

A Case of Bone Nonunion Treated with Iliac Bone and Allogeneic Bone Grafting Combined with Jiegudan

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Abstract: Fracture non-healing, also known as bone nonunion, is a common complication after fracture, but also one of the clinical problems in orthopedics. At present, there are various treatment methods for bone nonunion, and there is no perfect clinical solution. According to the specific situation of the patient, the individualized treatment plan is formulated. This paper uses the ILLAC crest and bone allograft combined with jiegudan to treat the bone nonunion, which provides a feasible idea for the setting of the clinical treatment plan.

Keywords: Bone Nonunion, jiegudan, autologous ILLAC bone, allogeneic bone graft, case report

1. Introduction

Fracture non-union, also known as bone nonunion, is a common complication after fracture. [1] The clear definition of bone non-union is still controversial. It is generally believed in China that fracture nonunion can be diagnosed for more than 6 months. The Food and Drug Administration (FDA) defined nonunion as nonunion following fracture treatment (surgical treatment or conservative treatment) for at least 9 months or 3 months. According to the AO principle of fracture management, when the clinical and imaging characteristics clearly show that the healing time of fracture is prolonged, then the nonunion is declared 6 to 8 months after the fracture unless it is accompanied by bone loss. Bone non-union is a difficult problem in orthopedic clinic, and it will also bring great mental and economic burden to patients. From February 2019 to January 2021, the author treated iliac crest and allograft with bone grafting for follow-up. The effect was satisfactory. The report is as follows.

2. Clinical data

The 56-year-old female patient was admitted to the hospital on 13 February 2019 in the outpatient clinic with the chief complaint of "motor pain of left lower limb for more than 27 months after internal fixation of left femoral shaft fracture". The patient had a fracture of the left femoral stem due to a fall 27 months ago, when he underwent incisional internal fixation surgery outside the hospital, with rehabilitation and functional exercise in the early postoperative period. At present, the main symptoms of the patient are pain in the left lower limb, aggravation of activity, local muscle atrophy, and increased tension.

Physical examination: Old surgical scars of approximately 5 cm, 6 cm and 14 cm in length could be seen in the left hip, distal thigh and anterior thigh, respectively, and X-ray showed (2019-02-12 outside hospital) that the fracture line of the left femoral stem was still obvious and gaps existed, and no significant local bone scab formation was seen. The fracture did not heal more than 6 months after surgery, which is consistent with the diagnosis of nonunion of the fracture [2].

Routine x-ray and electrocardiogram were performed to understand the current growth of the scab and the basic function of the heart. The patient was placed in the supine position after the effective intravertebral anesthesia, routinely disinfected and sterile towels were laid. An oblique incision was made along the lower edge of the iliac crest, about 6 cm long, and the skin, subcutaneous tissue and fascia were incised in turn, reaching the iliac bone. The periosteum was peeled off against the lateral surface of the iliac bone. The outer plate was selected for bone extraction. The bone was cut around the lateral surface of the iliac bone with a bone knife. Then a bone knife was inserted between the inner and outer plates and pried open. The bone was removed completely before a scraping spoon was

inserted into the inner and outer. The cancellous bone was scraped from the cancellous gap between the cortical bone plates. The bone wax was used to close the iliac bone marrow cavity to stop bleeding. The wound was flushed with metronidazole and saline, and one drainage strip was placed. The wound was sutured layer by layer, and the wound was dressed with a sterile dressing. The skin, subcutaneous tissue and fascia were incised sequentially along the original surgical incision on the anterior side of the left thigh, and the fracture of the upper middle femur was exposed by peeling, and the fracture line was clearly visible. The fracture line was clearly visible, and movement of the fracture line was seen in the active lower limb, and there was no significant bleeding. Scar tissue was thoroughly removed, and the sclerotic bone and bone scabs affecting the repositioning of the fracture were removed with a grinding drill. After rinsing with metronidazole and saline and counting the instruments and auxiliary materials, one drainage tube was placed, and the wound was closed layer by layer and dressed with sterile dressing. The operation went smoothly, with intraoperative bleeding of about 50 ml, no blood transfusion, and 1850 ml of fluids. The patient's vital signs were stable during and after the operation. The patient was advised to take 2.4g/time, 2 times/day of oral bone marrow rehab. On February 25, 2019, the X-ray was checked: the alignment of the left middle femur fracture was general and the bone scab formation was visible. After discharge, as shown in Figure 1, the patient was discharged from the hospital on regular oral doses of Jiegudan and was given external fixation of the left lower limb brace. The patient was followed up after the treatment, and the X-ray was repeated in January 2021, which showed that the fracture end had healed, as shown in Figure 2.

