International Journal of Biology and Life Sciences
ISSN: 2957-9511 | Vol. 5, No. 2, 2024

Analysis of the Curative Effect of Metatarsal Sinus Incision and "L"-shaped Incision in the Treatment of Calcaneal Fractures

Lu Zhang

Department of Orthopeadics, Jianli People's Hospital, Jianli, Jingzhou, Hubei, 433300, China

Abstract: **Objective** To compare the clinical efficacy of sinus tarsi incision and traditional operation in the treatment of calcaneal fractures. **Methods** A total of 46 patients with calcaneal fracture admitted to Jianli People's Hospital from June 2020 to January 2022 were included, including 37 males and 9 females. 23 patients in the control group were treated with "L" incision, and 23 patients in the experimental group were treated with tarsal sinus incision. The length of hospitalization, operation time an, surgical incision length, grainage volume, complication of the two groups were recorded respectively. The results of Bohler Angle and Gissane Angle were measured before and after operation. **Results** The operation time of the test group is shorter than that of the control group. Compared with the operation time of the two groups, the difference is statistically significant ($P<0.01$). The postoperative drainage flow of the test group is less than that of the control group. The contrast difference between the two groups in the operation area is statistically significant ($P<0.01$), and the length of the surgical incision in the test group is shorter than that of the control group. The length of the surgical incision is statistically significant compared with the length of the two groups ($P<0.01$). The number of days of hospitalization in the test group is shorter than the number of days in the control group, but there is no statistical significance ($P>0.05$). The patient's pre-operative Bohler angle measurement result and the Gissane angle measurement knot. The difference has no statistical significance ($P>0.05$). Bohler Angle in both control group and experimental group was significantly higher after surgery than before surgery ($P < 0.01$), and Gissane Angle was significantly lower after surgery than before surgery ($P < 0.01$). However, there was no significant difference in Bohler Angle and Gissane Angle between the two groups before and after surgery ($P > 0.05$). The complication rate of control group was higher than that of experimental group, but there was no significant difference between the two groups ($\chi 2=0.357$, $P > 0.05$). **Conclusion** For Sanders II and III calcaneal fractures, the "L" incision is like the sinus tarsi incision. However, the incision of tarsal sinus has the advantages of small trauma, short operation time and good recovery of patients.

Keywords: Calcaneal Fracture; Tarsal Sinus Incision; "L"-shaped Incision; Sanders Classification.

1. Introduction

Calcaneal fractures are common lower extremity fractures, with the majority being intra-articular fractures [1]. The mechanism of injury is primarily from high falls, with young and middle-aged males being the most affected demographic. Lateral axis radiographs of the calcaneus often show an increased width of the calcaneus, with significant changes in the Bohler and Gissane angles [2]. CT scans play a vital role in the classification of calcaneal fractures according to Sanders [3], as well as in the treatment and prognosis of the fractures. If not treated promptly, related complications such as traumatic arthritis and calcaneal pain syndrome may arise [4], affecting the patient's early rehabilitation and functional recovery, thereby impacting the quality of life. Therefore, open reduction and internal fixation is commonly adopted clinically [5-7]. Among the various incision options, the "L" shaped incision is widely used. Although the "L" shaped incision allows for ample exposure of the fracture site, it involves extensive soft tissue dissection, leading to a higher rate of skin edge necrosis and incision infection post-operatively [8, 9]. In recent years, with technological innovations, minimally invasive techniques have become increasingly widespread in the treatment of calcaneal fractures. This article aims to discuss and compare the clinical efficacy of the "L" shaped incision and the sinus tarsi incision.

2. Materials and Methods

2.1. General Information

A total of 46 patients with calcaneal fractures treated at Jianli City People's Hospital from June 2020 to January 2022 were selected for this study. The control group consisted of 23 patients, including 4 females and 19 males, with 9 cases of left calcaneal fractures and 14 cases of right calcaneal fractures; the age range was 22 to 75 years, with an average age of (44.3±13) years. The experimental group also consisted of 23 patients, including 5 females and 18 males, with 8 cases of left calcaneal fractures and 15 cases of right calcaneal fractures; the age range was 24 to 77 years, with an average age of (44.1±15.5) years. There was no statistically significant difference in general patient information between the two groups ($P>0.05$), indicating comparability. This study was approved by the hospital's medical ethics committee.

2.2. Inclusion and Exclusion Criteria

Inclusion criteria: **1)** Patients diagnosed with Sanders type II or III calcaneal fractures [3] **2)** No systemic diseases **3)** Age over 18 years; Exclusion criteria: **1)** Open fractures **2)** Lower extremity neurovascular diseases **3)** Concomitant fractures **4)** History of psychiatric diseases.

