

The Place of the Modified Palmer Technique for Articular Calcaneal Fractures

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Abstract

Surgical treatment of displaced articular fractures of the calcaneus is currently recommended by most authors. Different surgical procedures are described in literature. The purpose of this study is to evaluate the functional and anatomic results of articular fractures of the calcaneus surgically treated with the modified Palmer method and precise the place, the conditions, and the advantages of this technique for articular fractures of the calcaneus. This is a retrospective study assessing the outcomes of surgical treatment of articular calcaneal fractures surgically treated using the modified Palmer technique. Twenty-two patients underwent this surgery for 6 years. All patients have diabetes and/or smoking history, and physical examination revealed a severe swelling within the hindfoot. Sanders classification Type II was found in 6 cases, whereas 18 cases fell below Type III. The mean preoperative Bohler angle was about -2.7° . An extended lateral approach was performed, and the void caused by elevating the intra-articular surface was filled by an iliac crest graft firmly impacted in all cases. Additional limited fixation was performed in 71% of patients. On follow-up, the functional and anatomic results were analyzed, respectively, by Kitaoka and Babin's quotations, and the radiological assessment was based on Bohler angle. No cutaneous or infectious complications were observed after surgery. The mean postoperative Bohler angle was 21.9° , and it was 19.8° at the last follow-up with a significant difference. At follow-up, the mean functional Kitaoka score was 75; it was considered as excellent in four cases, good in ten, fair in eight, and poor in two patients. The modified Palmer technique is a simple surgical procedure to treat intra-articular calcaneal fractures. It provides encouraging results. This method is recommended in the case of Sander's II and III calcaneal fracture for patients with a high risk of cutaneous complications to avoid infection and cutaneous complications.

Keywords: Bone autograft, calcaneus, fixation, intra-articular fracture, Palmer technique

INTRODUCTION

Surgical treatment of displaced articular fractures of the calcaneus is currently recommended by most authors.^[1-4] Different surgical procedures are described ranging from simple recovery graft according to Palmer method to synthesis by plate via simple screwing.^[5,6] The original Palmer technique, by a lateral approach, elevates the intra-articular surface and the void caused is filled by a crest autograft firmly impacted without fixation. The modified Palmer technique performs an extended lateral approach, of elevating the articular surface, and then the reduction is maintained by an autograft and

supplementary fixation can be performed. This study aims to report the functional and anatomic results of intra-articular fractures of the calcaneus using the modified Palmer method and expose the place, the conditions, and the advantages of

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this technique for articular fractures of the calcaneus. The functional results were assessed with Kitaoka score which takes into account the following three parameters: pain, function, and alignment of the hindfoot.

MATERIALS AND METHODS

From 2010 to 2016, 22 patients with articular calcaneus were operated with the modified Palmer technique at our institute.^[5] This study included a total of 24 fractures (two bilateral fractures) with 14 men and 8 women. The mean age of the patients was 36 years (range, 16–61 years). All patients have one or more of the following factors: smoking (15 patients), diabetes (12 patients), and age >60 (5 patients). Before surgery, physical examination revealed, for all patients, a significant swelling and hematoma formation within the hindfoot, and the skin creases had disappeared. Preoperatively, the fracture was analyzed on radiological assessment including frontal and lateral views of the ankle and a retrotibial view. A computed tomography scan was performed in all cases. Injuries were classified according to the Sander's classification system.^[7]

The average time period from injury to surgery was 10 days (range, 6–15 days). All patients were treated surgically by a method derived from the Palmer technique.^[5] The original Palmer technique, by a lateral approach, elevates the intra-articular surface and the void caused is filled by a crest autograft firmly impacted. The approach was different to the original technique, and it is an extended lateral approach with a L-shaped incision following the shape of the foot [Figure 1]. This approach is then developed as a full-thickness flap, by elevating the peroneal tendons, sural nerve, and the calcaneofibular ligament. After elevating the articular surface, the reduction is maintained by an iliac crest graft firmly impacted [Figures 2 and 3] and supplementary fixation can be performed. Supplementary fixation was done in 19 (71%) cases using staples (8 cases), Kirchner wire (6 cases), and screws (5 cases). The immediate postoperative reduction was assessed radiographically using the Bohler angle. The data of each patient include postoperative local complications (infection, wound, and cutaneous necrosis), delay for weight bearing, pain, function, and alignment of the hindfoot.

