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## Clinical Trials Study

# Traditional Chinese medicine ointment combined with tuina therapy in treatment of pain and swelling after total knee arthroplasty

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## Abstract

### BACKGROUND

The most effective treatment for knee joint pain is total knee arthroplasty (TKA), but the risk of pain and swelling in patients after surgery is high. Ice application, ankle pump exercise and non-steroidal anti-inflammatory painkillers are the primary clinical treatments after surgery. However, long-term use of non-steroidal anti-inflammatory pain relievers can easily cause gastrointestinal damage. Traditional Chinese medicine (TCM) ointments and tuina therapy integrate TCM and manipulation, which effectively promotes the penetration of TCM into the skin lesions, improves local blood circulation and inflammatory reaction and has good long-term effects on patients.

### AIM

To evaluate the efficacy of TCM ointment combined with tuina therapy in the treatment of pain and swelling after TKA.

### METHODS

The randomized controlled clinical trial enrolled 80 patients who underwent TKA *via* the same procedure. The patients were randomly divided among the treatment group ( $n = 40$ ) and the control group ( $n = 40$ ). The control group was given an analgesia pump in addition to oral painkillers as the postoperative intervention. The treatment group received TCM ointment with tuina therapy in addition to the analgesia pump and oral painkillers in the postoperative period. The following variables were recorded 3 d before surgery and 3 d, 7 d and 14 d after surgery: Visual analogue scale (VAS) score; skin temperature; circumferences at 15 cm above and below the patella; maximum active knee flexion angle; and the knee injury and Osteoarthritis Outcome score (KOOS).

## RESULTS

After treatment, VAS was significantly lower in the treatment group than the control group at 7 d ( $t = 7.536$ ,  $P < 0.001$ ) and 14 d ( $t = 8.563$ ,  $P < 0.001$ ). The skin temperature of participants in the treatment group was significantly lower than that in the control group at 7 d ( $t = 2.968$ ,  $P = 0.004$ ) and 14 d ( $t = 4.423$ ,  $P < 0.001$ ). The circumference values of the two positions in the treatment group were lower than those in the control group at 7 d [ $t = 2.315$ ,  $P = 0.023$  (above);  $t = 2.121$ ,  $P = 0.037$  (below)] and 14 d [ $t = 2.374$ ,  $P = 0.020$  (above);  $t = 2.095$ ,  $P = 0.039$  (below)]. After 14 d of treatment, the maximum active knee flexion angle and KOOS of the two groups were significantly improved but were significantly higher in the treatment group ( $P < 0.05$  for both).

## CONCLUSION

TCM ointment and tuina therapy have significant advantages over standard care in the treatment of pain and swelling after TKA. This additional treatment may improve knee function but additional studies are needed to confirm our observations.

**Key Words:** Traditional Chinese medicine ointment; Tuina therapy; Total knee arthroplasty; Pain; Swelling

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**Core Tip:** Traditional Chinese medicine (TCM) ointments and tuina therapy integrate TCM and manipulation, which effectively promotes the penetration of TCM into skin lesions, improves local blood circulation and inflammatory reaction, and has a good long-term effect on patients. This study observed and compared several parameters after artificial knee arthroplasty in two groups. The control group received routine care, and the treatment group received routine care as well as a TCM ointment and tuina therapy. All parameters were significantly better in the treatment group, providing evidence that the integrated therapy may improve knee function in the long term.

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## INTRODUCTION

Knee osteoarthritis, also known as senile knee arthritis and hypertrophic knee arthritis, is one of the most common types of senile orthopedic diseases[1]. Long-term bone and joint wear decrease a patient's ability to move, including running, squatting and even walking. Currently, the most effective treatment for severe knee osteoarthritis is total knee arthroplasty (TKA)[2]. However, pain and swelling of the knee after the operation may impact rehabilitation and patient quality of life.

Treatments for the pain and swelling of the knee include ice compresses, ankle pump exercises, and non-steroidal anti-inflammatory analgesics. However, non-steroidal anti-inflammatory analgesics are not suitable for long-term administration, due to possible induction of gastrointestinal damage[3]. Rehabilitation methods, such as ice compresses and ankle pump exercises, can promote vasoconstriction and lymphatic return in the short term. Unfortunately, most patients remain bedridden for an extended period after surgery and have poor clinical compliance[4].

Traditional Chinese medicine (TCM) ointment combined with tuina therapy can effectively promote the penetration of TCM into the skin, improve local blood circulation and inflammatory response, and has good long-term efficacy for patients[5]. The primary objective of this study was to gain insight into



the benefits of TCM ointment and tuina therapy to treat pain and swelling after TKA.

