

Radiologic and Functional Outcome of Calcaneus Fracture: Open Reduction with Plate Fixation versus Closed Reduction and Percutaneous Screw Fixation

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ABSTRACT

Introduction: Calcaneus fractures are the most common tarsal fractures (60%), with more than 70% being intra-articular. The gold standard treatment for those intra-articular fractures is a lateral open reduction and internal fixation (ORIF) with plate and screws. However, minimally invasive techniques are emerging, to decrease the skin problems related to ORIF. This study aims to compare the traditional technique with the closed reduction and percutaneous fixation (CRPF) using Calcanail®. **Materials and Methods:** A total of 30 calcaneus fractures (27 patients) were submitted to surgery between 2015 and 2018. We performed ORIF in 16 calcanea and CRPF in 14 calcanea. We evaluated reduction through Bohler and Gissane angles and functional outcome through the American Orthopaedic Foot and Ankle Society hindfoot score and visual analog score for pain. **Results and Discussion:** The average age was 52 years old and a mean follow-up time of 45 months (minimum of 5 months). Time until definitive treatment was higher in ORIF (mean of 15.7, 69 days) than in CRPF (mean 9.5, 5 days), and the time from surgery to discharge from hospital was higher in ORIF (3.1, 1 days) compared to CRPF (1.1, 1 days). There was a statistically difference in the quality of reduction from ORIF to CRPF ($P < 0.05$). However, there was no statistically difference in the functional outcome between the two groups ($P > 0.05$). **Conclusion:** Although the quality of reduction is better in the plating group, there was no difference in the functional outcome in the two groups. More time of follow-up is needed to evaluate the long-term functional outcome.

Key words: Calcanail, calcaneus fractures, minimally invasive, percutaneous fixation

INTRODUCTION

Calcaneus fractures are the most common tarsal fracture (>60%) with a global incidence of 2%, and more than 70% are intra-articular fractures.^[1,2] These fractures were once treated with a cast; however, nowadays, the gold standard for these intra-articular fractures is open reduction and internal fixation (ORIF) with plate and screws [Figure 1], using the lateral approach [Figure 2].

However, there are some complications associated LIKE skin necrosis and infection,^[3] which made surgeons seek minimally-invasive approaches.^[4]

Possible advantages of the less invasive approaches are the lower rate of complications, shorter hospital stay, and shorter time between initial admission and surgery. Possible disadvantages are less quality of reduction and worst functional outcome. This study aims to compare ORIF and the closed reduction and percutaneous screw fixation (CRPF), since in the literature there are not almost data comparing these two techniques to treat calcaneus fractures.

MATERIALS AND METHODS

We retrospectively reviewed 30 calcanea (27 patients) between 2015 and 2018. The ORIF group had 16 calcanea and the

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CRPF had 14 calcanea. The assessment of the reduction was performed through radiologic evaluation (Bohler and Gissane angles), and the functional outcome was evaluated through the American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score and visual analog score (VAS) for pain. All the ORIF group was operated by the same surgeon, as well as the CRPF group. The surgical technique for ORIF was similar to the ones described in the literature.^[5] The surgical technique for CRPF was the same described in the groupfortho.com. We used the Calcanail® to fixate the fracture. The fracture was reduced by the distraction of two K-wires one in the talus and the other on the posterosuperior calcaneus tuberosity [Figure 3]. Before the introduction of the nail, we use a curved tamp to free up the fragments and push them toward the talus into the empty space created by the distractor [Figure 4]. Statistical analysis was performed with the SPSS statistical software using Mann–Whitney U-test.

