

Correlation of diclofenac sodium sustained-release capsules in conjunction with function training and VAS score after ankle fracture surgery

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Abstract. – OBJECTIVE: To investigate the effect of Diclofenac sodium sustained-release capsules combined with function training on functional recovery and Visual Analog Scale (VAS) score after surgery for ankle fractures.

PATIENTS AND METHODS: The study included 88 patients with ankle fractures who were surgically treated at our institution between October 2019 and October 2021. The individuals were randomized into experimental and control groups, with 44 patients in each group. Following their hospitalization, all patients had surgical therapy. After surgery, patients in the control group received conventional analgesics together with function training, whereas those in the experimental group received Diclofenac sodium sustained-release capsules along with function training. The efficacy of the post-surgical treatment in the two groups was then evaluated using functional recovery and VAS scores.

RESULTS: There was no significant difference in the VAS score between the two groups before intervention ($p>0.05$). After treatment, both groups experienced pain relief, with the VAS score of the experimental group being significantly lower than the control group ($p<0.05$). The number of patients in the experimental group who fully and partially complied with the study was 19 and 24, respectively, significantly higher than that of 15 and 20 in the control group. Only 1 patient in the experimental group was non-compliant, compared to 9 in the control group. The total compliance rate in the experimental group was 97.73%, much higher than that of 79.55% in the control group ($p<0.05$). Before the intervention, there was no significant difference in the range of active ankle motion between the two groups ($p>0.05$). After treatment, there was an improvement in the range of active motion of the ankle in patients from both groups.

CONCLUSIONS: After ankle fracture surgery, using Diclofenac sodium sustained-release capsules in conjunction with function training successfully lowers postoperative pain. It also maintains emotional stability and ensures sleep, factors which are helpful in improving patient compliance

to treatment and promoting functional recovery of the ankle. The clinical value of this treatment regimen is certain, and it deserves more widespread application.

Key Words:

Diclofenac sodium sustained-release capsule, Function training, Ankle fracture, Functional recovery, VAS score.

Introduction

A fracture is a bone disruption usually caused by mechanical injury and/or diminished bone strength. The size and direction of the causative force and the position of the foot at the time of the impact, all influence the type of fracture that a patient sustains. Typical manifestations include local deformation, abnormal motion of the limb, pain, swelling and the sound of bones rubbing against one another when the limb is moved¹. The ankle joint is composed of the lower ends of the tibia and fibula, and the talus. Ankle fractures are common, making up about 3.9% of all fractures, especially in young adults due to their weight-bearing joint². The clinical manifestations include pain, swelling, subcutaneous bruises, immobility, deformity, inability to walk and marked tenderness of the medial or lateral aspect of the lower leg^{3,4}. After a fracture occurs, it needs to be properly managed, as it may lead to arthritis and poor healing. The clinical treatment mainly takes the form of manual reduction and external fixation or open reduction and internal fixation, usually the latter. Ankle fractures are usually classified according to the Lange-Hansen or the AO classification^{5,6}. Proper management, often involving surgical intervention, is critical to prevent complications like arthritis^{7,8}.

Traditional Chinese medicine suggests that fractures damage meridians, exacerbating Qi and blood flow disruption caused by surgery. Yishen Jiegu Decoction may aid in recovery⁹. Liu et al¹⁰ believe that the surgical treatment of ankle fractures requires the stripping of the soft tissue around the fracture, which can pull the fractured end and damage the blood circulation near the ankle joint, causing joint pain, swelling, and red heat, and further hinder the recovery of ankle function. Ye et al¹¹ pointed out that traditional Chinese medicine and rehabilitation therapy are remarkable in promoting the rapid recovery of fractures. The passage from Pu Ji Fang¹² states: "If the blood flows through the meridians due to the upper fold, the way of blood flow is blocked, and the stasis does not disperse, it will be swelling". This indicates that swelling is a result of blood stasis and a lack of smooth blood circulation. It emphasizes the necessity of combining traditional Chinese medicine to promote blood circulation with functional exercise.

