



Case series

The role of acupuncture in pain and swelling control for postoperative tibial fracture treatment

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ABSTRACT

Background: Currently, intramedullary nailing for tibial fractures has very good postoperative treatment results. Combining the advantages of traditional medicine and modern medicine is a comprehensive treatment method that brings the best benefits to the patient.

Methods: The study method was a controlled clinical trial. The study included 60 patients with a definitive diagnosis of tibial fracture who underwent intramedullary nailing surgery. These patients were divided into 2 groups: with and without electroacupuncture treatment.

Results: Electro-acupuncture had a significant analgesic effect in 24–48 h after surgery: After 24 h or electroacupuncture, the pain difference in the study group and the control groups was 3.03 ± 1.25 and 2.46 ± 1.33 , respectively ($p < 0.05$). The VAS score difference between day 1 and day 2 in the study group and the control group was 0.61 ± 0.71 and 0.59 ± 0.67 , respectively ($p < 0.05$). At 48 h postoperatively, the circumference of the calf on the fractured side in the study group and the control group was 36.1 ± 2.1 and 37.3 ± 2.2 cm, respectively ($p < 0.05$). At 72 h postoperatively, the circumference of the calf in the study group and the control group was 35.9 ± 2.6 and 37.6 ± 2.8 cm, respectively ($p < 0.05$). The effect of electroacupuncture on bone healing did not differ between the study group and the control group ($p > 0.05$). During 7 days of using the treatment regimen, there were 3.3 % of patients with dizziness, 3.3 % of patients with vomiting/nausea, 3.3 % of patients with bleeding at the injection site. There was no difference in blood pressure, pulse rate, hematological indexes and biochemical indexes of patients before and after using the treatment regimen.

Conclusion: Electro-acupuncture has a significant analgesic effect 24 h–48 h after surgery. The effect of electroacupuncture on bone healing was not different between the two groups. Electroacupuncture is a safe, effective method with few side effects.

1. Introduction

Fractures of tibia are common fractures in all age groups. Currently, surgical treatment with intramedullary nail is effective for this injury. However, reducing postoperative pain and shortening the bone healing time is still a challenge. Today, modern medicine often uses analgesics, anti-inflammatory, anti-edematous drugs with the advantage of fast-acting, long-lasting but with many side effects. Therefore, when using them, it is necessary to closely monitor [1]. So far, there have been many studies on the analgesic effect of electroacupuncture after surgery and

found a significant therapeutic effect [2]. The authors of the Department of Orthopedics and Traumatology, Prince of Wales Hospital, The Chinese University of Hong Kong [3] conducted the study and came to the conclusion: Vibration with high frequency, low amplitude has the effect of increasing bone callus formation, ossification and bone healing in white rats with closed femoral fractures. Some other authors have also studied the effects of low amplitude [4–6] and high frequency [7,8] impact and give similar results on bone healing. However, there is still no complete study on the effect of electroacupuncture on patients after intramedullary nailing surgery. Therefore, with the aim of finding a

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method that combines modern medicine and traditional medicine to improve clinical effectiveness, con conducted this study with two goals:

1. Evaluation of the pain-relieving and bone healing of postoperative electroacupuncture after intramedullary nailing surgery in treatment of tibial shaft fractures.
2. Monitor unwanted effects of this treatment regimen.

2. Materials and methods

2.1. Research object

The study included 60 patients with tibial fractures who underwent intramedullary nailing surgery at the Orthopaedic Department, Xanh Pon general hospital, Vietnam. All surgeries are performed by a senior orthopaedic surgeon with 10 years of experience in the field of orthopaedic surgery. Patients were explained the purpose of the study and voluntarily consented to participate in the study.

2.2. Research methods

This is a prospective, controlled study. Sixty patients were randomly divided into 2 groups (30 patients each group):

- Group 1: Treatment using Paracetamol 1 g and Ketorolac 30 mg
- Group 2: Treatment using Paracetamol 1 g, Ketorolac 30 mg and electro-acupuncture at acupoints: Zusanli (ST-36), Diji (SP-8), Yinlingquan (SP-9), Yanglingquan (GB-34), Sanyinjiao (SP-6), Xuehai (SP-10) with M8 electro-acupuncture machine with a course of treatment once a day in 7 days.

All patients were examined and monitored at the Department of Trauma and Orthopedics, Saint Paul General Hospital, Hanoi, Vietnam. All patients underwent surgery and acupuncture (for the study group) with identical procedures. The evaluation of the results is also carried out by an independent observer (Figs. 1, 2).

