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Effect of Internal Fixation Combined With Inferior Tibiofibular Ligament Repair on Healing Quality of Ankle Fracture With Inferior Tibiofibular Joint Injury

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Objective: To investigate the clinical effect of internal fixation combined with anterior ligament repair of lower tibiofibular syndesmosis in the treatment of ankle fracture with lower tibiofibular syndesmosis injury.

Methods: From November 2017 to December 2021, 94 patients with ankle fracture and lower tibiofibular syndesmosis injury were selected as the research objects. According to the random number table generated by statistical software, the patients with ankle fracture and lower tibiofibular syndesmosis injury were divided into a combined group and a control group with 47 cases in each group. The patients in the combined group were treated with internal fixation combined with anterior ligament repair of lower tibiofibular syndesmosis, whereas the patients in the control group were treated with internal fixation combined with lower tibiofibular syndesmosis fixation. The operation time, bleeding volume, hospitalization time, and fracture healing time of the 2 groups were compared.

Results: The operation time of the combined group was longer than that of the control group ($P < 0.05$). The amount of bleeding, hospitalization time, and fracture healing time of the 2 groups were compared and analyzed ($P > 0.05$). The parameters of the lower tibiofibular space and the parameters of the lower tibiofibular overlap were compared between the

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combined group and the control group before operation and 3 and 6 months after operation. The parameters of the lower tibiofibular space in the combined group were lower than those in the control group at 3 and 6 months after the operation, and the parameters of the lower tibiofibular overlap at 3 months after the operation were higher than those in the control group ($P < 0.05$).

Conclusion: Internal fixation was combined with anterior ligament repair of lower tibiofibular syndesmosis in the treatment of ankle fracture with lower tibiofibular syndesmosis injury. Although the operation time is prolonged, it has a considerable effect on improving the reduction effect, promoting the recovery of joint function and reducing surgical complications.

Key words: Internal fixation – Anterior ligament repair – Ankle fracture – Tibiofibular joint injury

The ankle joint is an important load-bearing structure of the human body. Its stability depends not only on the bone structure, but also on the integrity of the surrounding ligament soft tissue.[1,2] The tibiofibular syndesmosis is an essential soft tissue structure around the ankle joint that plays an important role in maintaining ankle function.[3,4] Ankle fracture with lower tibiofibular syndesmosis injury is a special type of ankle fracture, which is mostly caused by indirect violent torsion, accounting for about 10% of ankle fractures. Among them, lower tibiofibular syndesmosis injury is often missed, and this can cause ankle instability and increase the risk of chronic ankle pain and traumatic ankle arthritis.[5,6]

At present, there are many methods for clinical treatment of ankle fracture with lower tibiofibular syndesmosis injury, each with advantages and disadvantages. Lower tibiofibular screw fixation is a common treatment method, which has the advantages of simple operation and high fixation strength.[7,8] However, cortical bone screw fixation may affect the degree of micromotion of the joint, and it is also prone to problems such as broken nails when placed in the body for too long.[9,10] The repair of the anterior ligament of inferior tibiofibular syndesmosis can repair the injury of inferior tibiofibular syndesmosis, but it cannot resist strong external force in the early stage after operation.[11,12] Therefore, this study attempts to combine internal fixation with anterior ligament repair of lower tibiofibular syndesmosis to explore the clinical effect of internal fixation in the treatment of ankle fracture with lower tibiofibular syndesmosis injury.

Research Object and Method

Basic data of research object

From November 2017 to December 2021, 94 patients with ankle fracture and lower tibiofibular syndesmosis injury were selected as the research objects. According to the random number table generated by statistical software, the patients with ankle fracture and lower tibiofibular syndesmosis injury were divided into a combined group and a control group with 47 cases in each group. Comparing the basic data of the patients in the combined group and the control group, the results showed that the 2 groups had good balance and comparability ($P > 0.05$). Inclusion criteria were the following: (1) The patient had a clear history of trauma and unilateral ankle fracture with lower tibiofibular joint injury. (2) Patients were aged 19 to 75 years. (3) The patient was admitted to the hospital within 48 hours after injury and was diagnosed by X-ray, computed tomography, and other imaging examinations. (4) According to the Lauge-Hansen ankle fracture classification standard, the fracture classification was anterior external rotation type, IV-degree rotation. (5) All patients were treated by the same group of medical staff in our hospital. (6) We fully communicated with patients and their families before surgery and completed the agreement. (7) Research methods were reviewed by medical ethics and implemented after the release of relevant documents.