Post-surgery function training is vital to boost blood circulation, aid fracture healing, and prevent atrophy^{13,14}. However, postoperative pain seriously affects the patient's ability to comply with function training, thereby reducing the effectiveness of treatment. Postoperative pain is a complex response of the body to the stress caused by surgery. Pain invariably occurs following fracture surgery, mainly because of damage to the soft tissues around the fracture, stimulation of nociceptors, or damage to the membrane of the fracture head. Proper analgesia in the postoperative period can blunt or totally prevent the body's response to the stress caused by surgery.

Diclofenac sodium sustained-release capsules¹⁵ main ingredient is Diclofenac sodium, which belongs to the class of non-steroidal anti-inflammatory drugs (NSAIDs), a class of drugs that act by inhibiting an enzyme called cyclooxygenase (COX), responsible for the synthesis of prostaglandins. Its chemical name is 2-[(2,6-dichlorobenzene base) amino] phenylacetate, and its chemical formula is $C_{14}H_{10}C_{12}N_2NaO_2$ ¹⁶. The drug is mainly used for its potent anti-inflammatory, analgesic, antipyretic and anti-rheumatic properties. Clinically, it is used to treat mild or moderate pain caused by various rheumatoid arthritis or osteoarthritis, low back pain and leg pain. Xiaozhuhuoxuetang, according to the method of invigorating Qi, activating blood and invigorating water, is derived from Buyang Huanwu Decoction and Fangji Huangqi

Decoction. It has a good effect on postoperative swelling and pain relief. In light of this, the purpose of this study is to investigate the impact of combining Diclofenac sodium capsules with function training on functional recovery and VAS score in ankle fracture patients post-surgery, offering insights for future clinical treatment and research.

Patients and Methods

Study Subjects

A total of 88 patients with ankle fractures who were surgically treated in our hospital from October 2019 to October 2021 were selected as the study subjects. The randomization was conducted using an online web-generated randomization tool (<http://www.randomizer.org/>). To avoid biases, the randomization procedure and assignment were managed by an independent assistant who was not involved in the screening or evaluation of the participants.

47 of the patients were males, and 41 were females. All patients were aged between 22 and 48 years old, with a mean of 35.25 ± 5.44 . All patients underwent open reduction and internal fixation after admission. There were 44 patients in each group. After surgery, patients in the control group received conventional analgesics together with function training, whereas those in the experimental group received Diclofenac sodium sustained-release capsules along with function training.

Before enrollment, the study obtained the signed informed consent of the patients. This study protocol was approved by The Ethics Committee of Affiliated Zhongshan Hospital of Dalian University (SH-HSY20191013). All procedures comply with the ethical guidelines of the Declaration of Helsinki.

Inclusion and Exclusion Criteria

Inclusion criteria

1. Patients with ankle fractures diagnosed by X-ray or Computed Tomography (CT)¹⁷.
2. Patients with closed fractures.
3. History of ankle trauma, joint swelling, deformity, pain, dysfunction, local tenderness, palpable bone friction, X-ray film of the affected side showing fracture line, discontinuous bone cortex, obvious separation and displacement of broken ends, ankle joint gap change.

Exclusion criteria

1. Patients with severe cardiac, cerebral or vascular diseases.
2. Patients that were allergic to the drugs used in this study.
3. Patients who were either pregnant or breast-feeding at the time of this study.

Also, it must be stated that all patients and their families were informed of the study, their participation was voluntary, and all of them signed the Informed Consent form.

