A Modified Posterolateral Approach for the Treatment of Posterior Malleolar Fracture

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Abstract

Background: To observe the clinical effect of a modified posterolateral approach internal fixation in the treatment of posterior malleolar fracture.

Method: From January 2015 to October 2018, 30 cases involving lateral and posterior malleolar fracture patient data were treated in our department. we observed operation time, fracture healing time and postoperative complications. At the time of the last follow-up, we evaluated ankle joint function by the American Orthopedic Foot Ankle Society (AOFAS) ankle- hindfoot scale, the Short Form-36 (SF-36) outcome Tools and the American Academy of Orthopaedic Surgeons (AAOS) Foot and Ankle Questionnaire.

Result: In this group of 30 patients, the operation time of the patients was 80-120min (median 90min). The 25 patients were followed up for more than 1 year. 3 ~ 5 months after the operation, all the patients had bony healing. 3 cases with superficial wound infection. No other complication was found. The mean AOFAS scores at the postoperative 6-month, 12-month, and final follow-up were 78.4 (range, 72–90), 89.4 (range, 80–96), and 90.8 (range, 84–96), respectively. The mean SF-36 scores at the postoperative 12-month and final follow-up were 82.4 (range, 77.6–90.6) and 84.6 (range, 77.8–92.6), the mean AAOS scores at the postoperative 12-month and final follow-up were 87.8 (range, 79–95), 90.6 (range, 82–96).

Conclusion: Modified posterolateral approach avoided stripping the muscular origins of flexor hallucis longus, reduced the adhesion, and can fix the lateral and posterior malleolar fracture in the same incision, is worth popularizing in clinical.

Background

Ankle fracture is the most common fracture in orthopedic clinical work[1], and represent about one-tenth of all fractures[2]. Most foot and ankle orthopedist agree that posterior malleolus fragments worsen patient clinical outcomes[3-5]. In all ankle fractures, the incidence of posterior malleolus involvement ranges from 7 to 44%[2,6,7]. The surgical method and indication of posterior malleolus fracture are still controversial[7-9]. The size of posterior malleolus fracture ranges from shell-like fragments to fragments involving more than 40% of the distal tibia articular surface. Although most foot and ankle orthopedic surgeons agree that the fragments involving more than 25-30% of the surface of the distal tibial should be fixed[10-12], there are still many surgeons believe that the surgical indications of posterior malleolar fragment should be expanded[8,13-15]. When the posterior malleolar fragment size is small , it can be reduced and fixed by minimally invasive approach, such as percutaneous reduction and cannulated screw fixation[15]. When the posterior malleolus fracture is large enough, posterior buttress plate can provide more reliable fixation[7]. Many ways have been described for open reduction and internal fixation of posterior malleolus fracture [16-20], such as the posterolateral approach and posteromedial approach. The entry of the posterolateral (PL) approach was through the interval between the flexor hallucis longus muscles and the peroneal muscles. The attachment of the flexor hallucis longus muscle will be

stripped from the fibula sometimes. Then the flexor hallucis longus muscle adhesion and hallux flexion deformity will happen after operation. The posteromedial approach have been shown to expose the back of the ankle well[21], but the adjacent blood vessel and nerve may be injured by overstretching the soft tissues[19,22], and the fractures of the lateral malleolus require additional surgical incision. In recent years, our team applied a modified posterolateral approach to expose the posterior malleolar fracture which can reduce damage to adjacent tissues.

Methods

Exclusion and Inclusion Criteria

This study reviewed a case series of ankle fracture involving posterior malleolar fracture and lateral malleolar fracture from January 2015 to October 2018. The inclusion criteria were: (i) The age older than 18 years; (ii) patients with ankle fractures involve lateral malleolar and posterior malleolar; (iii) posterior malleolar fractures were fixed by the modified posterolateral approach; (iv) posterior malleolar fracture is type 1 according to the Haraguchi classification²³, the size should be more than 10% in percentage of the tibial plafond. The exclusion criteria were: (i) pathologic fractures and open fractures; (ii) tibial pilon fractures; (iii) Patients with lower limb infections, tumors, congenital malformations and other diseases affecting lower limb function.