2.3. Research parameters

- Clinical and paraclinical characteristics of the patients in the study.
- Pain level assessed according to the VAS score.
- Swelling through average limb circumference at fracture site.
- Evaluation of long-term outcomes based on Johner-Wrushso's criteria for bone healing, bone axis and Ter Schiphorst's criteria for rehabilitation.
- Undesirable effects during the study in both groups: Record all patient complaints during the study period.

This case series has been reported in line with the PROCESS Guideline [9].

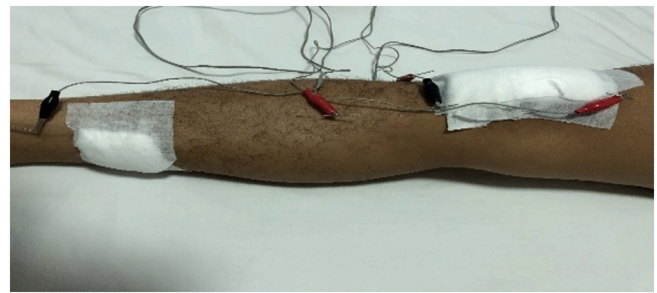


Fig. 2. Electro-acupuncture is placed and used on the patient.

3. Results

3.1. Patient characteristics

The mean age in the control group and in the study group were 35.6 ± 18.8 and 37.0 ± 22.1 years, respectively. The main age group in the study group was >49 years old (33.3 %), in the control group was 30–49 years old (36.7 %). The proportion of male in the control group and the study group was 60 % and 63.3 %, respectively.

3.2. Injury characteristics

The rate of traffic accidents accounted for largest in both the study group and the control group, they were 76.6 % and 83.4 %, respectively. The fracture locations of the tibia in the 2 groups are shown in Table 1. In both study and control group, the tibial fracture was mainly in the lower and middle third, accounting for 80 % and 76.7 %, respectively.

3.3. Clinical results

The VAS scores of the patients at the time before surgery, 24 h after surgery, 48 h after surgery and 72 h after surgery are shown in Table 2. The average VAS scores before surgery of the study group and the control group were 7.13 and 7.30, respectively. The difference is not significant ($p > 0.05$). At 24 h and 48 h after surgery, the VAS score of the study group was significantly lower than that of the control group ($p < 0.05$). However, at 72 h postoperatively, this difference was not

Table 1
Fracture site of tibia.

Fracture site	Study group (N = 30) (%)	Control group (N = 30) (%)
Proximal third	6 (20.0 %)	7 (23.3 %)
Middle third	10 (33.3 %)	11 (36.7 %)
Distal third	14 (46.7 %)	12 (40.0 %)
P	>0.05	

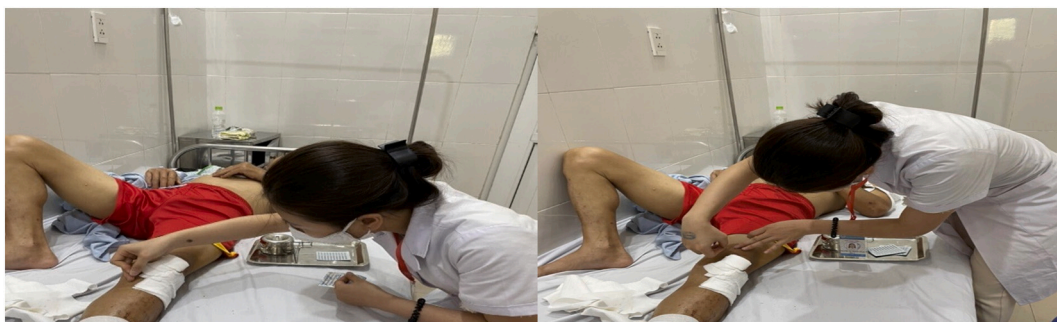


Fig. 1. Acupuncture performed on a patient after intramedullary nailing surgery.

Table 2
VAS pain scores of 2 groups of patients before and after surgery.

Time	VAS (X ± SD) score		p
	Study group (N = 30)	Control group (N = 30)	
Before surgery	7.13 ± 1.62	7.30 ± 1.81	>0.05
After surgery	24 h	4.12 ± 1.32	<0.05
	48 h	3.47 ± 1.04	<0.05
	72 h	2.90 ± 1.76	>0.05

significant.

