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Original article

Surgical treatment of calcaneal fractures with a special titanium AO plate

Sergio Rodríguez Rodríguez,* Rolando Benítez Garduño,** Carlos Oliva Raygoza***

"Lomas Verdes" Trauma and Orthopedics Hospital, IMSS

SUMMARY. Calcaneal fractures account for 60% of tarsal fractures, mostly in males in their productive age resulting in a considerable economic impact. They are still a major challenge for orthopedic surgeons because of the controversy in terms of management. Through a prospective, cross section, descriptive, and observation study, we analyzed 20 fractures in 16 patients. The average age was 44 years. The most affected side was the left side. The main cause was a long fall. It occurred as an isolated fracture in 65% of cases and in association with other injuries in the remaining 35%. In all cases open reduction, joint surface restoration and fixation with a special AO calcaneum plate, with or without bone graft, were performed. The most common complication was dehiscence of the wound in 20% of cases. The average follow up time was 20 months with excellent results in seven cases (35%), good in 12 (60%) of cases and fair in one (5%) case according to the Maryland functional evaluation for fractures of the calcaneum. Calcaneal fractures occur because of a high energy release mechanism so that a comprehensive assessment of the patient is required to rule out associated injuries. It is an injury that should be treated by an experienced surgeon.

Key words: calcaneum, fracture, bone graft.

RESUMEN. Las fracturas de calcáneo corresponden al 60% de las fracturas del tarso y en su mayoría ocurren en hombres en edad productiva, lo que representa un impacto económico considerable. Continúan siendo un reto para el cirujano ortopeda, ya que existe controversia en cuanto a su manejo. Mediante un estudio prospectivo, transversal, descriptivo y observacional, analizamos un total de 20 fracturas en 16 pacientes. La edad promedio fue de 44 años. El lado más afectado fue el izquierdo. La causa principal fue caída de altura. Se presentaron como fractura aislada en 65% de los casos y asociada a otras lesiones en 35% restante. En todos los casos se practicó reducción abierta, restitución de superficie articular y fijación con placa especial para calcáneo AO, con o sin aplicación de injerto óseo. La complicación más frecuente fue dehiscencia de la herida en el 20%. El seguimiento promedio fue de 20 meses, con resultados excelentes en siete casos (35%), bueno en 12 (60%) y regular en uno (5%), según la evaluación funcional de Maryland para fracturas de calcáneo. Las fracturas de calcáneo se producen por un mecanismo de alta liberación de energía por lo que se requiere evaluación integral del paciente para descartar lesiones asociadas, y es una lesión que debe ser tratada por cirujanos con experiencia.

Palabras clave: calcáneo, fractura, injerto óseo.

* Head of the Ankle-Foot Service.

** Head of the Orthopedics Division.

*** Physician assigned to the Hospital.

"Lomas Verdes" Trauma and Orthopedics Hospital

Mailing address:

Dr. Sergio Rodríguez Rodríguez. Calzada de la Viga 1756-303
Col. Héroes de Churubusco, Del. Iztapalapa CP 09090 México, D.F.
Telephone: 55 81 35 90. serro@prodigy.net.mx

Introduction

Fractures of the calcaneum, already described by Hippocrates (460-385 BC), account for 2% of total fractures in the body and it is the foot bones that are injured more frequently.¹⁰ Seventy per cent of these fractures are intra-articular and associated to other injuries both at the lumbar level (10%), and other sites of the limb (26%). Seven per cent of fractures are bilateral¹⁰ and 90% occur in men in their productive age, the fourth decade of their life, causing a major economic impact.³

Today there is controversy between conservative and surgical management of these fractures. However, it is

widely accepted that open reduction, joint surface restoring, and internal fixation is an appropriate therapeutic choice for treating displaced intra-articular fractures⁶ with loss of Böhler's angle.^{11,17} Also, they are contraindicated in people older than 60 years, with distal vascular disease, exposed fractures, severe injuries of soft tissues, local infection, and vital compromise of the patient.^{3,17}

The purpose of this study is to assess the outcome of treating multiple fragment joint fractures of the calcaneum by open reduction, joint surface restoring, and internal fixation with a special titanium AO plate.