Demographic Data of Patients

From January 2015 to October 2018, thirty patients meeting the above criteria, admitted to our hospital. All patients had unilateral ankle fracture, with 19 fractures on the left and 11 on the right ankle. The mean age of the patients was 46.0 ± 13.2 years (range, 19–68 years). In our series, the causes of injury were motor vehicle accident for 12 patients, ground-level fall for 16 patients, and falling from height for 2 patients. According to the Lauge-Hansen classification, 22 cases were supination external rotation (SER) stage III or IV fractures, 8 cases were pronation external rotation (PER) stage IV fractures. The size of the posterior malleolar fragment was $20.2\% \pm 9.5\%$.

Surgical Techniques

The injured ankle joint was fixed by a brace which can help reduce swelling and alleviate pain. If combined with ankle subluxation or dislocation, and reduction was difficult to maintain, calcaneal traction will be given. When the swelling goes down, and the “wrinkle” sign appears, open reduction and internal fixation will take place. After anesthesia, the patient was placed in a lateral prone position with the injured side facing up. Along with the posterior edge of the lateral malleolus and the middle point of the outer edge of the Achilles tendon, we make a longitudinal incision parallel to the outer edge of the Achilles tendon to the anterolateral arc of the lateral malleolus (figure1). Take care to protect the small saphenous vein and sural nerve. Exposing the underside of the Achilles tendon, the fascia on the surface of flexor hallucis longus will be found. Cut the fascia and pull the flexor hallucis longus to outside (figure2), posterior malleolus fracture will be found under the flexor hallucis longus. The fracture lines

can guide reduction of the posterior malleolar fragments, especially the medial fracture line and the top of the fracture line. After reduction, buttress plate was placed close to the joint line. Lateral malleolus fracture was fixed by lateral anatomical plate, and medial malleolus fracture was fixed by hollow screw.

Postoperative Protocol

In the first 2 weeks postoperatively, the injured ankle joint was fixed by a brace. Patients were advised to raise the limb and encouraged to activate the toes and the knee to help reduce swelling. The patients started ROM exercises after the brace was removed, and kept non-weight-bearing for 2 months. Patients began partial weight bearing at 2 months after operation, with full weight bearing by 3 months. Operative time, fracture healing time and postoperative complications were recorded, Postoperative X-rays were performed at the first week after surgery, 1-month, 3-month, 6-month, 12-month to Judge fracture healing. We evaluated the functions of all patients using American Orthopedic Foot and Ankle Society (AOFAS) scores at the 6-month, 12-month and final follow-up[24], using the Short Form-36 (SF-36) outcome

Tools and the American Academy of Orthopaedic Surgeons (AAOS) Foot and Ankle Questionnaire at the 12-month and final follow-up visits[25-26],

Results

In this group, the operation time of the patients was 80-120min (median 90min). A total of twenty-five of the thirty patients in our study were followed up for 12 to 18 months, with a median of 14 months. All cases healed 3 ~ 5 months after the operation. 3 cases with wounds superficial infection, and the wound healed through change dressing. There was no case of deep infection, hallux flexion deformity, and internal fixation displacement. The mean AOFAS scores at the postoperative 6-month, 12-month, and final follow-up were 78.4 (range, 72–90), 89.4 (range, 80–96), and 90.8 (range, 84–96), respectively. The mean SF-36 scores at the postoperative 12-month and final follow-up were 82.4 (range, 77.6–90.6) and 84.6 (range, 77.8–92.6), the mean AAOS scores at the postoperative 12-month and final follow-up were 87.8 (range, 79–95), 90.6 (range, 82–96) (figure 3).

Discussion

The indications for surgical treatment of posterior malleolar fracture remain a controversy[7-9]. Fragment size of the posterior malleolar fragment still affected treatment decisions[8,27,28]. As routinely, fragments of the posterior malleolus which are more than 25%–30% of the distal tibia articular surface will be treated surgically[10-12,28]. However, a lot of recent literature argue that surgical fixation of small fragments of the posterior malleolus may have a better effect on the clinical effects[8,13,15]. And also, posterior malleolus fixation relates to syndesmotic stability[14,28-30]. Then it may allow an opportunity to avoid standard syndesmotic fixation with screws, which bring about many complications[31].