At final follow-up, all the patients were evaluated clinically and radiographically. The final follow-up was at a mean of 36 months (range, 12–47 months) after surgery. The functional results were assessed with Kitaoka score^[8] which takes into account the following three parameters: pain, function, and alignment of the hindfoot. The results are considered excellent when the total score is between 95 and 100, good when it is between 80 and 94, fair when it is between 50 and 79, and poor when it is below 50 points. The anatomic results were evaluated on the frontal and lateral views of the ankle. The main parameter measured was the Bohler angle, allowing the quality of the reduction to be classified according to the Babin quotation.^[9] Anatomic result is considered very good when the Bohler angle is >25°, good when it is between 20° and 15°, fair when it is between 10° and 20°, and poor when it is <10°.



Figure 1: An extend lateral approach for calcaneal fracture



Figure 2: An iliac crest graft harvested to be firmly impacted after calcaneal fracture



Figure 3: The graft firmly impacted after reduction with good stability allowing no fixation

Statistical analysis was performed using IBM SPSS Statistics 20.0. Comparisons of preoperative and postoperative data were done using a two-tailed Student's *t*-test (level of significance, $P \leq 0.05$).

RESULTS

This study included 24 patients. All patients presented with a significant swelling and hematoma formation within the hindfoot with disappeared skin creases before the surgery. On the other hand, all the patients presented one or more of the following factors: smoking, diabetes, and age >60.

According to the Sanders classification, the fractures were Type II in 6 cases and Type III in 18 cases. The preoperative mean Bohler angle was -2.8° (range, $-2-32^\circ$). This technique was implemented by three surgeons at our institute. Postoperative soft-tissue complications were absent in our study. The mean delay for weight bearing was 87 days (mean, 80–100) after surgery. According to the Kitaoka score, the average score was 75 with extremes of 44 and 97. The mean postoperative Bohler angle was 21.9° , and it was 19.8° at the last follow-up. This surgery resulted in significant improvement in the mean values of Bohler's angle ($P < 0.005$). The loss of correction of initial elevation, corresponding to the difference between these two averages, was 2.1° (range, $0^\circ-7^\circ$), which was not statistically significant ($P = 0.12$). The functional results were excellent in four cases (16.66%), good in ten cases (41.66%), fair in eight cases (33.33%), and poor in two cases (8.33%). Subtalar osteoarthritis was identified in two cases at the follow-up; one of them was poorly tolerated requiring arthrodesis.

Based on the anatomical results according to the Babin classification, the reduction was excellent in six cases (25%), good [Figures 4-6] in ten cases (43%), fair in four cases (16%), and poor in four cases (16%).

DISCUSSION

The management of intra-articular calcaneal fractures remains challenging and controversial despite advances in diagnostic imaging and internal fixation.^[10] Comparative studies of functional treatment versus surgical treatment showed the superiority of surgery over functional outcome, guaranteeing a perfect reduction.^[2-4] The wide variety of surgical techniques and classifications, evaluation scores, and study criteria in the series makes comparative analysis difficult. The most significant finding of the present study is that the modified Palmer technique is a reliable technique to treat intra-articular calcaneal fractures with lower incidence of wound and infectious complications. This technique is recommended in the case of patients with severe swelling, patients with diabetes, elderly patients, and smoking patients in less delay of 6 days after trauma for calcaneal fracture Types II and III according to the Sander's classification.

The technique of elevating thalamic fragment associated with an impacted autograft was described for the first time by Lenormant and Wilmoth in 1932.^[11] Palmer^[5] in 1948 was the first to publish the results of a series of 23 cases, and Maxfield and Mcdermott^[12] in 1955 confirmed the encouraging results of this technique by a lateral approach. This method

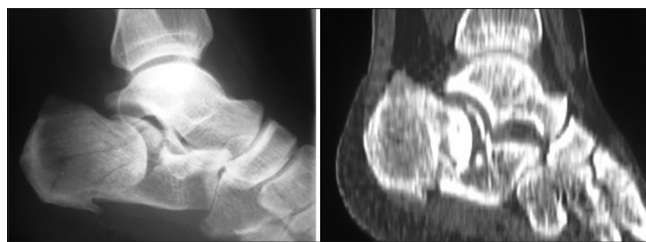


Figure 4: Preoperative X-ray (left) and computed tomography scan (right): displaced articular fracture of calcaneus



Figure 5: At final follow-up X-ray: restitution of the Bohler angle, measured at 20°



Figure 6: At final follow-up: Absence of lateral overflow and no frontal deviation of the hindfoot

was subsequently abandoned by surgeons because of the contrast between a good anatomical result and poor functional outcome. Many surgeons suggest several possible reasons for the failures of this procedure.^[13,14] First, the fracture may be so badly comminuted that it is technically impossible to obtain a satisfactory reduction by the original Palmer technique. At our institute, we respect the Duparc and Cavagna recommendations^[13] which recommend this technique mainly for Type II and III fractures. Second, the plantar surface of the