Methods

All patients underwent open reduction and internal fixation after admission. The details of the operation are as follows: continuous epidural anesthesia was given to all patients. Anteroinferior arc incisions were made for patients with medial malleolar fractures, and half-threaded bone screws or tension bands were used for fixation after reduction. For patients with lateral malleolar fractures, the incision was made lateral to the fibula, and the fibula condyle plate was used for fixation after reduction. If the patient had a posterior malleolar fracture, then 1-2 lag screws were placed posteriorly for tightening after reduction. Postoperative treatment was given to all patients after surgery¹⁸.

Patients in the control group were treated with conventional analgesics combined with function training after surgery. A single intramuscular injection of Pethidine (50 mg) was administered when the postoperative pain reached grade 3 (WHO pain classification). Function training was done on the principle of gradual increases in the amount and intensity of exercise. 1-4 days after surgery, patients were taught how to perform such exercises as the lifting of the leg, etc. 7 days after surgery, patients were taught how to perform function training of the ankle, knee and leg muscles. If the patient's ankle was neither swollen nor tender 3-4 weeks after surgery, then non-weight-bearing exercises were added to the exercise plan, gradually switching to weight-bearing and then on to full-weight exercises.

Patients in the experimental group were treated with Diclofenac sodium sustained-release capsules combined with function training after surgery. 25 mg of Diclofenac sodium sustained-release capsules were given after meals, 3 times daily for 4 consecutive weeks. The function training was identical to that described for patients in the control group.

On the basis of the two groups, guided by the method of invigorating Qi, activating blood and di-

verting water, self-made Xiaozhuhuoxue decoction was used for treatment. During the initial two weeks following the surgical procedure, the treatment regimen included 15 g each of *Astragalus*, *Radix paeoniae rubra* root, and *Atractylodes*, along with 10 g each of *Angelica tail*, *lumbricus*, *Ligusticum wallichii*, and *Radix Stephaniae Tetrandrae*. Additionally, 6 g each of *Carthamus tinctorius L* and *Persicae semen* were also prescribed. 3-4 weeks postoperatively, *Astragalus* 30 g was given, and the other doses remained unchanged. The above medicines were soaked in 500 mL of water for 10 min, decocted to extract 200 mL of juice, and taken with warm water in the morning and evening. One week is taken as a course of treatment for a total of 4 weeks of treatment.

Evaluation Indicators

VAS score

The Visual Analog Scale (VAS) was used to assess the severity of pain in the patient's ankle before and after treatment. The VAS for pain is a straight line, with one end meaning no pain, and another end meaning the worst pain imaginable. The patient marks a point on the line that matches the amount of pain that he or she feels. The lowest possible score is 0, and the highest is 10. A score of 3 or less indicates mild pain that has no impact on daily life. A score of 4-6 indicates moderate pain, pain that is evident but still tolerable. A score of 7 or greater indicates severe, unbearable pain.

Compliance

Through Healthcare Professional Observation, physicians or nurses can evaluate patient compliance by observing patient behavior within healthcare facilities. The Training Compliance Scale was used to evaluate the degree to which patients were complying with function training. The total score on this scale is 10. A score of 8 or greater means that the patient is fully compliant, that of 6 or greater but less than 8 means that the patient is only partially compliant, and a score lower than 6 means that the patient is non-compliant. The total compliance rate of patients in the two groups was calculated and compared using the formula: Total compliance rate = (full compliance + partial compliance) / total number of cases × 100%.

Range of active motion of the ankle

The range of active motion of the ankle was tested before and after treatment.

Statistical Analysis

SPSS 22.0 software (IBM Corp., Armonk, NY, USA) was used for data analysis. Measurement data was expressed as (\pm s), and the independent samples *t*-test was used. Enumeration data was expressed as the number of cases (%), and the Chi-square test was used. $p < 0.05$ indicates that the comparison is statistically significant.