Exclusion criteria were (1) fractures caused by pathologic causes (malignant tumors, tuberculosis); (2) combined with immune system diseases; (3) patients with vascular and nerve injury; (4) mental illness or senile dementia, unable to complete the relevant communication; (5) history of drug abuse or drug dependence; and (6) previous neurologic or muscle diseases, leading to lower limb dysfunction.

Surgical approach

The patients in the combined group were treated with internal fixation combined with anterior tibiofibular ligament repair, epidural anesthesia, and lateral position surgery. The medial malleolus was taken as

the medial approach, and the fibula approach was selected according to the height of the fracture line. The lateral fibula approach was taken when the height was 6 cm. The posterolateral approach was taken for the posterior malleolus. A small incision was made in front of the anterior tibiofibular ligament. First, the fibula fracture was reduced and fixed with plate and screw. Next, reset the medial malleolus fracture, screw compression fixation and suture and repair the anterior tibiofibular ligament under direct vision. The ankle bone was fixed with screws after reduction. The stability of the lower tibiofibular joint was judged by the hook test followed by suture incision and pressure dressing.

The patients in the control group were treated with internal fixation combined with lower tibiofibular fixation. The anesthesia method and fracture end treatment were the same as above. The lower tibiofibular bone was fixed with screws and, from the posterolateral fibula to the anteromedial tibia, tilted 25° to 30° into 1 to 2 screws.

The ankle joints of both groups were fixed with plaster for 1 week after operation. After 6 to 8 weeks, partial weight-bearing exercise was started, and full weight-bearing exercise was carried out for 10 to 12 weeks.

Observation indicators and inspection methods

The operation time, bleeding volume, hospitalization time, fracture healing time, ankle joint Kofoed score, lower tibiofibular space parameters, lower tibiofibular overlap parameters, and incidence of surgical complications were compared between the 2 groups.

The ankle joint function recovery score of patients was evaluated by the ankle joint Kofoed scale,[13] mainly from the patient's pain perception (50 points), ankle joint function evaluation (30 points), ankle joint activity score (20 points), and other aspects. The higher the total score, the better the recovery of ankle joint function.

The parameters of lower tibiofibular space and lower tibiofibular overlap were measured by X-ray before operation and 3 and 6 months after operation.

Statistical processing

The data were processed by SPSS21.0. The measurement data of ankle pain, function, activity, and total score of ankle joint Kofoed scale collected in this study were described by the ($\bar{\chi} \pm s$) method. The comparison hypothesis test between the two groups of the above measurement data was performed by independent sample t test. The count data (gender composition ratio, combined disease) were described by the number of cases (percentage), and the statistical comparison hypothesis test method was the χ^2 test.

Table 1 Comparison of surgical and postoperative fracture healing indexes between the combined group and the control group

	Combined group	Control group	t	p
Operation time, min	114.3 ± 12.4	107.6 ± 13.0	2.557	0.012
Bleeding volume, mL	54.9 ± 13.8	51.7 ± 12.4	1.182	0.240
Hospitalization time, days	9.6 ± 2.2	9.1 ± 2.4	1.053	0.295
Fracture healing time, weeks	12.9 ± 1.4	13.2 ± 1.8	0.902	0.369

Results

Comparison of surgical and postoperative fracture healing indexes between the combined group and the control group

The operation time of the combined group was longer than that of the control group ($P < 0.05$). The amount of bleeding, hospitalization time, and fracture healing time of the 2 groups were statistically analyzed and compared ($P > 0.05$). See Table 1.

Comparison of lower tibiofibular space parameters and lower tibiofibular overlap parameters between the combined group and the control group before and after surgery

The parameters of lower tibiofibular space and lower tibiofibular overlap shadow were compared between the combined group and the control group before operation and 3 and 6 months after operation. The parameters of lower tibiofibular space in the combined group were lower than those in the control group at 3 and 6 months after operation, and the parameters of lower tibiofibular overlap shadow at 3 months after operation were higher than those in the control group ($P < 0.05$). See Table 2.