Many surgical approaches both direct and indirect reduction have been reported[7,19]. Indirect percutaneous reduction and hollow screw fixation is minimally invasive surgery, but it does not allow adequate visualization of the fragment to reduce the displaced posterior malleolus fragment. Studies have shown that this technique does not achieve the same level of anatomic reduction of the posterior malleolus as direct reduction[7]. Some posterior approach have reported in the literatures, such as the posterolateral approach and posteromedial approach[16-17]. The posteromedial approach, which near the ankle tube, the neurovascular bundle may be injured by traction when operation. And it provides excellent visualization of the medial two-thirds of the posterior malleolus, but cannot provide visualization and exposure of the lateral one-third, syndesmosis, and fibula, which are always involved in trimalleolar fracture[19]. The posterolateral approach which hinges on the peroneal tendons laterally and the flexor hallucis longus muscle medially, can permit safe exposure of approximately onehalf of the posterior malleolus, but the achilles tendon and the flexor hallucis longus muscle belly make it difficult to get more medial[19]. And if you want to expose more widely and proximally, the attachment of the flexor hallucis longus muscle will be stripped from the fibula, then the flexor hallucis longus muscle adhesion and hallux flexion deformity may happen after operation (figure 3). A modified posteromedial approach had been reported in the literature [16], which hinges on the tibialis posterior and flexor digitorum longus and neurovascular bundle medially, and the flexor hallucis longus muscle and tendon laterally. It can provide a good exposure of the the distal posterior malleolus[19], but it does not expose the fibula fracture .

Our approach is a hybrid-type of the posterolateral approach and the modified posteromedial approach. It combines the advantages of the two approaches. The skin incision is same to the posterolateral approach which is along with the middle point of the outer edge of the Achilles tendon and the posterior edge of the lateral malleolus. The inside tissue space learns from the modified posteromedial approach, which expose the posterior malleolar fracture between the flexor hallucis longus and neurovascular-bundle. Firstly, it is able to reduce and fix both the posterior and lateral malleolus fractures by one skin incision; secondly, it will help to reduce the damage to the flexor hallucis longus when exposing posterior malleolar fracture, then the flexor hallucis longus muscle adhesion and hallux flexion deformity will be avoided; thirdly, It permits exposure of the Similar range of the distal posterior malleolus to the modified posteromedial approach. Especially, it can well expose the inner margin of the fracture block of posterior malleolus, which play an important role in reducing posterior malleolus fracture anatomically.

Conclusions

In our case series, we reduced and fixed both the posterior and lateral malleolus fractures by the modified posterolateral approach successfully, and the complications were rare. We believe that the modified posterolateral approach is a surgical approach worth popularizing.

This study is our first report of this modified posterolateral approach. Our aim was to provide a new modified posterolateral approach that can help the surgeon expose the lateral and posterior malleolus well. At the same time, the injury to hallux long flexor muscle is reduced. It has some limitations, such as

a small sample size, retrospective study design, no control group. We need future prospective cohort studies and randomized controlled clinical trials with a big sample size.

Abbreviations

AOFAS: American Orthopedic Foot and Ankle Society scores; SF-36: Short Form-36; AAOS: American Academy of Orthopaedic Surgeons

Declarations

Ethics approval and consent to participate

The protocol for this retrospective study was reviewed and approved by Research Ethics Committee of the Second Affiliated Hospital of Wenzhou Medical University, the reference number LCKY2019-254, and the requirement for informed consent was waived due to the retrospective nature of the study.

Consent for publication

Not applicable

Availability of data and materials

The datasets analysed during the current study are available from the corresponding author on reasonable request

Competing interests

The authors declare they have no competing interests.

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Authors' contributions

WLF: analysis of the data, and writing of the manuscript; JZHK: research design, Surgeon; MCC: research design, Surgeon. All authors were fully involved in the study and approved the final version of this manuscript.

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Figures

Figure 1

the incision of the modified posterolateral approach

Figure 2

pull the flexor hallucis longus to outside we can see the area in where we place the plate and screw.

Figure 3

These pictures show that: this patient underwent surgery for trimalleolar fracture by the traditional posterolateral approach one year ago. When plantar stretch, we can't see the hallux flexion deformity, but when dorsiflex the ankle, it shows the hallux flexion deformity.