Results

Clinical Data

There were 44 patients in the control group, 24 males and 20 females. The average age of the patients was 35.69 ± 5.18 years. The time for a fracture to be diagnosed was 0.5-5.3 hours, with an average of 3.02 ± 2.18 hours. The cause of injury was traffic accidents in 8 cases, falling from a height in 9 cases, spraining in 13 cases, and other mechanisms of injury in 14 cases. There were 44 patients in the experimental group, 23 males and 21 females. The average age of the patients was 35.08 ± 5.67 years. The time for a fracture to be diagnosed was 0.8-5.1 hours, with an average of 3.11 ± 2.14 hours. The cause of injury was traffic accidents in 9 cases, falling from a height in 10 cases, spraining in 12 cases, and other mechanisms of injury in 14 cases. The clinical comparison between the two groups was not statistically significant ($p > 0.05$) (Table I).

VAS Score

There was no significant difference in the VAS score between the two groups before intervention ($p > 0.05$). After treatment, there was pain relief in patients from both groups, with the VAS score of the experimental group (0.91 ± 0.35) being

significantly lower than that of the control group (1.59 ± 0.51) ($p < 0.05$) (Table II).

Compliance

The number of patients in the experimental group who fully and partially complied with the study was 19 and 24 respectively, significantly higher than that of 15 and 20 in the control group. Only 1 patient in the experimental group was non-compliant, compared to 9 in the control group. The total compliance rate in the experimental group was 97.73%, much higher than that of 79.55% in the control group ($p < 0.05$) (Table III).

Range of Active Motion of the Ankle Joint

There was no significant difference in the active range of motion of the ankle joint between the two groups before intervention ($p > 0.05$). After treatment, there was an improvement in the active range of motion of the ankle joint in patients from both groups. The dorsiflexion and plantarflexion angles of the patients in the experimental group were 15.54 ± 2.58 and 31.43 ± 4.08 respectively, greater than those of 12.14 ± 2.48 and 28.49 ± 3.11 seen in the control group ($p < 0.05$) (Table IV).

Discussion

The ankle joint is one of the most important weight-bearing joints in the human body. Due to its special anatomical structure and function, it is prone to traumatic fractures and other injuries. Ankle fractures are a common injury in sports. If treatment is untimely and incorrect, the patient runs the risk of losing motor function. As such,

Table I. Comparison of general data ($\bar{x} \pm s$).

Group	n	Sex		Age (years)	Time for a fracture to be diagnosed (hours)		Cause of injury			
		M	F		Range	Mean	Traffic accidents	Falls	Sprains	Other
Control group	44	24	20	35.69 ± 5.18	0.5-5.3	3.02 ± 2.18	8	9	13	14
Experimental group	44	23	21	35.08 ± 5.67	0.8-5.1	3.11 ± 2.14	9	10	12	13
<i>t</i>	-	-	-	0.527	-	0.195	-	-	-	-
<i>p</i>	-	-	-	0.600	-	0.846	-	-	-	-

Table II. Comparison of VAS scores in both groups before and after treatment ($\bar{x} \pm s$).

Group	n	Before intervention	After intervention
Control group	44	4.98 \pm 0.83	1.59 \pm 0.51*
Experimental group	44	5.07 \pm 0.69	0.91 \pm 0.35*
<i>t</i>	-	0.553	7.292
<i>p</i>	-	0.582	<0.001

* indicates that the difference before and after the intervention within a given group is statistically significant, $p < 0.05$.

Table III. Comparison of compliance after intervention (%).

Group	n	Fully compliant	Partially compliant	Non-compliant	Compliance rate
Control group	44	15 (34.09)	20 (45.45)	9 (20.45)	35 (79.55)
Experimental group	44	19 (43.18)	24 (54.55)	1 (2.27)	43 (97.73)
χ^2	-	7.221			
<i>p</i>	-	0.007			

Table IV. Comparison of active range of motion before and after treatment ($\bar{x} \pm s$).