Table 1: Results of different surgical techniques for articular calcaneal fracture

| Authors years | Surgical techniques | Graft | Follow-up (months) | Functional results (excellent and good) (%) | Loss of correction | Immediate complications (%) |
|------------------------------------------------|--------------------------|-------|--------------------|---------------------------------------------|--------------------|-----------------------------|
| Laughlin <i>et al.</i> , 1996 ^[21] | Plate fixation | No | 33 | 78 | 1° | 6.7 |
| Besse <i>et al.</i> , 2000 ^[22] | Plate fixation and screw | No | 31 | 88 | 5.2° | 3.8 |
| Khorbi <i>et al.</i> , 2006 ^[26] | Screwing | No | 35 | 72 | 3° | 6.4 |
| Di Schino <i>et al.</i> , 2008 ^[14] | Screw and wires | Yes | 18 | 64,7 | 0.67° | 0 |
| Bellaaj <i>et al.</i> , 2018 | Staples, wire, and screw | Yes | 36 | 58 | 2.1° | 0 |

calcaneus may be so fragmented that it will not support the bone graft which, in turn, is to support the articular surface. Then, fixation is necessary for the stability of the graft. Di Schino *et al.*^[14] used two Kirschner wires to rebuild the plantar surface before snapping the graft. In our study, when the plantar surface presented discontinuity, we attached the graft to the calcaneal tuberosity and apophyse by fixation. By applying these recommendations, we believe that this surgical technique offers better results. Di Schino *et al.*^[14] routinely used a bone graft, fixed by wires and screws, to control the elevation in the intra-articular surface. They obtained 76% excellent and good results, and stability of the montage was satisfactory as the loss of correction at follow-up was only 0.67°.

The time of surgery was also a subject of controversy. Some authors prefer to operate these fractures in the first 24 h before the swelling and the cutaneous complications.^[15,16] Al-Mudhaffar *et al.*^[17] showed that surgery before the 7th day posttraumatic is accompanied by a very high rate of cutaneous complications. At our institution, surgery was performed after the subsidence of local swelling and appearance of skin wrinkles, and not before 6 days after the trauma.

The anatomic correction is highly recommended for articular calcaneus fracture, and is independent of surgical technique because it optimizes the occurrence of malunion and allows the realization of potential secondary arthrodesis in the case of subtalar osteoarthritis.^[18-20] To maintain this reduction, most authors favor fixation of the reduction, especially with a plate.^[21-23] They have more than 85% excellent and good results.^[14] Unfortunately, the fixation with plate increases the risk of infection and cutaneous complications whose rates can reach 28% in the series of plate fixation.^[15,17,24,25] Screw fixation proved to have good results in literature with less complications than plate fixation.^[26,27] To avoid these complications, we propose the modified Palmer technique. Indeed, this technique exposes a minor risk of skin necrosis.^[11,28] This technique has a lower rate of infectious and cutaneous complications [Table 1]. This technique is used when there is a suspicion of high risk of postoperative infection and cutaneous complications, especially in the case of severe swelling in the hindfoot, patients with diabetes, elderly patients, and smoking patients. For fixation, it's not necessary when the graft was firmly impacted offering a good stability frequently obtained when the plantar cortical was continued. If not, a limited fixation must be performed by staple, Kirchner wire, or screw and avoid the osteosynthesis with plate to limit the risk of infection and wound complication. The choice of the material depends on the type of fracture.

To fill the subthalamic void, a graft may be necessary. However, the need for bone grafting in the treatment of displaced intra-articular calcaneal fracture is still controversial.^[29-31] Different grafts are possible. In our series, we used only an autograft harvested from the iliac crest.

It is difficult to compare the results of different series reported because of the varying techniques and classification systems. The study has several limitations. The limitations of the present study are that it is a retrospective investigation, the sample size was small, and the investigation period was short. Despite these limitations, this study provides evidence that the modified Palmer technique leads to good results. The less high risk of infection and cutaneous complications can justify this technique, especially in the presence of severe swelling in the hindfoot, for elderly patients, patients with diabetes, and those with a smoking history. This technique must be reserved for calcaneal fracture Type II or III according to the Sander's classification. We recommend fixation to support the graft when the stability of the graft is enough frequently observed with a discontinued plantar surface.

CONCLUSION

An elevated fragment associated with a bone graft, according to Palmer, is a simple surgical technique to treat intra-articular calcaneal fractures. Encouraging functional results of the technique are conditioned by the restoration of the Bohler angle and the correct positioning of the graft. This procedure should not apply to all fractures of the calcaneus, but should be reserved for Types II and III of Sander's classification, which can decrease the risk of infection and wound complication by avoiding plate fixation.

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Conflicts of interest

There are no conflicts of interest.

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