The average circumference of the limb at the fracture site of the patients before and after surgery is shown in Table 3. At the time before surgery and 24 h after surgery, the mean limb circumference at the fracture site of the two groups was similar ($p > 0.05$). But at 48 h and 72 h postoperatively, the mean limb circumference at the fracture site of the study group was significantly lower than that of the control group ($p < 0.05$).

In terms of long-term outcomes, the study group had 23/24 patients (95.8 %) able to return to normal activities as before the injury, while this rate in the control group was 21/23 (91.3 %).

3.4. Radiograph results

- After 4 weeks of treatment, the majority of patients in the study group and the control group had grade I callus (66.6 % and 73.4 %, respectively).
- After 12 weeks, the proportion of patients in the study group with grade III callus was 90.0 %; in the control group was 80.0 %.
- At the time of final follow-up, all patients in both control and study groups had grade III bone fractures.

3.5. Unwanted effects of the treatment regimen

In the study group, we recorded 1 case of dizziness, 1 case of bleeding at acupuncture site, 1 case of anorexia. Meanwhile, in the control group, no cases of these conditions were recorded.

4. Discussion

Once injured (including bone fractures), blood circulation immediately becomes stagnant leading to swelling. Therefore, in the treatment of trauma, increasing the blood circulation is indispensable [10].

According to the theory of traditional medicine, “The qi is injured, it hurts”, “the pain is caused by the qi and blood not circulating, the qi and blood is stagnant”, which means that the operation of “qi and blood” in the meridians is obstructed. Therefore, treatment needs to “clear the meridians and regulate blood and qi”. Acupuncture is a non-drug treatment with a mechanism to regulate the activity of the meridian system [11,12]. Therefore, acupuncture on the acupoints on the meridians will help blood circulation [11,13].

We used acupressure points: Zusanli (ST-36), Diji (SP-8), Yinlingquan (SP-9), Yanglingquan (GB-34), Sanyinjiao (SP-6) and Xuehai (SP-10) as local acupoints that have the effect of qi and blood circulating, helping to relieve pain. Zusanli, the 36th point of the stomach meridian, is an important point, belonging to the Earth element. This point brings

Table 3
Average limb circumference at the fracture site.

Time	Circumference (cm)		p
	Study group (N = 30)	Control group (N = 30)	
Before surgery	31.1 ± 1.7	30.6 ± 1.5	>0.05
After surgery	24 h	36.9 ± 2.6	>0.05
	48 h	36.1 ± 2.1	<0.05
	72 h	35.9 ± 2.6	<0.05

qi to the lower body [15,16]. Zusanli is one of the 14 key points of acupuncture to improve qi, one of the “revival of yang” acupuncture has the effect of improving and restoring yang. Yanglingquan is an important acupoint, mastering of heat [15,16].

All qi is important, but Shaoyang qi is decisive, because Shaoyang controls the new qi. Yinlingquan point has the effect of regulating digestion, stagnation, and regulating the bladder [15,16]. The Diji is the 8th point of the spleen meridian, which is used in qi disorders caused by circulatory stagnation [15]. The Xuehai is the 10th point of the spleen meridian. From the point of view of Eastern medicine, Xuehai contains the “blood sea”, which plays an extremely important role in regulating the body's activities [16]. The Sanyinjiao point has the effect of supporting Yin and spleen, ventilation stagnation, reducing humidity and wind, regulating blood, improving the liver and kidney. The Sanyinjiao is also one of the 14 key points of acupuncture to improve qi, one of the “reviving yang” acupuncture points that improve and restore yang. Therefore, electro-acupuncture of acupoints has the effect of activating blood circulation, reducing moisture, combined with proper rehabilitation, can help ventilate the blood, help reduce swelling in patients with fractures after surgery [14].

In our study, the two groups of patients had no difference in mean age and male:female ratio ($p > 0.05$). The majority of patients are men of working age. A study by Trinh Thi Le (2015) on 42 patients with open fractures of tibia showed that the average age of the patients was 35.5 ± 18.5 years, ranging from 18 to 79 [17]. In our study, the fracture site of the tibia was mainly in the middle third and the distal third. These results are different from those of Trinh Thi Le with the most common fracture sites being the middle third and the upper third (47 % and 47 %) [17]. However, research by Le Viet showed that the upper third fracture accounted for 0.8 %, the middle third fracture accounted for 49.1 %, the lower third fracture accounted for 43.6 %, and the segmental fracture accounted for 5.5 % [18]. Bui Tien Hung study [19] also showed similar results when the fracture site was mainly in the lower third and the middle third. This result can be explained because the tibia is an anatomical structure with a triangular prism with the tibial crest anteriorly. This result may be because the tibia is an anatomical structure with a triangular prism with the tibial crest anteriorly. The lower third of the tibia has a rounded cylindrical shape, a feature that makes it susceptible to fracture in the presence of injury [20].