3. Discussion

Bone Nonunion is a kind of very difficult to cure orthopedic disease, cause bone factors have age, infection, fracture blood, fracture end separation, fracture end fixation, and many other factors, treatment mostly choose surgery, but because of its treatment is difficult, sometimes need to operate many times, in spending a lot of money and resources at the same time, if the treatment is not timely may cause fracture site dysfunction, severe cases can cause disability, to the patient's psychological and economic pressure. According to study [3]: The current nonunion treatments include non-surgical treatments such as small splint, plaster fixation, TCM therapy and physical therapy; surgical therapy and other therapies. Study [4] shows that surgery is currently an effective treatment for bone nonunion after fracture surgery. The effect of some method alone is not obvious, but the effect is more obvious.



Figure 1: Upper left: Patient, female, 56 years old, left femoral backbone fracture, preoperative X-ray fracture fracture line is still obvious and the gap exists, no obvious callus formation. Upper right: The X-ray in January 2021 shows that the fracture end has healed.

Bone graft is divided into autologous bone graft, allogeneic bone graft and artificial bone graft. Allograft bone transplantation refers to the bone of the allogeneic donor, pruning and splicing to the site of the bone defect of the recipient. The advantages of this material are sufficient source, no requirement for the size and shape of the material, good biological activity, and good effect on the repair of bone tissue. However, the higher failure rate is also the disadvantage of this method, mainly manifested as bone non-union, fatigue fracture, rejection reaction and bone resorption. Autologous bone transplantation refers to the own healthy bone tissue transplantation to the affected to fill the defect, strengthen fixation and promote healing of a kind of surgery, the case of cortical bone transplantation is one of the ways, it has high strength, bone graft supporting effect, no rejection reaction, disadvantages for the source is limited, crawling replace slow. The bone conductivity and

bone induction performance of autologous bone are superior, which contains growth factors, which can make fracture healing faster, and there is no obvious abnormal reaction. If autologous bone mass is limited, [5] should be combined. In this case, it is also a feasible treatment method to use iliac bone and bone allograft combined with proprietary Chinese medicine to treat bone nonunion.

Traditional Chinese medicine believes that the healing of fracture should undergo removing congestion, regeneration and integration. Modern medicine believes that the healing of fracture can be divided into hematoma mechanical stage, primitive callus stage and callus transformation period. The cognition of traditional Chinese and western medicine in the process of fracture healing is consistent. In the long practice accumulation of traditional Chinese medicine, it has accumulated a lot of medication and treatment experience for different periods of fracture, which has a unique effect on accelerating fracture healing and improving the quality of life. It can be seen that traditional Chinese medicine plays a positive role in fracture healing, which can be specifically reflected in improving local blood circulation, improving the activity of osteoblast cells, regulating bone growth factors, improving the quality of bone callus, improving the content of trace elements, and promoting the secretion of growth hormone.

Bone does not connect, fracture delay healing belongs to the doctor of traditional Chinese medicine "bone impotence" category, began in "element ask impotence theory", cloud: " kidney qi heat, waist ridge does not lift, bone withered and bone reduction, hair for bone impotence... kidney water dirty also, this water fire, bone withered and pulp deficiency, so foot not let body, hair for bone impotence. "Traditional Chinese medicine, the onset of bone impotence is mainly closely related to the kidney, spleen, liver," Su ask "records:" bone injury must move in the kidney, tendon injury must move in the liver, the kidney does not nourish the bone, the blood does not moisten, the tendon is loose and can not bundle bone ". The syndrome differentiation of this disease is characterized by "more deficiency and more blood stasis", and the treatment mainly nourishes the liver and kidney, promotes blood circulation and removes blood stasis as the treatment principle.