## MATERIALS AND METHODS

### Subjects

This study was a prospective study, and 80 patients (16 males and 64 females) were enrolled as research participants. All patients suffered from severe knee osteoarthritis and underwent TKA in the Fourth Department of Arthritis, Wangjing Hospital, China Academy of Chinese Medical Sciences between July 2021 and March 2022. Their age range was 56–82 years, with an average age of  $68.18 \pm 6.08$  years. The average body mass index was  $24.59 \pm 2.69$  kg/m<sup>2</sup>. There were 47 cases with the left lower limb affected and 33 cases with the right lower limb affected. According to a random number table, the patients were divided into two equal groups of 40 patients, the treatment group and the control group. The general data of the patients in the two groups were not significantly different (Table 1). All patients signed an informed consent form, which was approved by the Ethics Committee of Wangjing Hospital, Chinese Academy of Chinese Medical Sciences.

Inclusion criteria were as follows: (1) Met the diagnostic criteria for knee osteoarthritis and TKA[6]; (2) Age from 60 years old to 80 years old; (3) Voluntarily participated in the study and signed the informed consent form; and (4) Postoperative limb pain and swelling were obvious with visual analogue scale (VAS) points  $\geq 4$ .

Exclusion criteria were as follows: (1) Serious diseases, such as severe conditions of the cardiovascular, cerebrovascular or hematopoietic system, or mental disorders; (2) Severe dysfunction of the liver and kidney; (3) Autoimmune diseases, allergy diseases, and acute or chronic infectious diseases; (4) Postoperative complications; and (5) Skin damage, ulceration, allergy to TCM and skin diseases.

Patients were discontinued from the study if: (1) They had poor compliance or were not treated as prescribed; (2) They had incomplete data leading to the inability to evaluate the efficacy of the treatment; (3) They reported poor tolerance of the treatment; (4) They had deep vein thrombosis during the treatment; or (5) They showed drug allergy during treatment.

### Study design

Both groups of patients received standard care after TKA. This consisted of patients being prescribed oral ibuprofen codeine sustained tablets, ice compress application continually for 72 h after the operation, and air pressure blood circulation apparatus utilization 20 min bid.

Patients in the treatment group received a TCM ointment and tuina therapy beginning on the 3<sup>rd</sup> d after the operation. The TCM ointment was applied to the acupoints of Zusanli (ST 36), Sanyinjiao (SP 6), Taichong (LR 3), Chengshan (BL 57), Shangjuxu (ST 37) and Futu (ST 32) on the affected side. Then, acupoint-tuina therapy was performed by pressing and rubbing each acupoint for 2 min. Next, local tuina therapy was performed by rubbing, kneading and scrubbing. The therapy was focused on the running parts of the meridians on the lower limbs, which includes the foot *yangming* stomach channel, the foot *taiyin* spleen channel and the foot *jueyin* liver channel. The treatment was applied for 20 min once a day for 14 d.

The TCM ointment was composed of Chuanxiong (*Rhizoma Chuanxiong*), Niuxi (*Radix Achyranthis Bidentatae*), Jixueteng (*Caulis Spatholobi*), Jinyinteng (*Caulis Lonicerae Japonicae*), Mangxiao (*Natrii Sulfas*), Moyao (*Myrrha*), Ruxiang (*Olibanum*), Huangqi (*Radix Astragali*), Shigao (*Gypsum Fibrosum*), Weilingxian (*Radix et Rhizoma Clematidis*) and Bingpian (*Borneolum Syntheticum*). These herbs were processed and mixed with paraffin oil petroleum jelly to make the ointment.

### Observation factors

The following variables were measured on the third day before the operation and days 3, 7 and 14 after the operation, except for the knee range of motion and knee injury and Osteoarthritis Outcome score (KOOS), which were measured on the 3<sup>rd</sup> d before the operation and 14 d after the operation.

**VAS score:** Pain was evaluated by the VAS, with a total of 10 points (0–3 for mild pain, 4–6 for moderate pain, and 7–10 for severe pain).

**Skin temperature**[7]: The skin temperature of the patient's operation site [Zusanli (ST 36) acupoint] was measured.

**Lower extremity swelling:** The circumferences at 15 cm above and below the patella were measured with a tape measure. The measurement was repeated three times and averaged.