RESULTS

The mean age of our group was 52 years old (ORIF – 47 years old and CRPF – 55 years old). About 81% of the patients were male (ORIF – 87.5%; and CRPF – 78.5%). The follow-up time was 45 months (minimum of 5 months). The mean time to definite treatment was 15,69 days in the ORIF group and 9,5 day in the

CRPF group. The mean time of hospital stay after surgery was 3,1 days in the ORIF group and 1,1 days in the CRPF group. The Sanders classification distribution in the ORIF group was 43.7% Type II, 18.7% Type III, and 37.5% Type IV. The Sanders classification distribution in the CRPF group was 50% Type II, 35.7% Type III, and 14.3% Type IV. The mean Bohler and Gissane angles in the pre-operative were 4, 8° and 116, 0°, respectively. The mean Bohler and Gissane angles in the post-operative were 18, 3° and 120, 6°, respectively. In the ORIF group, the Bohler angle changed from 5,9° pre-operative to 25,6° post-operative and the Gissane angle changed from 110,2° pre-operative to 118,9° post-operative. In the CRPF group, the Bohler angle changed from 3,7° pre-operative to 10,2° post-operative and the Gissane angle changed from 122,7° pre-operative to 122,5° post-operative. The VAS score was 2, 09 in the ORIF group and 2, 22 in the CRPF group. The AOFAS score was 87, 5 in the ORIF group and 79, 1 in the CRPF group. There were two complications in the ORIF group: one wound dehiscence and one intra-articular screw. There were no complications in the CRPF group.

DISCUSSION AND CONCLUSION

The lateral approach with ORIF with plate and screws is the gold standard to treat intra-articular calcaneus fractures. It is possible to visualize the fracture pattern and facilitates a more anatomic

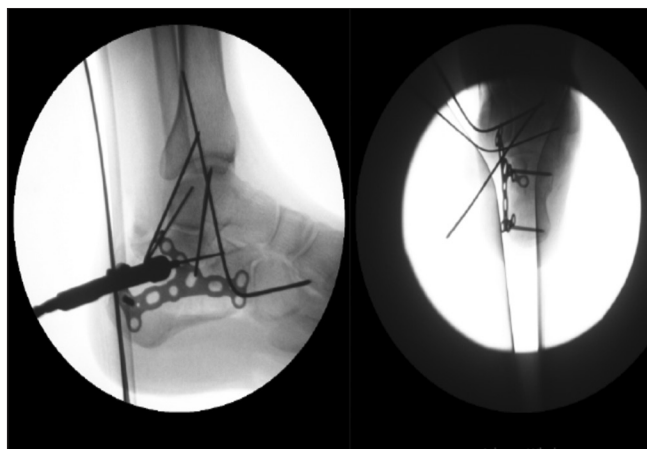


Figure 1: Open reduction and plate fixation (intraoperative)



