of treatment, the reduction in the Lequesne index was 8.61±1.341, a statistically significant difference (p<0.001).

Comment: After 21 days of treatment, the increase in knee range of motion was 30.16 ± 7.2^0 ($p<0.001$).

Table 3. Mean knee range of motion at each time point

Measure		Time point			
		D0	**D7**	**D14**	**D21**
Mean ± SD		94.52±7.66	104.84±7.52	115.18±7.15	124.68±7.34
Median (min–max)		95.00 (70.00–110.00)	105.00 (80.00–115.00)	115.00 (95.00–130.00)	125.00 (110.00–140.00)
Increase	**D_7-D_0**	10.32±3.95			
	D_{14}-D_7	10.34±4.17			
	D_{21}-D_{14}	9.50±2.98			
	D_{21}-D_0	30.16±7.26			
p*		$p_{(D7- D0)}$ <0.001 ; $p_{(D14- D0)}$ <0.001; $p_{(D21- D0)}$ <0.001			
p**		<0.001			

* Wilcoxon signed-rank test

** Friedman test

3.2.4. Treatment effectiveness by heel-to-buttock distance

Comment: After 21 days of treatment, the mean heel-to-buttock distance decreased from 25.95±8.49 cm to 9.84±5.72 cm, and the median decreased from 25 cm to 10.0 cm ($p<0.001$)

Table 4. Change in mean heel-to-buttock distance at each time point

Measure		Time point			
		D0	D7	D14	**D21**
Mean ± SD		25.95±8.49	20.44±7.92	15.16±7.14	9.84±5.72
Median (min–max)		25.00 (10.00–40.00)	20.50 (5.00–33.00)	15.50 (1.00–27.00)	10.00 (0.00–21.00)
Reduc-tion	**D_7-D_0**	5.52 (1.89)			
	D_{14}-D_7	5.27 (1.39)			
	D_{21}-D_{14}	5.32 (2.58)			
	D_{21}-D_0	16.11 (4.36)			
p*		$p_{(D7- D0)}$ <0.001 ; $p_{(D14- D0)}$ <0.001; $p_{(D21- D0)}$ <0.001			
p**		<0.001			

* Wilcoxon signed-rank test

** Friedman test

3.2.5. Changes in TM signs after treatment

Comment: There were statistically significant differences in the proportions of TM signs such as spirit, tongue shape, coating thickness, coating texture, pulse, tinnitus, and

aching low back (p<0.001). There was no difference in coating color (p>0.05)

Table 5. Selected TM signs before and after treatment (n = 62)

Sign	Group	Study group				p value
		D0		D21		
		n	%	n	%	
Spirit and complexion	Rosy, alert	24	38.7	61	98.4	<0.001*
	Pale, fatigued	38	61.3	1	1.6	
Tongue shape	Enlarged, puffy	52	83.9	0	0.0	<0.001**
	Thin	3	4.8	2	3.2	
	Normal size	7	11.3	60	96.8	
Tongue color	Red	1	1.6	1	1.6	<0.001**
	Pink	14	22.6	56	90.3	
	Pale	47	75.8	5	8.1	
Coating thickness	Thick	43	69.4	0	0.0	<0.001**
	Thin	18	29.0	22	35.5	
	Neither thick nor thin	1	1.6	40	64.5	
Coating color	White	62	100	60	96.8	0.500*
	Yellow	0	0.0	2	3.2	
Coating texture	Dry	1	1.6	0	0.0	<0.001**
	Moist	20	32.3	44	71.0	
	Sticky, greasy	41	66.1	18	29.0	
Tinnitus	Yes	39	62.9	19	30.6	<0.001*
	No	23	37.1	43	69.4	
Sleep	Normal	24	38.7	59	95.2	<0.001*
	Poor	38	61.3	3	4.8	
Aching low back	Yes	47	75.8	3	4.8	<0.001*
	No	15	24.2	59	95.2	
Pulse depth	Floating	15	24.2	6	9.7	0.004*
	Deep	47	75.8	56	90.3	
Pulse rate	Rapid	0	0.0	0	0.0	<0.001**
	Slightly rapid	1	1.6	0	0.0	
	Moderate	1	1.6	48	77.4	
	Slightly slow	25	40.3	14	22.6	
	Slow	35	56.5	0	0.0	
Pulse strength	Weak	47	75.8	1	1.6	<0.001*
	Forceful	15	24.2	61	98.4	

*McNemar test/binomial distribution

** Marginal homogeneity test

3.2.6. Association between TM pattern and VAS pain relief after treatment

Comment: After 21 days of treatment, VAS pain relief was greater in the wind-cold-dampness pattern than in the wind-cold-dampness with liver-kidney deficiency pattern

3.2.7. Adverse effects:

No adverse effects were recorded during treatment

Table 6. Association between TM pattern and pain relief on the VAS after treatment