2.3. Methods

2.3.1. Preoperative Preparation

Experimental group: After hospital admission, patients underwent routine preoperative examinations, lateral axis X-ray, and ankle joint three-dimensional CT scans. The affected limb was elevated, and local ice packs were applied for 24-48 hours until significant swelling reduction (wrinkles appearing on the lateral skin of the foot) before surgery. Control group: Preoperative preparation was the same as the experimental group.

2.3.2. Surgical Procedure

2.3.2.1 Experimental Group

The sinus tarsi incision was used: After successful anesthesia, the patient was placed in a lateral position, with a tourniquet applied to the upper limb. The area was disinfected, and towels were laid out. The surgical incision, about 6cm long, started 1cm below the tip of the lateral malleolus, running above the tendons of the long and short peroneal muscles, and diagonally towards the base of the fourth metatarsal. The skin was incised sharply down to the deep fascia, exposing and protecting the peroneal tendons. The long and short peroneal tendons were retracted posteriorly and downwards, the calcaneofibular ligament was sharply severed at the calcaneal stopping point, fully exposing the posterior facet of the subtalar joint. Hematoma from the fracture ends was cleared, joint depression was reduced, fracture ends were realigned, and the width, length, and height of the calcaneus were restored. Temporary fixation with Kirschner wires was applied, followed by placement of a plate. Fluoroscopy confirmed good fracture reduction and plate positioning before screws were inserted for fixation, a drain was placed, and the wound was sutured.

2.3.2.2 Control Group

The "L" shaped incision treatment was employed: After successful anesthesia, the procedure for the control group was similar to the experimental group, but with an "L" shaped incision comprising a vertical part between the peroneal tendons and Achilles tendon, and a horizontal part from the angle towards the base of the fourth metatarsal, directly reaching the lateral surface of the calcaneus. Soft tissues and periosteum attached to the lateral wall of the calcaneus were sharply dissected. Kirschner wires were inserted at the neck, body of the talus, and cuboid to bend and retract the skin, fully exposing the posterior facet of the subtalar joint. Joint depression and fracture ends were reduced, and the width, length, and height of the calcaneus were restored. Temporary fixation with Kirschner wires was followed by plate placement. Fluoroscopy confirmed good fracture reduction and plate positioning before screws were inserted for fixation, a drain was placed, and the wound was sutured.

2.3.3. Postoperative Management

Postoperatively, anti-infection treatment was administered, the affected limb was elevated for swelling reduction, the drainage tube was removed after 24 hours, and appropriate ankle and toe exercises were initiated. Gradual weight-bearing activities were introduced after 6 weeks.

2.4. Statistical Methods

Data analysis was performed using SPSS 25.0. Quantitative data were expressed as mean ± standard deviation (x±s), and comparisons between groups were made using independent samples t-tests. Count data were represented as rates, and group comparisons were made using the $\chi 2$ test. A P value of <0.05 was considered statistically significant.

2.5. Observation Indicators

Surgical duration, incision length, postoperative drainage volume, incision complications, and hospital stay were recorded for both groups. Bohler and Gissane angles were measured before and after surgery.

3. Results

3.1. Comparison of Surgical Indicators between the Two Groups

The operation time, incision length, postoperative drainage volume, hospital stay, and complication rates of the two groups were compared. The experimental group had a significantly shorter operation time than the control group, which was statistically significant ($P<0.01$). The postoperative drainage volume of the experimental group was less than that of the control group, which was statistically significant ($P<0.01$). The incision length in the experimental group was shorter than that in the control group, which was statistically significant ($P<0.01$). The control group had 2 cases of skin necrosis around the incision, including 1 case with exposed hardware, while the experimental group had no cases of flap necrosis, but the difference was not statistically significant ($P>0.05$).

Table 1. Comparison of surgical indicators between the two groups

Group	Operation Time (min)	Incision Length (cm)	Postoperative Drainage Volume (ml)	Hospital Stay (days)	Complications (cases)
Control Group	70.9±5.1	13.6±0.5	212.1±15.0	16.8±0.7	2
Experimental Group	62.1±5.4	5.5±0.6	111.9±14.5	16.3±0.9	1
t/χ^2	5.669	51.201	23.034	1.939	0.357
P-value	0.000	0.000	0.000	0.059	0.550

3.2. Comparison of Bohler and Gissane Angles before and after Surgery

Both the control group and the experimental group showed a significant increase in the Bohler angle after surgery ($P<0.01$), and a significant decrease in the Gissane angle after surgery ($P<0.01$). However, there was no statistically significant difference between the two groups in the

preoperative and postoperative Bohler and Gissane angles (P>0.05).