Material and methods

This is a prospective, cross section, descriptive, observation study conducted between February and December 1998 with a clinical, X-ray follow up of no less than 14 months and of no more than 24 months.

The study included adult patients of both genders with an intra-articular calcaneal fracture of recent trauma etiology. Patients with exposed fracture or distal vascular disease were excluded and those not showing for their subsequent control were eliminated. A method to recognize the fractures involved using the Essex-Lopresti X-ray classification and Sanders tomography classification.^{12,17}

We analyzed a total of 20 fractures in 16 patients – 15 males and one female – who underwent open reduction, joint surface restoring and internal fixation with a calcaneum specific AO plate. The minimum age was 23 years and the maximum age was 74 with an average of 44 years. The most affected side was the left side in 50% of cases, the right side in 25% of cases and bilateral in 25% of cases. The main cause was a long fall in 90% of cases, a car accident in 5% and direct contusion in 5%. They occurred as an isolated fracture in 65% of cases and associated to other injuries in the remaining 35% (*Chart 1*). The type of fracture according to the Essex-Lopresti and Sanders classifications are shown in *Charts 2* and *3*.

A surgical approach involved an extended "L" posterolateral incision in 13 cases (65%) and lateral longitudi-

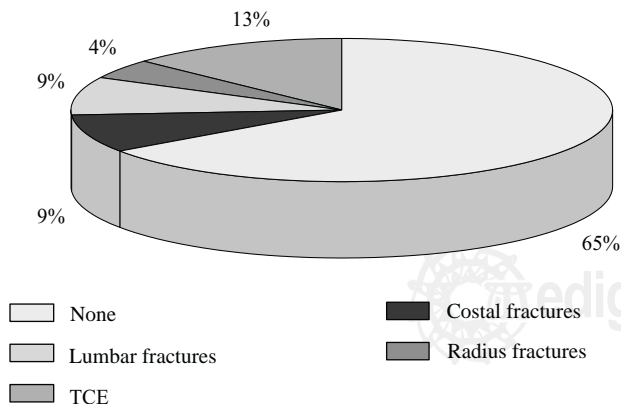


Chart 1. Associated injuries.

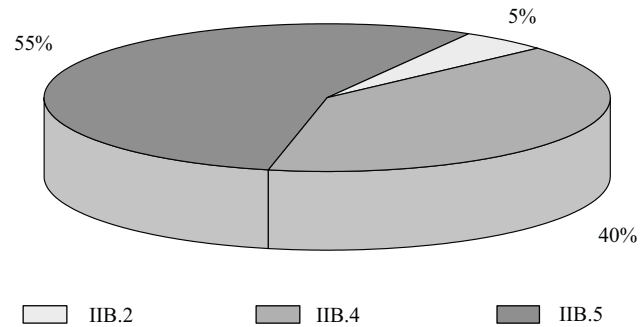


Chart 2. Essex-Lopresti fracture classification.

nal in 7 cases (35%). An autologous bone graft from the iliac crest was used for 13 cases (65%), the tibia in one (5%), interpose in one (5%), a homologous graft in 2 (10%), and graft was used in 3 cases (15%).

The outcome was assessed by the Maryland functional scale (*Table 1*). For statistical analysis of scalar variables central trend and dispersion measures were used while for nominal variables, the Chi² test was used for a sample where $p < 0.05$ is considered as statistically significant.

Results

The results according to the Maryland functional assessment were classified as excellent, 7 cases (35%); good, 12 cases (60%); fair, one case (5%); and poor, none. The functional results were analyzed and showed a statistically significant value with $p: 0.0025$.