**Range of motion and KOOS**[8]: The knee range of motion and KOOS were used to evaluate the patient's pain, exercise, entertainment, quality of life and other items, with a total score of 100 points. The higher the score, the better the recovery of the patient's knee joint function.

**Table 1 Comparison of general data between the treatment and control groups**

Group	Sex, M/F	Age (yr)	BMI in kg/m <sup>2</sup>	Educational level, illiterate/primary school/senior high school/ junior college/college and university	Surgical limb, L/R
Treatment, <i>n</i> = 40	6/34	67.28 ± 5.51	24.44 ± 2.37	2/1/23/12/2/0	22/18
Control, <i>n</i> = 40	10/30	69.07 ± 6.54	24.92 ± 2.24	0/1/26/11/0/2	25/15
$\chi^2/t$	1.250	1.332	1.020	6.227	0.464
<i>P</i> value	0.264	0.187	0.310	0.285	0.496

M: Male; F: Female; BMI: Body mass index; L: Left; R: Right.

### Statistical analysis

All collected patient data were processed using SPSS 26.0 statistical software (IBM Corp., Armonk, NY, United States). Measurement data were expressed as mean ± SD ( $\bar{x} \pm s$ ), and qualitative data were expressed as frequencies. The measurement data were first analyzed for normality, followed by the *t*-test for those that conformed to the normal distribution and the rank-sum test for those that did not conform. Count data were compared using the  $\chi^2$  test. In the  $\chi^2$  test, if the sample size was  $\geq 40$  but the theoretical number of one of the grids was  $1 \leq T < 5$ , then the continuity corrected  $\chi^2$  test was used. If the theoretical number  $T < 1$  or the sample size was  $< 40$ , then Fisher's exact probability method was used. All statistical analyses were based on two-sided hypothesis testing, and the test level was  $\alpha = 0.05$ . Differences were considered statistically significant when  $P < 0.05$ .

## RESULTS

### VAS scores

There was no significant difference in the VAS scores between the two groups on the 3<sup>rd</sup> d before the operation and the 3<sup>rd</sup> d after the operation ( $P > 0.05$ ). After the treatment, the VAS scores of the treatment group were significantly lower than those of the control group 7 d after the operation ( $t = 7.536$ ,  $P < 0.000$ ) and 14 d after the operation ( $t = 8.563$ ,  $P < 0.000$ ) (Table 2).

### Skin temperature

There was no significant difference in skin temperature between the two groups at 3 d before or after the operation ( $P > 0.05$ ). The skin temperature in the treatment group was significantly lower than in the control group on day 7 after the operation ( $t = 2.968$ ,  $P = 0.004$ ) and on day 14 after the operation ( $t = 4.423$ ,  $P = 0.000$ ) (Table 3).

### Lower extremity swelling

There was no statistically significant difference between the upper and lower circumferences of the patients 3 d before and after the operation ( $P > 0.05$ ). The circumference above and below the patella were significantly lower in the treatment group 7 d after the operation ( $t = 2.315$ ,  $P = 0.023$  and  $t = 2.121$ ,  $P = 0.037$ , respectively) and 14 d after the operation ( $t = 2.374$ ,  $P = 0.020$  and  $t = 2.095$ ,  $P = 0.039$ , respectively) (Table 4).

### KOOS

There was no significant difference in the range of motion of the knee joint and the KOOS between the two groups before treatment ( $P > 0.05$ ). Fourteen days after surgery, the range of motion of the knee joint and the KOOS of the two groups were significantly improved. The knee range of motion and KOOS of the treatment group were significantly higher than those of the control group ( $P < 0.05$ ) (Table 5).

## DISCUSSION

TKA is the primary treatment choice for patients with severe knee osteoarthritis as it can effectively relieve pain, improve knee function and improve quality of life[9]. However, the disadvantages of severe trauma due to the operation and many postoperative complications are a concern to patients[10]. Joint swelling and pain are the most reported complications caused by TKA. Ice is one of the most

**Table 2 Comparison of visual analog scale scores between the two groups**

Group	-3 <sup>rd</sup> d	3 <sup>rd</sup> d	7 <sup>th</sup> d	14 <sup>th</sup> d
Treatment, <i>n</i> = 40	6.75 ± 0.92	5.30 ± 0.79	2.57 ± 0.84	0.80 ± 0.93
Control, <i>n</i> = 40	6.60 ± 0.84	5.65 ± 0.80	4.00 ± 0.85	2.70 ± 1.04
<i>t</i>	0.758	1.965	7.536	8.563
<i>P</i> value	0.451	0.053	0.000	0.000

-3<sup>rd</sup> d: 3 d before the operation; 3<sup>rd</sup> d: 3 d after the operation; 7<sup>th</sup> d: 7 d after the operation; 14<sup>th</sup> d: 14 d after the operation.