Time		Control group (n=44)	Experimental group (n=44)	<i>t</i>	<i>p</i>
Before intervention	Dorsiflexion	6.78 \pm 2.31	6.67 \pm 2.28	0.225	0.823
	Plantar flexion	9.93 \pm 2.68	9.87 \pm 2.94	0.100	0.921
After intervention	Dorsiflexion	12.14 \pm 2.48*	15.54 \pm 2.58*	6.302	<0.001
	Plantar flexion	28.49 \pm 3.11*	31.43 \pm 4.08*	3.801	<0.001

*indicates that the difference before and after intervention within a given group is statistically significant, $p < 0.05$.

the goal of treatment is to restore function¹⁹. Due to its complex structure, the ankle joint can undergo many types of fractures. The treatment method for a fractured ankle has evolved from simple conservative treatment to complex surgical treatment. Limb swelling and pain are very likely to occur after fractures. Modern medicine believes that trauma such as surgery will lead to a protective response in the body, and some inflammatory factors will be released from the whole body or part of the body. Such inflammatory factors will strongly stimulate nerve pain signals, leading to pain, muscle spasm, obstruction of venous and lymphatic backflow, significant expansion of the vessel wall, increased permeability, and tissue swelling^{20,21}. At present, conventional treatments, such as elevation of the affected limb, hemostasis, and pain relief after surgery, are unpromising. Traditional Chinese medicine believes that swelling and pain after fractures are caused by post-traumatic imbalance of Qi. If the circulation of Qi and blood is not smooth, there will be stasis, which will cause damage to

the meridians. Swelling after ankle joint surgery is mostly related to Qi and blood deficiency, Qi stagnation and blood stasis²².

Diclofenac sodium sustained-release capsules are effective at relieving swelling and pain in and around the fractured ankle. When combined with function training, these capsules can improve the patient's muscle strength, as well as maintain stability and improve the function of the knee joint²³. Xiaozhu Huoxue Decoction, according to the method of invigorating Qi, activating blood and invigorating water, is derived from "Buyang Huanwu Decoction and Fangji Huangqi Decoction", used to treat rheumatism syndrome, and has the effect of invigorating Qi and expelling wind, invigorating spleen and diuretic water. The two methods can be used to treat swelling and pain after ankle fracture surgery, invigorate Qi, promote blood circulation and remove blood stasis, diuresis and swelling. With this consideration in mind, our study selected 88 patients with ankle fractures who were surgically treated in our hospital as the study

subjects and investigated the effect of Diclofenac sodium sustained-release capsules combined with function training on functional recovery and VAS score after ankle fracture surgery.

The results showed that after treatment, there was pain relief in patients from both groups, but the VAS score of patients in the experimental group (0.91 ± 0.35) was significantly lower than that of those in the control group (1.59 ± 0.51). Also, the total compliance rate of patients in the experimental group (97.73%) was higher than that of patients in the control group (79.55%). The postoperative pain caused by the body's response to the stress caused by surgery brings with it a series of pathophysiological alterations. The reason may be that Diclofenac sodium sustained-release tablet belongs to non-steroidal anti-inflammatory and analgesic drugs, and its mechanism of action is to inhibit the activity of cyclooxygenase, indirectly inhibit the synthesis of leukotrienes, and have a strong inhibitory effect on the synthesis of prostaglandins, relieving joint swelling and pain symptoms^{24,25}. *Astragalus* can stabilize the surface, supports sores, and diuretic water, and the initial dosage is moderate, considering that in the early stage of fracture, the main purpose is to promote blood circulation and dredging collaterals, avoid too much Qi invigorating, hinder the dispersal of blood stasis, and reuse *astragalus* in the later stage. Long-term fracture coupled with long-time sedentary and lying down result in muscle atrophy, and unavoidable aggravation of Qi and blood deficiency, so it is given to strengthen Qi, invigorate the spleen and lung, help Qi and blood to dredge collaterals and reduce swelling; safflower, peach kernel, *Ligusticum wallichii* are minister medicines. Safflower dispels blood stasis and relieves pain, peach kernel promotes blood circulation and removes blood stasis, and *Ligusticum wallichii* promotes blood circulation and promotes Qi; *Radix Stephaniae Tetrandrae* is employed for the management of conditions such as eczema sores, rheumatic arthralgia, and embolism due to its therapeutic properties that encompass reducing swelling, expelling wind, and alleviating pain; *Angelica tail* promotes blood circulation, aiding in the breakdown of stagnant blood; *Red peony root* possesses the ability to clear heat and cool the blood, effectively dispersing blood stasis; *Atractylodes Rhizoma* dries dampness; *lumbicus* has the effect of promoting blood circulation and diuresis, and is often used in combination with Qi and blood stasis medicines for diseases of Qi deficiency and blood stasis, and blocked meridian.