Figure 2: Lateral approach

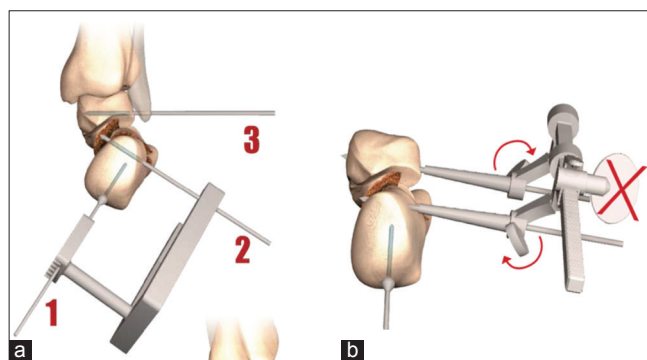


Figure 3: (a and b) Distraction technique for fracture reduction

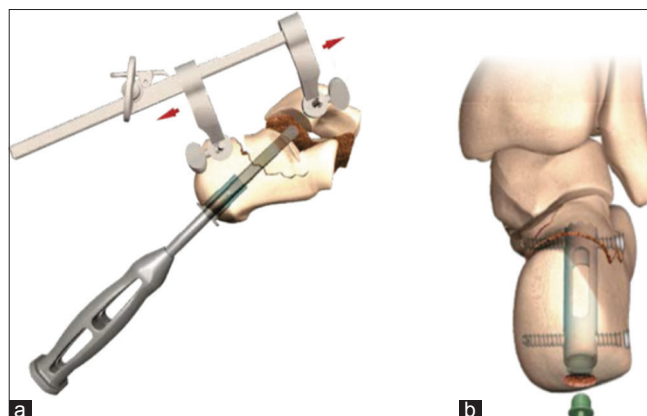


Figure 4: (a and b) Calcanail® surgical technique

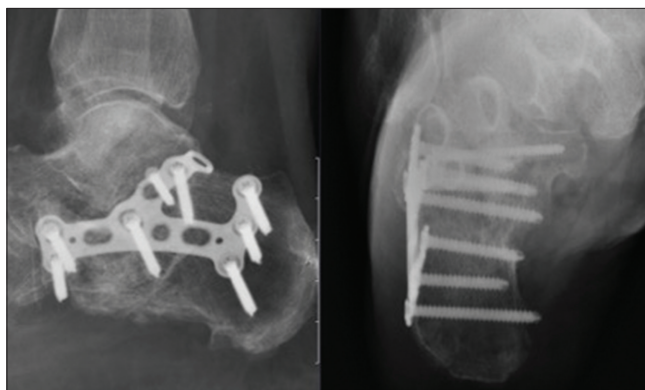


Figure 5: Post-operative open reduction and internal fixation

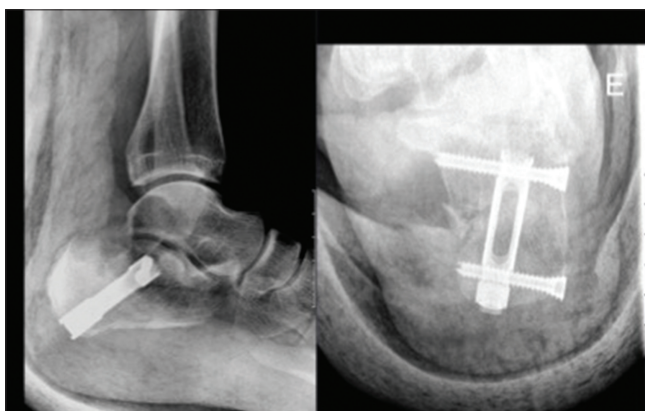


Figure 6: Post-operative closed reduction and percutaneous fixation

reduction.^[6] However, there are articles in the literature that reports complications such as skin necrosis and infection as high as 20–37%.^[7] There is a global trend in orthopedic surgery in minimally invasive surgery because it reduces soft-tissue damage and the time for surgery because it does not depend on soft-tissue healing. On the disadvantages, the surgeon does not visualize directly the fracture, which makes anatomic reduction much more difficult and much more dependent on the substantial use of fluoroscopy. In the literature, there is a lack of studies comparing the outcomes of these two methods of reduction and fixation calcaneus fractures. The choice of surgical technique was only surgeon preference and was not based on patient characteristics or fracture pattern [Figures 3 and 4]. One surgeon only performs ORIF and the other surgeon only performs CRPF. All the fractures were operated by these two surgeons. We reviewed 30 calcanea to determine which technique has better outcomes. In the ORIF group, there was a variation of 19, 5° on Bohler angle between the pre-operative and post-operative in comparison to just 6,4° on the CRPF group. This difference was statistically significant ($P < 0.05$). However, there was no statistic difference in the Gissane angle between the two groups [Figures 5 and 6].

However, we found no difference regarding the clinical outcome. Although the results (AOFAS score and VAS score) were better

with ORIF, the results were not statistically relevant. Although we believe that there is a correlation between reduction and functional outcome, we have conflictual results, in the sense, that there was a statistically difference in the reduction, there was no statistically difference in the clinical outcomes. In our CRPF group, there was a lower complication rate, shorter length of stay, and shorter time to surgery. In the ORIF group, there were two complications: One patient had skin necrosis and was submitted to several plastic surgeries to cover the wound; other patients had one intra-articular screw, which was revised. There are some limitations to this study. The number of cases is limited, and second, the time of follow-up is short. Longer follow-up time would allow us to evaluate if the clinical outcomes were similar or if there was a statistically difference between the two groups. It also was not assessed other anatomic parameters such as varus/valgus, length, width, and height, which would give us more details about the reduction.

This study compared the open reduction with closed reduction of intra-articular fractures of the calcaneus and found a difference in the reduction (just evaluated by Bohler angle). However, the functional outcome is very similar between the two groups. The recommendation we can make by this study is that the surgeon must make and individualize choice in the technique to use, based on personal experience with the technique.

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