Jiegudan is produced by Shaanxi Provincial Hospital of Traditional Chinese Medicine, which Prescription comes from the veteran TCM doctor Zhu Xinggong [6]. The main ingredients are: hairy antler, pseudo-ginseng, radix dipsaci, radix achyranthis bidentatae, eucommia ulmoides, myrrh, frankincense, nux vomica, ephdra sinica stapf. The main therapeutic principles of the whole prescription are to continue tendons and bones, relieve arthralgia and pain, stop bleeding and build muscle, replenish liver and kidney, and strengthen muscles and bones. Hairy Antler, Eucommia ulmoides, Radix Dipsaci and Radix Achyranthis Bidentatae all have the function of tonifying liver and kidney and strengthening bones and muscles. The combination of four drugs can strengthen the kidney and tendons. Modern research.[7] Shows: hairy antler has the effect of regulating bone metabolism, promoting osteoblast proliferation, reducing the number of osteoclasts and alleviating bone loss. Zhao Jirong et al. [8] It is believed that Eucommia ulmoides's water, alcohol extract, or serum containing drugs can promote osteoblast proliferation, activate bone reconstruction, and improve bone metabolism. There is a study [9] It shows that Radix Dipsaci can accelerate the recovery of the fracture. There are also studies [10] find: Edysterone extract of Radix Achyranthis Bidentatae may play a protective role in chondrocyte damage, β -Ecdysterone may inhibit Osteoporosis and improve bone metabolism, Achyranthes bidentata polysaccharides can significantly increase the bone mineral density, bone minerals, and trabecular bone thickness of ovariectomized rats. With the production of frankincense, myrrh, nux vomica, pseudo-ginseng to activates blood circulation and dredges channels, reduces swelling and promotes muscle growth, has the effect of removing blood stasis and promoting new blood production. In order to follow the Ideological of "It is better to promoting circulation of blood rather than stop bleeding", and "no matter how, always to remove blood stasis first". According to the study[11]: The effective active ingredient of frankincense has anti-inflammatory, analgesic, antibacterial, antioxidant effect, etc. The effective active ingredient of myrrh can act on the nervous system, bone metabolism system, with antibacterial, anti-inflammatory, promoting blood circulation and analgesic, anti-tumor and other effects. A study[12] It shows that panax notoginseng saponins can inhibit antiplatelet aggregation, reduce blood lipid and inhibit the apoptosis of vascular endothelial cells. At the same time, Lu Yanhua[13] And others believe that nux vomica has the effect of regulating immunity, promoting nerve function recovery, anti-inflammatory analgesia, anti-osteogenesis, and promoting fracture healing and repairing cartilage damage.

As a pure Chinese medicine preparation, Jiegudan has a good effect on the healing and rehabilitation of fracture. This prescription is mainly continuous reinforcement, supplemented by hemostasis and stasis, and fixed yuan, which is set for the last two stages of fracture. The patients in the case show slow bone healing, middle-aged and elderly women, deficiency of liver and kidney, and

local tendons and blood damage and block the operation of qi and blood. Over time, blood stasis block and new blood does not occur, resulting in bone non-connection. The treatment method should promote blood circulation and remove blood stasis, and nourish liver and kidney, which is in line with the indications of bone Denmark.

Through TCM syndrome differentiation, Jiegudan is selected as the postoperative adjuvant treatment drug for patients, which can not only promote blood circulation, remove blood stasis and relieve pain, but also continue bone and stop bleeding. At the same time, with the early rehabilitation treatment after fracture, enhance the muscle strength of related muscle groups, and prevent the disuse atrophy and thrombosis. Finally, it not only shortens the time of fracture healing, reduces the occurrence of postoperative complications, but also makes the patients return to normal life faster, and the treatment effect is satisfactory.