The combination of various medicines can promote blood circulation and remove blood stasis, promote the circulation of Qi and blood in local swelling, regulate the spleen and lung, transport and resolve water and dampness, and also benefit water and reduce swelling.

Clinically relevant studies²⁶ have found that the respiratory and circulatory complications that occur in the postoperative period may be a consequence of the pain experienced during that period. This pain also tends to affect the patient's appetite and sleep, which is not helpful in the recovery process. Therefore, it is cardinal that patients are given adequate anesthesia in the postoperative period. This not only relieves postoperative pain but also helps to avert perioperative complications. Pethidine (chemical formula: $C_{15}H_{21}NO_2$) is an organic compound that acts as an agonist at opioid receptors. It is commonly used as an analgesic in clinical practice. It shares the same mechanism of action as Morphine, but its analgesic effect is only about a tenth (1/10) that of Morphine and has a duration of action of about 2-4 hours. It suppresses respiration and also has weak sedative and antiemetic effects. Diclofenac sodium sustained-release capsules are superior to Pethidine. They have a quicker onset and a longer duration of action. When the pain has been relieved, patients have a more enthusiastic outlook on treatment, and they tend to trust their doctors even more. This improves the patients' compliance with treatment and function training. This observation is in line with the findings of this study. Previous studies²⁷ have alluded to the invasive nature of ankle fracture surgery. Trauma secondary to fracture, and surgery that is otherwise meant to treat the fracture both cause pain, swelling and dysfunction of the ankle. By promoting blood and lymph circulation around the ankle, function training prevents the development of muscle spasms around the ankle.

In this study, the range of active motion of the ankle joint was evaluated by measuring the dorsiflexion and plantar flexion angles of the ankle joint. The results showed that the range of active motion of the ankle joint in patients from both groups improved after treatment, but a greater improvement was seen in the experimental group than in the control group. This indicates that treatment with Diclofenac sodium sustained-release capsules combined with function training after ankle fracture surgery effectively promotes func-

tional recovery. This finding is consistent with the findings of the above-mentioned studies²⁶. This can probably be explained by the fact that because the treatment of ankle fractures usually takes the form of open reduction and internal fixation, this tends to reduce blood circulation around the ankle, leading to pain and swelling. With the passage of time, this leads to the formation of adhesions and stiffness of the joint. To that end, it is critical that the patient exercise following surgery in order to enhance blood circulation in the damaged limb and, therefore, promote recovery. Function training can increase blood circulation and encourage the creation of new microcirculations in the soft tissues surrounding the fracture. Function training can also improve muscular contraction, which aids in the formation of new bone at the fracture site. Furthermore, function training avoids muscle atrophy surrounding the joint^{28,29}.

Limitations

However, there are a few limitations to consider. First, the sample size was small, which might bias the results towards null. Second, it is almost impossible to determine which drug played the most significant role since we used multiple drugs in this study. To overcome these limitations, future studies with larger sample sizes and exploration of the specific mechanism of these drugs are required.