Comparison of ankle joint Kofoed scale scores between the combined group and the control group

The ankle joint pain, function, activity, and total score of the ankle joint Kofoed scale were compared between the combined group and the control group before operation and 3 and 6 months after operation. The scores of ankle joint pain, function, and activity in the combined group were higher than those in the control group 3 months after operation. The total score of the ankle joint Kofoed scale in the combined group was significantly higher than that in the control group 3 and 6 months after operation ($P < 0.05$).

Table 2 Comparison of lower tibiofibular space parameters and lower tibiofibular overlap parameters between the combined group and the control group before and after surgery

	Time	Combined group	Control group	*t*	*p*
Lower tibiofibular gap parameters	T1	7.59 ± 1.60	7.81 ± 1.74	0.638	0.525
	T2	4.16 ± 0.95	4.70 ± 1.02	2.656	0.009
	T3	4.20 ± 0.88	4.86 ± 0.94	3.514	0.001
Lower tibiofibular overlap shadow parameters	T1	3.89 ± 1.26	4.10 ± 1.15	0.844	0.401
	T2	8.27 ± 1.84	7.46 ± 1.53	2.321	0.023
	T3	8.40 ± 1.93	7.82 ± 1.80	1.507	0.135

Note: T1 = before operation, T2 = 3 months after operation, T3 = 6 months after operation.

Comparison of surgical complications between the combined group and the control group

The complications of the 2 groups were observed. There were 4 cases in the combined group and 12 cases in the control group. The complication rate of the 2 groups was compared. The combined group was lower than the control group and had an obvious difference ($P < 0.05$).

Discussion

This study found that the operation time of the combined group was longer than that of the control group. The amount of bleeding, hospitalization time, and fracture healing time were compared between the 2 groups. The parameters of lower tibiofibular space and lower tibiofibular overlap in the combined group were lower than those in the control group at 3 months after operation. This result suggests that, although the operation time of internal fixation combined with anterior tibiofibular ligament repair in the treatment of ankle fracture with tibiofibular syndesmosis injury is prolonged, it can achieve better reduction effect and reduce tibiofibular separation. This is because the repair of the anterior tibiofibular ligament after the reduction and fixation of the bony structure can resist the strength of the external rotation force, maintain the ankle space, and maintain the stability of the ankle joint in the external rotation position.[14]

This study also found that the total score of the ankle joint Kofoed scale in the combined group was considerably higher than that in the control group at 3 and 6 months after operation. The above results suggest that internal fixation combined with anterior ligament repair of lower tibiofibular syndesmosis in the treatment of ankle fracture with lower tibiofibular syndesmosis injury can promote the recovery of ankle function. Surgical internal fixation can restore the anatomic structure of the lateral malleolus after the treatment of the bone structure injury, correct the axial rotation, and maintain the physiologic function of ligament composition after ligament repair, which is conducive to the early rehabilitation exercise of patients after operation, and can promote the blood circulation of the fracture end and accelerate the fracture healing.[15]

This result suggests that internal fixation combined with anterior ligament repair of the lower tibiofibular syndesmosis in the treatment of ankle fracture with lower tibiofibular syndesmosis injury can reduce the risk of surgical complications, such as delayed fracture healing, incision infection, urinary system infection, and postoperative joint stiffness. This is because the anterior tibiofibular ligament repair can better maintain the stability of the ankle joint and increase local blood perfusion, which is conducive to fracture healing. Patients can get out of bed early after operation, which helps to improve the immune function of patients, enhance their own disease resistance, and reduce the risk of infectious complications. Early postoperative rehabilitation exercise is also beneficial to the recovery of joint function and preventing postoperative joint stiffness.[16]

In summary, although the operation time of internal fixation combined with anterior tibiofibular ligament repair for ankle fracture with tibiofibular syndesmosis injury is prolonged, it has an evident effect on improving the reduction effect, promoting joint function recovery and reducing surgical complications.

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