Table 2. Comparison of Bohler and Gissane angles before and after treatment between the two groups

Group	Control Group		Experimental Group	
	Bohler Angle	Gissane Angle	Bohler Angle	Gissane Angle
Preoperative	14.5±1.5	128.6±4.2	14.3±1.1	130.4±3.3
Postoperative	31.0±2.4	117.1±2.2	30.9±3.0	118.1±2.9
t-value	-27.966	11.663	-24.622	13.516
P-value	0.000	0.000	0.000	0.000

3.3. Typical Case

Figure 1. The preoperative imaging data

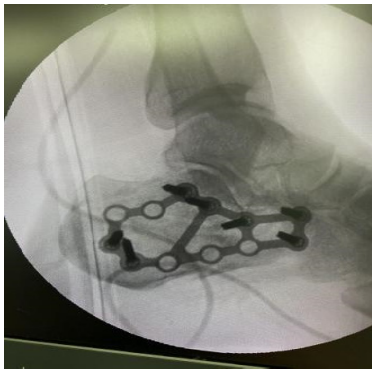

Figure 2. The intraoperative fluoroscopy after internal fixation

Figure 3. The sinus tarsi surgical incision

Note: The patient is a 42-year-old male with a left calcaneal fracture. Figure 1 shows the preoperative imaging data, Figure 2 shows the intraoperative fluoroscopy after internal fixation, and Figure 3 shows the sinus tarsi surgical incision.

4. Discussion

Currently, among the various surgical approaches for treating calcaneal fractures, the "L" shaped incision is predominantly chosen by clinicians because it clearly exposes the joint surface for direct reduction and plate fixation and was once the standard approach for treating calcaneal fractures [10]. However, with the widespread clinical application of this technique, the drawbacks of this traditional internal fixation method have been exposed: large trauma, high rates of skin flap necrosis, and infection [11-14]. As a result, scholars at home and abroad have made many explorations in minimally invasive treatment of calcaneal fractures, such as percutaneous minimally invasive screw fixation and the sinus tarsi incision technique. The sinus tarsi incision has numerous advantages: small incision, less trauma, protection of soft tissue blood supply, shorter operation time, and it can reduce the occurrence of skin necrosis in the operative area and lower the risk of infection and other complications [15].

In the control group, the operation required the release and dissection of the lateral skin flap of the calcaneus, and the placement of a plate to fix the fracture increased the tension of the sutured incision, leading to an increased risk of complications such as necrosis of the incision edges and infection, with severe cases resulting in exposed hardware. Studies have shown that for calcaneal Sanders II and III type fractures, the sinus tarsi incision is effective and can significantly reduce soft tissue complications [15-17]. This study shows that the experimental group had a lower rate of postoperative complications compared to the control group, but the difference was not statistically significant, which may be related to the small number of cases; subsequent studies will continue to increase the number of cases.

The key in treating calcaneal fractures is to restore the three dimensions of the calcaneus: width, length, and height [17, 18]. The sinus tarsi incision can clearly expose the posterior facet of the subtalar joint, the lateral wall, and the lateral fracture blocks, and with the use of related tools for traction and prying, it is possible to reduce the length, width, and height of the calcaneus. In this study, both groups showed significant changes in the Bohler and Gissane angles after surgery compared to before surgery, with statistical significance, but there was no significant difference between the two groups, which is consistent with the results of Lv Y et al. [19].

The results of this study also showed that the postoperative drainage volume in the experimental group was lower than that in the control group, and the operative time was shorter,

which is consistent with the results reported by domestic scholars [20]. Furthermore, studies have shown that the sinus tarsi incision can reduce the occurrence of injuries to the sural nerve and the peroneal tendons [21]. In summary, the sinus tarsi incision and the traditional surgical approach are essentially the same in efficacy, but the sinus tarsi incision has the advantages of less trauma, shorter operation time, is more acceptable to patients, and is more conducive to patient recovery.

References

[1] Yao H, Liang T, Xu Y, et al. Sinus tarsi approach versus extensile lateral approach for displaced intra-articular calcaneal fracture: a meta-analysis of the current evidence base [J]. Journal of Orthopaedic Surgery Research, 2017, 12(1): 43.

[2] Wang Xizhe, Han Xiaoping, Zhang Jie, et al. Research and new progress in the anatomy of minimally invasive surgery for calcaneal fractures [J]. Hebei Medical Journal, 2021, 27(1): 174-176.

[3] Allegra PR, Rivera S, Desai SS, et al. Intra-articular calcaneus fractures: current concepts review [J]. Foot & Ankle Orthopaedics, 2020, 5(3).