Conclusions

Treatment with Diclofenac sodium sustained-release capsules combined with function training after ankle fracture surgery can effectively reduce postoperative pain, as well as maintain emotional stability and ensure good quality sleep. All these factors improve patient compliance with treatment and promote functional recovery. This method of treatment has a definite clinical application value and deserves more widespread application in clinical practice.

Ethics Approval

The protocol was approved by the Ethics Committee of the Affiliated Zhongshan Hospital of Dalian University (SH-HSY20191013).

Informed Consent

Written informed consent was obtained from patients involved in the study.

Conflict of Interest

The authors declare that no conflict of interest is associated with this work.

Authors' Contributions

This work was performed by all authors named in this article, and all liabilities pertaining to claims relating to the content of this article will be borne by all of them.

Data Availability

All data generated or analyzed during this study are included in this published article.

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References

- 1) Lee S, Lin J, Hamind KS, Bohl DD. Deltoid Ligament Rupture in Ankle Fracture: Diagnosis and Management. *J Am Acad Orthop Surg* 2019; 27: e648-e658.
- 2) Briet JP, Hietbrink F, Smeeing DP, Dijkgraaf GW, Verleisdonk EJ, Houwert RM. Ankle Fracture Classification: An Innovative System for Describing Ankle Fractures. *J Foot Ankle Surg* 2019; 58: 492-496.
- 3) Karim A, So E, Taylor BC, Degenova D, Nace WC. Ankle Fracture Fixation: Medial or Lateral First? *J Foot Ankle Surg* 2019; 58: 75-79.
- 4) Fisher N, Atanda A, Swensen S, Egol KA. Repair of Bimalleolar Ankle Fracture. *J Orthop Trauma* 2017; 31: S14-S15.
- 5) Mason LW, Marlow WJ, Widnall J, Molloy AP. Pathoanatomy and Associated Injuries of Posterior Malleolus Fracture of the Ankle. *Foot Ankle Int* 2017; 38: 1229-1235.
- 6) Goost H, Wimmer MD, Barg A, Kabir K, Valderrabano V, Burger C. Fractures of the ankle joint: investigation and treatment options. *Dtsch Arztebl Int* 2014; 111: 377-388.
- 7) Hsu RY, Ramirez JM, Blankenhorn BD. Surgical Considerations for Osteoporosis in Ankle Fracture Fixation. *Orthop Clin North Am* 2019; 50: 245-258.