**Table 3 Comparison of skin temperature between the two groups (°C)**

Group	-3 <sup>rd</sup> d	3 <sup>rd</sup> d	7 <sup>th</sup> d	14 <sup>th</sup> d
Treatment, <i>n</i> = 40	37.34 ± 0.28	37.21 ± 0.26	36.93 ± 0.21	36.63 ± 0.31
Control, <i>n</i> = 40	37.29 ± 0.34	37.24 ± 0.32	37.09 ± 0.27	36.94 ± 0.32
<i>t</i>	0.755	0.422	2.968	4.423
<i>P</i> value	0.452	0.674	0.004	0.000

-3<sup>rd</sup> d: 3 d before the operation; 3<sup>rd</sup> d: 3 d after the operation; 7<sup>th</sup> d: 7 d after the operation; 14<sup>th</sup> d: 14 d after the operation.

**Table 4 Comparison of lower limb swelling between the two groups**

	Group		<i>t</i>	<i>P</i> value
	Treatment, <i>n</i> = 40	Control, <i>n</i> = 40		
Upper circumference in cm				
-3 d	53.35 ± 4.94	51.83 ± 4.34	1.461	0.148
3 d	52.83 ± 4.91	51.51 ± 4.29	1.274	0.206
7 d	48.32 ± 4.57	50.53 ± 3.97	2.315	0.023
14 d	45.68 ± 4.69	47.96 ± 3.89	2.374	0.020
Lower circumference in cm				
-3 d	39.59 ± 3.58	38.16 ± 3.78	1.734	0.087
3 d	38.96 ± 3.55	37.50 ± 3.85	1.768	0.081
7 d	36.71 ± 2.95	39.21 ± 6.86	2.121	0.037
14 d	34.96 ± 2.96	36.70 ± 4.35	2.095	0.039

-3 d: 3 d before the operation; 3 d: 3 d after the operation; 7 d: 7 d after the operation; 14 d: 14 d after the operation.

popular interventions for these two complications. This method may ameliorate the inflammatory response, pain and edema because the permeability of blood vessels may decrease due to shrinking blood vessels at the surgical site[11]. However, in the process of icing, nurses must monitor the patient's blood supply, peripheral nerve sensation and skin temperature to avoid frostbite of the skin due to the low temperature[12,13]. Another widely adopted postoperative intervention is the ankle pump apparatus. It can significantly improve blood circulation and lymphatic return of the lower extremities to effectively prevent venous thrombosis. However, patient compliance can be unsatisfactory, or the patient may refuse the intervention due to postoperative pain[14,15].

In this study, the postoperative treatment was performed by applying a prepared TCM ointment and tuina therapy to the affected side. The pain, swelling and skin temperature of the patients in the treatment group were significantly better than those of the patients in the control group 7 d and 14 d after surgery. According to TCM, the association of ointment and tuina therapy can regulate qi and blood because they directly warm the meridians to unblock the congealing cold. This improves the function of the internal organs, reinforces healthy qi and eliminates pathogenic factors.



**Table 5 Comparison of knee range of motion and knee injury and Osteoarthritis Outcome score between the two groups of patients**

Group	Knee range of motion in degrees		KOOS score	
	-3 <sup>rd</sup> d	14 <sup>th</sup> d	-3 <sup>rd</sup> d	14 <sup>th</sup> d
Treatment, <i>n</i> = 40	95.23 ± 2.11	115.32 ± 2.12	65.83 ± 1.39	85.52 ± 0.82
Control, <i>n</i> = 40	95.14 ± 2.24	113.34 ± 2.16	65.73 ± 1.33	80.32 ± 1.13
<i>t</i>	0.185	4.138	0.329	23.556
<i>P</i> value	0.854	0.000	0.743	0.000

KOOS: Knee injury and Osteoarthritis Outcome score; -3<sup>rd</sup> d: 3 d before the operation; 14<sup>th</sup> d: 14 d after the operation.