In this study, we assessed pain according to the VAS scale. The results of our study on the analgesic effect of electroacupuncture showed that, 24 h after surgery, the pain level in the study group decreased to 4.12 ± 1.32, in the control group to 4.81 ± 1.29. After 48 h of surgery, the pain level in the study group decreased to 3.47 ± 1.04, in the control group to 4.20 ± 1.26. After 72 h of surgery, there was no difference in pain level between the two groups with $p > 0.05$. Thus, it can be seen that the early analgesia support effect of electro-acupuncture is evident in about 24–48 h after surgery.

Fractures cause damage to soft tissue, muscle tissue systems and cavities, causing stagnation of qi and blood, and obstruction of qi. Accumulation of blood qi causes swelling, pain, redness, or bruising. Therefore, electro-acupuncture at the qi and blood circulation acupoints can help to ventilate the blood and help reduce swelling in patients with fractures after surgery. The study showed that, after 24 h of surgery, the circumference of the fractured limb in the study group was 36.9 ± 2.6 cm, while in the control group it was 36.1 ± 2.8 cm. There was no difference between the two groups with $p > 0.05$. After 48 h, the circumference of the fracture site in the study group was 36.1 ± 2.1 cm, while in the control group it was 37.3 ± 2.2 cm. There is a difference between the two groups with $p < 0.05$. After surgery 72 h, the circumference of the fractured limb in the study group was 35.9 ± 2.6 cm, while in the control group it was 37.6 ± 2.8 cm. There is a difference between the two groups with $p < 0.05$. Thus, electroacupuncture also has a supportive effect in reducing edema in patients after surgery due to tibial fractures.

Based on the evaluation criteria, in the study group, 95.8 % of

patients returned to normal activities (equivalent to good and very good), while in the control group it was 91.3 %. There was no difference between the two groups ($p > 0.05$). Compared with previous studies, we see similarities. Le Viet's study showed that 91.9 % of patients returned to normal activities [18]. Thus, in our study, electro-acupuncture did not have a supportive effect on promoting bone healing in patients after intramedullary nailing surgery due to tibial fractures.

Regarding the unwanted effects of the treatment regimen, we noted that electroacupuncture is a safe, effective method with few side effects. This result is similar to the study of Cao Thi Huyen Trang and Bui Tien Hung when the authors showed that the use of electroacupuncture in patients after arthroscopic surgery for anterior cruciate ligament rupture did not cause any side effects [21]. Similar to the results of author Tran Thien An and colleagues when studying the method of spinal manipulation combined with electroacupuncture in the treatment of low back pain due to spondylolisthesis, the authors showed no cases who suffers from unwanted clinical effects such as pricking, bleeding, broken needles, pricking nerves. [22].

4.1. Limitations of the study

Our study cannot avoid limitations such as the small number of patients in the study groups, the short follow-up time and the lack of control over the accuracy of the acupuncture points.

5. Conclusions

Through the study of 60 patients divided into two groups: combined treatment with electro-acupuncture and non-electro-acupuncture group, we draw the conclusion: Electro-acupuncture has a significant analgesic effect in 24–48 h after surgery. The effect of electroacupuncture on bone healing was not different between the two groups. Electro-acupuncture is a safe, effective method with few side effects. Research needs to continue to be carried out and followed up with a larger number of patients.

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Ethical approval

The procedures used in this study inhere to the tenets of the Declarations of Helsinki.

Consent

We introduced the patient to sign informed consent and attached the manuscript.

Author contribution

DTT contributed to performed the operation, revising, and approval for publishing.

LTQ, HNNT, TLK contributed to assist the operation, data collection, analysis and interpretation, manuscript drafting.

LTQ, HNNT contributed to data collection, analysis and interpretation, manuscript drafting.

Registration of research studies

Not applicable.

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Declaration of competing interest

We declare that we have no known competing financial interests or personal relationships with anyone that could have appeared to influence the work reported in this paper.