Eight patients (40%) suffered some postoperative complications. Of these, four were dehiscences of the wound which improved with dressing changing at home. One patient, which required a homologous graft, had an infection that developed into osteomyelitis of the calcaneum and skin necrosis requiring curettage and flap rotation. Three patients complained from hyperesthesia on the surgical scar. With regards to complications with the kind of approach used, an extended "L" posterolateral approach, 3 patients had scar hyperes-

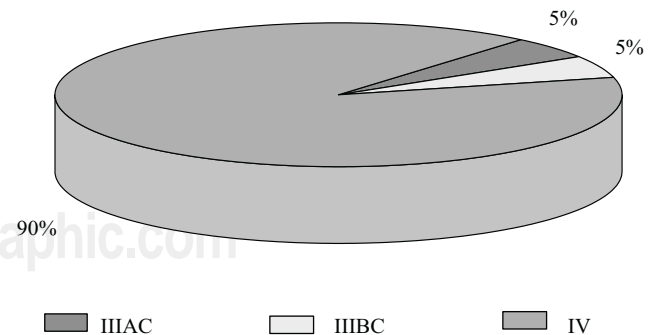


Chart 3. Sanders fracture classification.

Table 1.		
Maryland Scale		
1. Pain		
None: even in sports activities	45	
Mild: no changes in sports or at work	40	
Light: minimum changes in sports or at work	35	
Moderate: decreased in sports activities	30	
Strong: in minimum sports activities, when taking a bath, simple house chores, strong pain deserving frequent pain killers	10	
Disabled: incapable of working or going shopping	5	
2. Function		
Gait		
Distance walked		
Unlimited	10	
Mild limitation	8	
Moderate limitation (2-3 streets)	5	
Severe limitation (1 street)	2	
Only in closed places	0	
Stability		
Normal	4	
Mild instability when walking	3	
Occasional missed steps (1-2 steps)	5	
Frequent missed steps	1	
Uses braces	0	
Support		
None	4	
Cane	3	
Crutches	2	
Wheel chair	0	
Claudicating		
None	4	
Mild	3	
Moderate	2	
Severe	1	
Inability to work	0	
Shoes (tolerance)		
Any kind	10	
Only some	9	
Broad, loose	7	
With braces	5	
Incapable of wearing shoes	0	
Stairs		
Normal	4	
With a handrail	3	
With some other help	2	
Disabled	0	
Terrain		
No problem on any surface	4	
Problems on stones and hills	2	
Problems on flat surfaces	0	
Cosmesis		
Normal	10	
Mild deformity	8	
Moderate deformity	6	
Severe deformity	0	
Multiple deformities	0	
Mobility (ankle, subtalar, half foot, and metatarsal phalangeal)		
Normal	5	
Mildly diminished	4	
Strongly diminished	2	
Ankylosis	0	
Excellent, 90-100; good, 75-89; poor, 50-74; very bad, < 50		



Figure 1. Axial section of the calcaneum where the multiple fragment fracture can be seen.



Figure 2. Anatomical restoration of the calcaneal fracture fixated with a special titanium AO plate.

thetia, 3 suffered superficial skin necrosis, and one, osteomyelitis. For the lateral longitudinal approach only one case had superficial skin necrosis.

The minimum hospital stay time lasted 9 days and the maximum stay lasted 126 days averaging 20 days. Patients continued being managed on an outpatient basis for 6 weeks at least and for no more than 22 months, with an average management time of 6 months.

Discussion

Calcaneal fractures continue to be a challenge for orthopedic surgeons. The controversy about their management

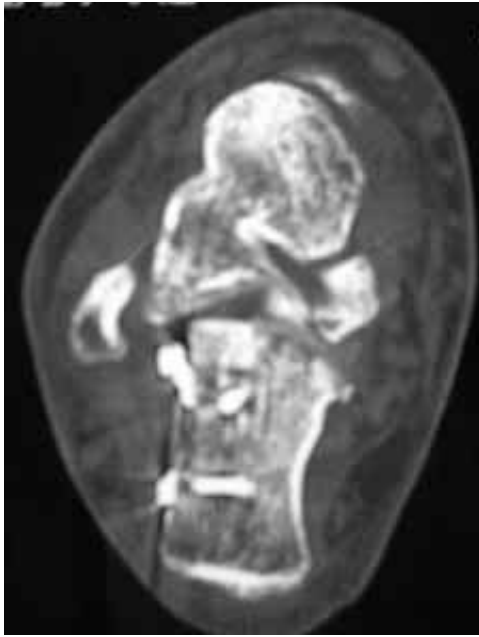


Figure 3. This figure shows the consolidation and some titanium screws maintaining the reduction of 8 week old fractures.