TM pattern	Pain relief on the VAS								p
	No pain		Mild		Moderate		Severe		
	n	%	n	%	n	%	n	%	
Wind-cold-dampness	5	33.3	10	66.7	0	0.0	0	0.0	0.016*
Wind-cold-dampness with liver-kidney deficiency	3	6.4	44	93.6	0	0.0	0	0.0	

**** Fisher's exact test***

3.2.8. Patient satisfaction after treatment

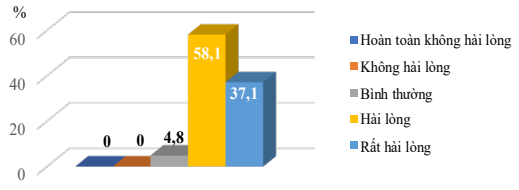


Figure 1. Patient satisfaction after treatment

4. DISCUSSION

4.1. General characteristics of the study participants

The study included 62 participants, with a female-to-male ratio of 1.7/1. This is similar to the study by Macías-Hernández et al. (2020) of 204 people in Mexico, in which women accounted for 60.8% of patients diagnosed with knee OA [14].

Age: Patients aged 60 years and older predominated, at 66.1%. This is fairly similar to the study by Zhang et al., in which the mean age of patients was 61.06 ± 8.47 years [15].

Occupation: Light work predominated (45.2%), followed by heavy work (37.1%) and moderate work (17.7%). Our results are similar to the study by Parsons CM et al. of 7,391 participants, in which light manual work and light work accounted for high proportions (35.9% and 30.0%, respectively), whereas heavy work accounted for only 9.4% [16].

Treatment before the study: 70.9% of patients had been treated before the study, mainly with modern medicine (54.8%). This is similar to the study by Mai Ngoc Duoc, in which 62.07% of patients had been treated before the study [17].

BMI: mean 23.34 ±3.03 kg/m^2; 59.7% of patients had a BMI within the normal range. Although most patients with knee OA had a normal BMI, overweight and obesity were still present in a relatively high proportion of the study population [18].

Clinical symptoms: 40.3% of patients had right knee pain; left knee pain alone and bilateral knee pain were less common, at 27.4% and 32.2%, respectively. The proportion of right knee involvement in our study was nearly the same as in the study by Ho Thuy Dung and Tran Do Thanh Phong (2025), in which 40.1% of patients had right knee pain, whereas the proportion with left knee pain was lower in our study (27.4% vs. 37.0%) [19].

Common clinical symptoms were mechanical pain (100%), the gelling phenomenon (100%), limited mobility (100%), knee crepitus (98.4%), and pain occurring frequently during both day and night (75.8%). These findings are consistent with the typical clinical features of knee OA. The high frequency of these symptoms may be related to the chronic, progressive nature of the disease. In the early stage, when symptoms are mild, patients may tend to adjust their activities or tolerate the symptoms rather than seek medical care. Only when pain persists, recurs, and begins to affect movement and daily activities do patients come to the hospital for examination and treatment. In addition, the participants were mostly older adults whose symptoms were marked enough to warrant outpatient treatment with thread embedding and ultrasound, which may help explain the high frequency of clinical manifestations in this study.

Paraclinical findings: On X-ray, most patients had grade 2 knee OA (67.7%),

followed by grade 3 (17.7%) and grade 1 (14.5%). This is broadly consistent with the study by Nguyen Cong Minh, in which grade 2 accounted for 64.29% and grade 3 for 35.71% of patients [7]

Distribution of TM patterns: wind-cold-dampness and wind-cold-dampness with liver-kidney deficiency accounted for 24.2% and 75.8%, respectively. The predominance of the wind-cold-dampness Bi pattern with liver-kidney deficiency is consistent with the age profile of the sample, in which 66.1% of patients were aged 60 years or older. In TM theory, advanced age and prolonged illness gradually deplete the liver and kidney and reduce qi and blood. When the body's healthy qi is weakened, pathogenic wind, cold, and dampness readily invade the meridians, obstructing qi and blood and causing pain and limited mobility [2].

4.2. Treatment outcomes

After 21 days of treatment, pain on the VAS improved steadily and fairly evenly. The mean VAS score decreased from 72.63 ± 5.90 mm at D0 to 20.71 ± 9.99 mm at D21. Our results are similar to those of Bui Thi Thanh Thanh and Nguyen Thi Thanh Tu (2024) [13]. This reduction in VAS may be related to the complementary effects of thread embedding and therapeutic ultrasound. In modern medicine terms, thread embedding provides prolonged stimulation at the acupoints, which may modulate the inflammatory response, increase local circulation, and activate endogenous analgesic mechanisms [20], [21], whereas therapeutic ultrasound has mechanical and thermal effects that help improve circulation and relieve pain [22]. In TM terms, thread embedding and therapeutic ultrasound may help unblock the meridians and collaterals and promote the flow of qi and blood, thereby relieving pain [23].