References

- [1] Dao Van Phan, Nguyen Tran Giang Huong, Nguyen Trong Thong, et al., Pain reliever, antipyretic, anti-inflammatory, in: Pharmacology, Vietnamese Medical Publisher, 2007, pp. 147–164.
- [2] Nghiem Huu Thanh, Study on the change of pain threshold and some physiological parameters in patients receiving pain relief by electroacupuncture after goiter surgery, *Vietnam. Med. Journal* 7 (2) (2011) 95–100.
- [3] Kwok Sui Leung, Hong Fei Shi, Wing Hoi Cheung, Ling Qin, Wai Kin Ng, Kam Fai Tam, Ning Tang, Low-magnitude high-frequency vibration accelerates callus formation, mineralization, and fracture healing in rat, *Wiley InterScience*, www.interscience.wiley.com, 2008, <https://doi.org/10.1002/jor.20753>.
- [4] B.A. Christiansen, M.J. Silva, The effect of varying magnitudes of whole-body vibration on several skeletal sites in mice, *Ann. Biomed. Eng.* 34 (2006) 1149–1156.
- [5] S. Judex, X. Lei, D. Han, et al., Low-magnitude mechanical signals that stimulate bone formation in the ovariectomized rat are dependent on the applied frequency but not on the strain magnitude, *J. Biomech.* 40 (2007) 1333–1339.
- [6] K. Ward, C. Alsop, J. Caulton, et al., Low magnitude mechanical loading is osteogenic in children with disabling conditions, *J. Bone Miner. Res.* 19 (2004) 360–369.
- [7] W.H. Cheung, H.W. Mok, L. Qin, et al., High-frequency wholebody vibration improves balancing ability in elderly women, *Arch. Phys. Med. Rehabil.* 88 (2007) 852–857.
- [8] E. Puricelli, L.M. Ulbrich, D. Ponzoni, et al., Histological analysis of the effects of a static magnetic field on bone healing process in rat femurs, *Head Face Med* 2 (2006) 43.
- [9] R.A. Agha, C. Sohrabi, G. Mathew, T. Franchi, A. Kerwan, O'Neill N for the PROCESS Group, The PROCESS 2020 guideline: updating consensus Preferred Reporting Of CasE Series in Surgery (PROCESS) guidelines, *International Journal of Surgery* 84 (2020) 231–235.
- [10] 中医骨伤科学, 中国中医药出版社, 2013, pp. 51–59.
- [11] Pham Van Trinh, Le Thi Hien, in: *Pathology of Traditional Medicine*, Vietnamese Medical Publisher, 2008, pp. 16–18.
- [12] Nguyen Nhuoc Kim, Tran Quang Dat, in: *Acupuncture and Non-drug Therapies* 13–15, Vietnamese Medical Publisher, 2008, pp. 29–152, 192–200.
- [13] Thuy, in: *Acupuncture*, Vietnamese Medical Publisher, 2005, pp. 161–198.
- [14] Pham Van Trinh, *Outline of fractures*, in: *Pathology of Traditional Medicine*, Vietnamese Medicine Publisher, Hanoi, 2008.
- [15] Pham Duy Nhac Thuy, Hoang Bao Chau, *General Acupuncture*, Vietnamese Medicine Publisher, Hanoi, 2002.
- [16] Nguyen Nhuoc Kim, Tran Quang Dat, *Acupuncture and Non-drug Therapies*, Vietnamese Medical Publisher, Hanoi, 2017.
- [17] Trinh Thi Le, *Results of Caring for Patients After Surgery for Open Fracture of Tibial at Viet Duc Hospital*, Thang Long University, Hanoi, 2015. Bachelor of Nursing thesis.
- [18] Le Viet, *Evaluation of the Results of Treatment of Open Fractures of the Lower Leg by Intramedullary Nailing at Saint Paul Hospital*, Hanoi Medical University, Hanoi, 2014. Master's Thesis of Medicine.
- [19] Bui Tien Hung, *Evaluation of the Effect of "LX1" Cream on Patients After Surgery for Closed Leg Fractures*, Hanoi Medical University, Hanoi, 2015. Doctorate of Medicine Thesis.
- [20] Tran Dinh Chien, *Bone healing process and factors affecting bone healing process*, in: *Surgical Pathology*, Vietnamese People's Army Publisher, Hanoi, 2002.
- [21] Cao Thi Huyen Trang, Bui Tien Hung, *Evaluating the early analgesia after arthroscopic surgery for anterior cruciate ligament rupture by electroacupuncture method*, *Vietnamese Journal of Medical Research* 103 (5) (2015) 96–102.
- [22] Tran Thien An, Tu. Nguyen Thi, Thai Van Anh, Tran Le Hien, Vo Hiep Minh, *Evaluation of the effectiveness of spinal manipulation method in combination with electroacupuncture in the treatment of low back pain due to degeneration spine*, *Vietnam. J. Clin. Med.* 59 (2020) 57.