The ointment was primarily composed of herbs that can activate blood and relieve stasis, such as Ruxiang (*Olibanum*) and Chuanxiong (*Rhizoma Chuanxiong*). The tuina therapy used in this study was an integration of various manipulation methods of traditional Chinese tuina, such as scrubbing manipulation, acupoint-pressing manipulation, rubbing manipulation and kneading manipulation. The application of these manipulations in a tender way can relax the tense muscles and release spasms. It can also promote the absorption of drugs, improve local blood circulation and accelerate the reduction of inflammatory reactions, thus achieving the purpose of eliminating swelling and relieving pain. At the same time, tuina therapy applied to local regions may bring the movement of the corresponding muscle tissue, resulting in the improvement of metabolism of inflammatory substances in local lesions. This action can induce the recovery of local capillary endothelial function and the enhancement of blood circulation in local lesions.

In this study, tuina therapy was applied to the acupoints on the patient's affected side. The acupoints were Zusanli (ST 36), Sanyinjiao (SP 6), Taichong (LV 3), Chengshan (BL 57), Shangjuxu (ST 37) and Futu (ST 32). Applying pressure to these acupoints can effectively improve muscle tension. Moreover, the manipulation of Zusanli (ST 36) and Sanyinjiao (SP 6) acupoints has a significant effect on the regulation of the liver, spleen and kidney and the alleviation of knee joint pain and lower extremity numbness[16]. The acupoint tuina therapy applied on the Taichong (LV 3), Chengshan (BL 57) and Shangjuxu (ST 37) acupoints can significantly improve atrophy and impediment (*bi*) of the lower extremities[17].

Tuina therapy conducted on a group of acupoints can promote the blood circulation of the lower extremities. Moreover, the therapy is conducted at a relatively quick frequency, which is adopted to reduce large-scale movements of the patient's bones and joints, and to reduce the damage caused by the manipulation. Treatment compliance is typically satisfactory because the scrubbing and kneading manipulation improves soft tissue relaxation of tendons and ligaments, which is soothing to the patient. Our results also indicated that edema was reduced in the treatment group 7 d and 14 d after surgery. Similarly, Tao *et al*[18] observed that the combination of ointment and massage manipulation had a positive effect on improving postoperative pain and edema.

## CONCLUSION

TCM ointment combined with tuina therapy has significant advantages in treating pain, swelling, skin temperature and knee joint range of motion after artificial TKA. Additional studies with a longer follow-up time and larger sample size will confirm the benefits of adding this treatment to the postoperative care of TKA as well as determine the mechanism of action in reducing the inflammatory response.

## ARTICLE HIGHLIGHTS

### Research background

Total knee arthroplasty (TKA) is the preferred treatment for patients suffering from severe osteoarthritis. The pain and swelling of the knee after the operation may impact rehabilitation and patient quality of life. Routine care to treat these complications includes icing, ankle pump exercises and non-steroidal anti-inflammatory analgesics. However, there are drawbacks to these treatments.

### Research motivation

The use of traditional Chinese medicine (TCM) ointments can warm meridians, regulate qi and blood, and improve viscera function. It can effectively relieve pain, significantly recover function, and significantly improve the quality of life. Tuina therapy has been shown to enhance the penetration of

ointments and has a good long-term effect on patients.

### Research objectives

This study aimed to identify a benefit to adding a TCM ointment and tuina therapy to routine care for TKA.

### Research methods

The randomized controlled clinical trial enrolled 80 patients who underwent TKA and were divided into two equal groups. All patients received routine care, with the treatment group also receiving TCM ointment with tuina therapy. The following variables were recorded 3 d before surgery and 3 d, 7 d and 14 d after surgery: Visual analog scale score; skin temperature; and circumferences at 15 cm above and below the patella. The maximum active knee flexion angle and the knee injury and Osteoarthritis Outcome score were recorded before surgery and 14 d after surgery.

### Research results

All measured variables were significantly improved in the treatment group compared to the control group, who only received routine care during the postoperative period.

### Research conclusions

Treatment with a TCM ointment and tuina therapy for knee arthroplasty patients effectively promoted the local lesion site metabolism and blood circulation, and had a significant inhibitory effect on the local inflammatory response and oxidative stress response.

### Research perspectives

Additional studies with a longer follow-up time and larger sample size will confirm the benefits of adding this integrative treatment to the postoperative care of TKA as well as determine the mechanism of action in reducing the inflammatory response.

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## FOOTNOTES

**Author contributions:** Jiang B contributed to the conceptualization and data curation; Xu HR, Wang QL, Kong H, Zhang H, Tian J, Ding Y, Yang RX and Zhang L contributed to project administration; Xing L contributed to writing, including review and editing, and project administration; and all authors read and approved the final manuscript.

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