- 8) Tengberg PT, Ban I. Treatment of ankle fractures. *Ugeskr Laeger* 2018; 180: V11170883.
- 9) Zhang W. Effect of staging treatment of Huoxue Shujin Jiegu Fang on functional recovery after ankle fracture surgery [In Chinese]. *Chinese J Tradit Med Sci Tech* 2022; 29: 460-461.
- 10) Liu XD, Cui LP, Li ZH, Hou LG. Effects of Yangxue Zhitong Pills on Recovery of Joint Function and Bone Metabolism after Ankle Fracture Operation [In Chinese]. *World Chinese Med* 2019; 14: 1237-1241.
- 11) Ye C, Fu KS, Lou HK. Effects of Huoxue Xiaozhong Decoction combined with rehabilitation therapy on limb swelling, pain and wrist function after distal radius fracture [In Chinese]. *New Chinese Med* 2020; 52: 98-101.
- 12) Ma T, Qu WJ, Chen DQ, Bi RX, Xie WP. Analysis of the medication pattern of "Puji Fang" for treating knee osteoarthritis based on data mining. *China Medical Herald* 2023; 20: 9-12.
- 13) Kronborg L, Bandholm T, Palm H, Kehlet H, Kristensen MT. Effectiveness of acute in-hospital physiotherapy with knee-extension strength training in reducing strength deficits in patients with a hip fracture: A randomised controlled trial. *PLoS One* 2017; 12: e0179867.
- 14) Tassignon B, Verschueren J, Delahunt E, Smith M, Vicenzino B, Verhagen B, Verhagen E, Meeusen R. Criteria-Based Return to Sport Decision-Making Following Lateral Ankle Sprain Injury: a Systematic Review and Narrative Synthesis. *Sports Med* 2019; 49: 601-619.
- 15) Biernat P, Musial W, Goslawska D, Pluta J. The impact of selected preparations of trace elements - magnesium, potassium, calcium, and zinc on the release of diclofenac sodium from enteric coated tablets and from sustained release capsules. *Adv Clin Exp Med* 2014; 23: 205-213.
- 16) Zhou YZ, Wang WG, Tian K, Huang H, Jia M. Efficacy and safety of Biqi capsule in the treatment of knee osteoarthritis: A protocol of a randomized controlled trial. *Medicine* 2021; 100: e25476.
- 17) Scheer RC, Newman JM, Zhou JJ, Oommen AJ, Naziri Q, Shah NV, Pascal SC, Penny GS, Mckean JM, Tasi J, Uribe JA. Ankle Fracture Epidemiology in the United States: Patient-Related Trends and Mechanisms of Injury. *J Foot Ankle Surg* 2020; 59: 479-483.
- 18) Yalin M, Aslantaş FC, Duramaz A, Bilgili MG, Baca E, Koluman A. The common comorbidities leading to poor clinical outcomes after the surgical treatment of ankle fracture-dislocations. *Ulus Travma Acil Cerrahi Derg* 2020; 26: 943-950.
- 19) Rammelt S, Manke S. Syndesmosis injuries at the ankle. *Der Unfallchirurg* 2018; 121: 693-703.
- 20) Zuo SG, Tuo SB, Xiang YY. Research progress of traditional Chinese medicine on perioperative swelling of ankle fractures [In Chinese]. *Inn Mongolia J Tradit Chinese Med* 2021; 40: 138-140.
- 21) Wang XF, Xiong T. Effects of staged modified and subtracted treatment of Jie Gu Du Duan Recipe on joint function after external fixation of ankle fractures [In Chinese]. *Chinese J Tradit Med Sci Tech* 2020; 27: 142-143.
- 22) Wang Q, Guo L, Bai P, Wang T, Guo Y, Li KF, Wen H, Huang WZ. Application of Yiqi Xugu Mixture and Chonglei Tongluo Recipe in postoperative rehabilitation of ankle fractures. *TCM Guzheng* 2021; 33: 17-22.
- 23) Xing MX, Zhang FL. Effects of Jiegu Suduan recipe on joint function after external fixation of ankle fractures [In Chinese]. *J Pract Chinese Med* 2021; 37: 1281-1282.
- 24) Yao W. Study on the effect of Erbi Capsules combined with Diclofenac Sodium Sustained Release Tablets in the treatment of 20 patients with scapulohumeral periarthritis. *J Contemp Med* 2018; 16: 144-145.
- 25) Singh K, Sharma R, Rai J. Diacerein as adjuvant to diclofenac sodium in osteoarthritis knee. *Int J Rheum Dis* 2012; 15: 69-77.
- 26) Bertocchi P, Antoniella E, Valvo L, Alimonti S, Memoli A. Diclofenac sodium multisource prolonged release tablets--a comparative study on the dissolution profiles. *J Pharm Biomed Anal* 2005; 37: 679-685.
- 27) Kołodziejczyk MK, Kołodziejska J, Zgoda MM. Technological and pharmacotherapeutic properties of selected drugs with modified release of diclofenac sodium]. *Polim Med* 2012; 42: 121-132.
- 28) Bükür N, Şavkın R, Ök N. Comparison of Supervised Exercise and Home Exercise After Ankle Fracture. *J Foot Ankle Surg* 2019; 58: 822-827.
- 29) Moseley AM, Beckenkamp PR, Haas M, Herbert RD, Lin CC. Rehabilitation After Immobilization for Ankle Fracture: The EXACT Randomized Clinical Trial. *JAMA* 2015; 314: 1376-1385.