Lequesne index: After 21 days of treatment, the reduction in the Lequesne index was 8.61±1.341 points, a statistically significant difference ($p<0.001$). This is similar to the study by Mai Ngoc Duoc (10.474±0.987) [17]. On the Lequesne index, higher scores reflect greater functional impairment; the index was developed to assess the severity of knee OA and to monitor changes over time. These results show that the treatment not only relieved pain but also helped improve patients' mobility and their ability to perform activities of daily living [12].

Knee range of motion: After 21 days of treatment, the increase in knee range of motion was 30.16 ± 7.2^0 ($p<0.001$). The treatment clearly improved knee motor function. In TM terms, it did so by improving the function of the tendons and bones and unblocking the meridians, because knee movement depends on the tendons and bones: the liver governs the tendons, and the kidney governs the bones and marrow. When the liver and kidney are deficient, the tendons and bones lose nourishment; wind-cold-dampness obstructing the meridians can also cause pain and limited mobility [23]

Heel-to-buttock distance: After 21 days of treatment, the mean heel-to-buttock distance decreased from 25.95±8.49 cm to 9.84±5.72 cm, and the median decreased from 25 cm to 10.0 cm ($p<0.001$). This is similar to the study by Tran Thi Yen, in which the reduction after 14 days of combined therapeutic ultrasound and electroacupuncture in the study group was -9.5±3.12 (cm) [24]. However, during the study we observed that the heel-to-buttock distance did not fully correspond to the degree of pain or the limitation of knee flexion in all patients. Some patients had severe pain and limited knee flexion but only a small heel-to-buttock distance; conversely, some patients had mild pain and relatively good knee flexion but a large heel-to-buttock distance. This suggests that the heel-to-buttock distance is affected by several factors other than joint range of motion, of which tightness of the quadriceps, especially the rectus femoris, is considered important [25]

TM signs: there were statistically significant differences before and after treatment in the proportions of TM signs such as spirit, tongue shape, coating thickness, coating texture, tinnitus, back pain, sleep, and pulse ($p<0.05$), except for coating color ($p = 0.500$). This may be because almost all patients already had a white coating before treatment. A white coating indicates cold or cold-dampness and is also the physiological coating color in the absence of pathogenic heat [26]. Therefore, although coating thickness and texture changed markedly, the coating could remain white, with no statistically significant difference in color. However, this finding needs to be confirmed by

studies with longer follow-up, because the assessment is also influenced by the practitioner's experience, lighting, timing, and the patient's condition.

Association between TM pattern and VAS pain relief after treatment: In the wind-cold-dampness group, 33.3% of patients reached no pain and 66.7% still had mild pain, whereas in the wind-cold-dampness with liver-kidney deficiency group only 6.4% reached no pain and the remaining 93.6% had mild pain. In TM theory, the wind-cold-dampness pattern is an excess pattern, caused mainly by wind, cold, and dampness invading the meridians, which obstructs qi and blood and blocks the channels, resulting in pain. For this pattern, the treatment principle is to dispel wind, disperse cold, eliminate dampness, unblock the meridians and collaterals, and relieve pain [2]. Once the pathogens are removed and qi and blood flow freely, pain usually improves quickly. Therefore, patients with the wind-cold-dampness pattern may respond better to treatments that unblock the meridians and collaterals, such as thread embedding and therapeutic ultrasound. However, because the number of patients in the two patterns was unbalanced, the evidence is not sufficient to confirm a difference in treatment effectiveness between patterns.

During treatment, no adverse effects of thread embedding or therapeutic ultrasound, such as local pain, bleeding, hematoma, infection, reaction to the thread, or fainting, were recorded.

Patient satisfaction after treatment: 58.1% of patients were satisfied and 37.1% were very satisfied. Only 4.8% rated their satisfaction as neutral, and no patient was dissatisfied or very dissatisfied. These results reflect patient-centered care, related to effectiveness, convenience, and perceived safety. Thread embedding provides prolonged acupoint stimulation and requires fewer interventions and lower costs than acupuncture. Combined with therapeutic ultrasound, the method helps relieve pain and improve function while being convenient and economical, which may contribute to greater patient acceptance and satisfaction.

Limitations: This was a before-and-after interventional study without a control group, which limits the control of confounding factors and the generalizability of the results. The number of patients in the two TM patterns was unbalanced, which limits comparison of treatment effectiveness between patterns. Neither patients nor assessors were blinded, and the 21-day follow-up did not allow assessment of whether the effect was maintained in the medium and long term.

5. CONCLUSION

After 21 days of thread embedding combined with therapeutic ultrasound, patients with primary knee osteoarthritis showed improvements in pain and motor function. Controlled studies with longer follow-up are needed to determine the effectiveness and safety of this method.

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