Figure 4. CAT reconstruction showing the consolidation of the fracture and reduction of the joint surface after 8 weeks.

continues because the outcome was not as favorable as desired. These fractures occur because of a high energy release mechanism requiring comprehensive evaluation of the patient to rule out associated injuries. It is an injury that should be treated by experienced surgeons. From the very moment when these injuries are diagnosed they become difficult since simple X-ray film is not sufficiently clear. For a better space orientation and diagnosis of the injury, calcaneal fractures should be examined by a simple X-ray on lateral, axial, and oblique projection, in addition to CT scanning. The latter is essential for diagnosis. It indicates the severity of the injury allowing for the surgical procedure planning and guidance towards the injury prognosis^{8,15} (Figure 1).

Fractures of the calcaneum have been subject to a great variety of treatments. At present, there is an attempt to set which one will be the best choice. In a randomized study, comparing the outcome from conservative vs surgical treatment of intra-articular fractures, Thordarson et al. concluded that by open reduction through a lateral approach, joint surface restoring, a bone graft, stable internal fixation, and early mobilization, the clinical outcome is better than with the conservative treatment or indirect reductions.¹⁵ Other studies clinically evaluating pain, edema, activity, range of motion, return to work, and joint consistency on the X-ray, have shown the benefits of surgical treatment of displaced intra-articular fractures.^{7,8,11,15,17} The purpose of open reduction is to restore the calcaneal anatomy (height, length and thickness), reconstruct the subtalar and calcaneocuboid joint by a low profile plate, causing the least amount of injury to soft tissues and peroneal muscles to achieve an early mobilization.^{2,17}

Two surgical approaches are described to expose the calcaneum: the extended "L" lateral approach and the lateral longitudinal approach. The former is broadly recommended. It decreases the incidence of sural nerve injury, infection of soft tissues and necrosis of the skin flap in addition to providing a better vision of the bone along the entire extension.^{5,6,13,16} We performed both approaches and found better vision of the bone, all along with the extended "L". However, in spite of what the literature claims, it was with this approach that more skin cover complications occurred. It behooves us, therefore, to pay special attention to handling soft parts.

Regarding the osteosynthesis material, we were able to confirm that the reports in the literature about the calcaneum specific AO plate, which must be of titanium, provides more biocompatibility and flexibility, allowing the plate to be molded to the lateral border of the calcaneum. Its anatomical shape and "T" anterior and posterior extensions allow for good fracture stability (Figure 2).^{4,6,7} Notice that titanium plates have the advantage of allowing for a tomography follow-up as they produce a lower resonance phenomenon than steel thus allowing us to see the reduction and consolidation of the fracture (Figures 3 and 4).

Complications occurring in our study were primarily related to soft parts. Interestingly they occurred in older patients (average 51 years of age). The world literature reports a total 10% of complications in calcaneal fractures. Of these, 5 to 10% account for skin cover injuries, 2% to 8% for infections, and 5% for surface nerve injury.^{7,8,15-17}

According to the age of patients, our best outcome was seen in people younger than 50 years of age. These findings are consistent with the world literature. According to the Maryland functional scale assessed after an average 20 month follow-up, we got 35% excellent outcome, 60% good outcome and 5% fair outcome. Fractures of the calcaneum occur mostly in patients during their productive age. It is, therefore, essential to prevent sequelae and achieve work reintegration. The main etiology is a long fall so safety systems should be implemented throughout the work and home areas.

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