At present, the perfect method of treating bone nonunion still needs to be further studied. The specific treatment plan should be customized according to the patient's own situation, and should not be confined to pure surgical therapy or conservative therapy. The authors believe that the treatment method of the iliac crest and bone allograft grafting was consistent with the objective situation of the patient, and the curative effect was satisfactory. Through two ways of bone transplantation, play their own material advantages, foster strengths and avoid weaknesses. At the same time, through the accurate TCM syndrome differentiation, select the traditional Chinese medicine suitable for the patients, to realize the syndrome differentiation and treatment. It not only gives full play to the advantages of bone grafting surgery for bone reconstruction, but also carries forward the advantages of traditional Chinese medicine to promote accelerated bone healing, reflecting the treatment concept of integrated Chinese and western medicine, and can be regarded as an effective method to treat bone nonunion.

References

- [1] Wu Hangtian, Zhao Xingqi, Hu Yanjun, Yu Bin. *Diagnosis and treatment recommendations for fracture nonunion [J]. Bioorthopaedic Materials and Clinical Research*, 2019, 16 (04): 33-36.
- [2] Xu Shaoting, Ge Baofeng, Xu Yinkan. *Practical Bone Science [M]. 4 Edition. Beijing: People's Military Medical Press, 2014:1153-1154.*
- [3] Liang Zhou, He Zhong. *Progress in the clinical treatment of bone nonunion [J]. Modern medicine and health care*, 2021, 37 (01): 75-78.
- [4] Mangold D, Bishop A T, Moran S L, et al. *Applications of the Vascularized Medial Femoral Condyle for Nonunion with Associated Bone Loss of the Foot: A Case Series[J]. Foot & Ankle Orthopaedics*, 2019, 4(4):2473011419S0029-.
- [5] Shen Wendong, Wang Kuai, Lu Jun, Tang Yueping. *Comparison of the efficacy of two different bone graft methods during pedicle nail fixation in posterior thoracolumbar burst fracture [J]. Journal of Nanjing Medical University (Natural Science edition)*, 2014, 34 (11): 1561-1563.
- [6] Zhang Junfeng, Zhu Xinggong. *Old traditional Chinese medicine injury department common prescriptions introduction [J]. Shaanxi Traditional Chinese Medicine*, 1980 (03): 38 + 48.
- [7] Zhong Lilun, Peng Yingjun, Lin Zhidong, Lu Yaoming, Guo Da, Niu Wei. *Effect of hairy antler on bone metabolism and related research progress [J]. Chinese Journal of Osteoporosis*, 2020, 26 (12): 1861-1863 + 1872.
- [8] Zhao Jirong, Yang Tao, Zhao Ning, Ma Tong, Xue Xu, Li Weinong, Zhang Licun. *Progress in signaling pathways related to osteoporosis after *Eucommia ulmoides* induced osteogenic differentiation of MSCs [J]. Chinese Journal of Osteoporosis*, 2020, 26 (12): 1868-1872.
- [9] Wang Xiangjie, Pan Yuexing, Du Zhixian, Zhou Ying, Liu Mei, Guo Yunliang. *Effect of Zhuangjinjian'gutang on Effect of bone morphogenetic protein-7 and neuropeptide Y expression in a fractured callus [J]. Chinese Journal of Traditional Chinese Medicine*, 2013, 28 (08): 2420-2422.
- [10] Ju Yang, Qu Ningning, Ren Yanling. *Research on radix *achyranthis bidentatae* for Preventing and Treating Osteoporosis Based on Network Pharmacology [J]. China Journal of Traditional Chinese Medicine*, 2020, 38 (03): 40-44 + 260-261.
- [11] Cao Xuhan, Bai Zixing, Sun Chengyi, Yang Yanjun, Sun Weidong. *"Frankincense-myrrh" for knee osteoarthritis [J]. China Organizational Engineering Research*, 2021, 25 (05): 746-753.
- [12] Lu Shuli, Feng Yan, Gao Jie, Jin Xianggong, Wang Yixin, Chen Keji. *Progress in the clinical application of *Panax notoginseng* in cardiovascular diseases [J]. General Practice in China*, 2021, 24 (05): 539-545.
- [13] Lu Yanhua, Gao Ningyang. *Progress of pharmacological effect and synergistic method of *nuxvomica* [J]. Shanghai Journal of Traditional Chinese Medicine*, 2019, 53 (05): 93-97.