[4] Zhang Haowei, Lv Lin, Ni Ming. Research progress in the treatment of calcaneal fractures with intramedullary fixation [J]. Chinese Journal of Traumatology and Orthopaedics, 2021, 23(5): 458-460.

[5] Zeng Huibin, Lin Binglu. Clinical application of minimally invasive sinus tarsi approach for internal fixation in calcaneal fractures [J]. Minimally Invasive Medicine, 2015, 10(5): 670-671.

[6] Deng Changhua, Wu Xinbao. Clinical observation of minimally invasive plate internal fixation in the treatment of patients with calcaneal fractures [J]. Chongqing Medicine, 2013, 42(27): 3287-3289.

[7] Sun Wei, Huang Guowei, Wei Shan, et al. Treatment of tongue-type calcaneal fractures with hollow screws via sinus tarsi incision [J]. Chinese Journal of Bone and Joint Surgery, 2015, 8(1): 81-83.

[8] Liu Lianghong. Study on the application of lateral L-shaped incision internal fixation combined with wound cleansing agents in the treatment of calcaneal fractures [J]. Modern Medicine & Health, 2020, 14(21): 42-44.

[9] Zheng Zhihui, Cai Peibiao, Guan Keli, et al. Comparison of pry reduction minimally invasive plating and "L"-shaped incision internal fixation in the treatment of calcaneal fractures [J]. Chinese Journal of Tissue Engineering Research, 2020, 24(15): 2342-2348.

[10] Khazen G, Rassi CK. Sinus tarsi approach for calcaneal fractures: the new gold standard? [J]. Foot & Ankle Clinics, 2020, 25(4): 667-681.

[11] Pan Hongliang, Teng Dao, Sun Zhenxing, et al. Risk factors and preventive measures for postoperative complications after lateral extended "L"-shaped incision surgery in patients with calcaneal fractures [J/CD]. Electronic Journal of Foot and Ankle Surgery, 2022, 9(2): 11-15.

[12] Bai Jing, Nie Shanshan, Wang Xiaohan, Fu Lei. Analysis of factors related to poor incision healing after L-shaped approach for calcaneal fractures [J]. Chinese Journal of Traditional Medical Traumatology & Orthopedics, 2021, 29(05): 21-24+28.

[13] Zhao Deyuan, Qin Rujie, Lu Xiangjun, et al. Comparative study on the efficacy of sinus tarsi and lateral L-shaped incision approaches in the treatment of unilateral Sanders II, III type calcaneal fractures [J]. Journal of Trauma Surgery, 2021, 23(8): 599-602, 608.

[14] Lu Zhenglong, Kuang Wenzhong, Xie Zejie, et al. Comparison of incision healing and complications between sinus tarsi incision and lateral L-shaped incision plate internal fixation in the treatment of calcaneal fractures [J]. Chinese Journal of Bone and Joint Injury, 2020, 35(4): 430-432.

[15] Guan Yulong, Lv Chun'e, Zhao Xiaoliang, et al. Treatment efficacy of Sanders II, III type calcaneal fractures via sinus tarsi incision [J]. Chinese Journal of Orthopaedic Surgery, 2021, 29(10): 954-957.

[16] Chen Jian, Yan Zhizhong, Ma Mingming. The effect of the modified sinus tarsi incision on the treatment of Sander II~III type calcaneal fractures [J]. Journal of Clinical Military Medicine, 2020, 48(4): 433-434.

[17] Zhang Maolin. The impact of the modified sinus tarsi incision and traditional L-shaped incision internal fixation on the prognosis and functional recovery of patients with calcaneal fractures [J]. China Contemporary Medicine, 2023, 30(11): 84-87.

[18] Zhao Deyuan, Qin Rujie, Lu Xiangjun, et al. Comparison of the efficacy of sinus tarsi approach and lateral L-shaped incision approach in the treatment of unilateral Sanders II, III type calcaneal fractures [J]. Journal of Trauma Surgery, 2021, 23(8): 599-602, 608.

[19] Lv Y, Zhou YF, Li L, et al. Sinus tarsi approach versus the extended lateral approach for displaced intra-articular calcaneal fractures: a systematic review and meta-analysis [J]. Archives of Orthopaedic and Trauma Surgery, 2021, 141(10): 1659-1667.

[20] Peng C, Yuan B, Guo W, et al. Extensile lateral versus sinus tarsi approach for calcaneal fractures: a meta-analysis [J]. Medicine (Baltimore), 2021, 100(31): e26717.

[21] Yang Bo. Meta-analysis of the efficacy of the sinus tarsi incision versus the traditional lateral L-shaped incision in the treatment of Sanders II and III type calcaneal fractures [J]. Chinese Clinical Research, 2022, 35(12): 1699-1705.