Evaluation of Patients Undergoing Minimally Invasive Surgical Treatment for Calcaneus Fractures

Article · June 2015

CITATIONS
0

READS
29

10 authors, including:

Carlos Daniel Candido de Castro Filho
PUC Campinas
6 PUBLICATIONS **4** CITATIONS
SEE PROFILE

Antenor Rafael Mazzuia
Pontifícia Universidade Católica de Campinas (PUC-Campinas)
3 PUBLICATIONS **4** CITATIONS
SEE PROFILE

Randal Rudge Ramos
33 PUBLICATIONS **283** CITATIONS
SEE PROFILE

JACOBS PUBLISHERS

OPEN ACCESS

Jacobs Journal of Surgery

Research Article

Evaluation of Patients Undergoing Minimally Invasive Surgical Treatment for Calcaneus Fractures

Carlos Daniel Candido de Castro Filho[1], Antenor Rafael de Oliveira Mazzuia[2], Cintia Kelly Bittar[3], Mário Sergio Paulilo de Cillo[3], Randal Rudge Ramos[4], Carlos Augusto de Mattos[5], Letícia Ambrosano[6]

[1]*Orthopaedist, intern in the Service of Orthopaedics and Traumatology, PUC-Campinas, Celso Pierro General and Maternity Hospital*

[2]*Resident physician in the Service of Orthopaedics and Traumatology, PUC-Campinas, Celso Pierro General and Maternity Hospital*

[3]*Orthopaedist, PhD in Surgery, Chair of the Service of Foot and Ankle Surgery, PUC-Campinas, Celso Pierro General and Maternity Hospital*

[4]*Orthopaedist, intern in the Service of Orthopaedics and Traumatology, PUC-Campinas, Celso Pierro General and Maternity Hospital*

[5]*Orthopaedist, Chair of the Service of Orthopaedics and Traumatology, PUC-Campinas, Celso Pierro General and Maternity Hospital*

[6]*Medical student, School of Medicine, PUC-Campinas, Celso Pierro General and Maternity Hospital*

**Corresponding author: Dr. Castro Filho Carlos Daniel Candido, PUC – Campinas, Alameda dos Pintassilgos, 735, Mairiporã - SP – Brazil, Tel: +55 19 9924-2401; Email: cdccfilho@hotmail.com*

Received: 02-10-2015

Accepted: 05-15-2015

Published: 06-18-2015

Abstract

We evaluated the functional results obtained following minimally invasive surgical treatment of calcaneus fractures and the incidence of soft-tissue complications. Between 2006 and 2010, 27 intra-articular fractures of the calcaneus were treated using a minimally invasive technique. Sander's tomography classification was used for the preoperative evaluation. The surgical technique was a lateral approach with minimal fixation. The surgery focused on the talocalcaneal joint without dislocating soft tissues, fixation using only screws and wires, and no use of plates or grafts. Johnson's functional scale from the American Orthopaedic Foot and Ankle Society (AOFAS) and walking capacity were used to evaluate the clinical and functional aspects. Pre- and postoperative X-rays were used to evaluate Böhler's and Gissane's angles. In postoperative evaluations, 59.25% of patients showed good or excellent clinical results and all cases showed angle improvement. No soft-tissue complications were observed. The average AOFAS scale was 78.5 points. We found satisfactory clinical and functional results, with increasing radiological values and minimal complications.

Level of Clinical Evidence
This is a cross sectional study, level of clinical evidence 3.

Keywords: Calcaneus Fractures; Minimally Invasive Treatment; Ankle; Sanders Classification; Surgical Treatment of Calcaneus Fractures; AOFAS.

Introduction

Calcaneus fractures comprise 2% of human body fractures. They usually occur as a result of high-energy trauma, such as falls and car crashes [1]. Fifty percent of cases are associated with other fractures, such as fractures of the tibial shaft, hip, or lumbar spine [2,4]. The tarsus bones are the most affected, with 75% predominance among intra-articular fractures [2].

Poor results are often achieved after treating this kind of fracture as they are complex and it is difficult to reduce and maintain congruence. These fractures can incapacitate patients due to pain and chronic articular stiffness, in addition to hind foot deformities that cause difficulty in wearing conventional shoes [3].

Retrospective studies have shown that conservative treatment is generally used for undisplaced fractures in elderly people and in patients with comorbidities [3,5,7,8]. However, surgical treatment is a better option for displaced fractures in adults up to 70 years old [7, 8].

The preferred repair technique is the extended lateral approach and osteosynthesis with plates and screws [3-5]. Some patients present with soft-tissue complications (8–32% of cases) [5] and 43.5% require complementary procedures to remove implants [6]. Other authors have published results for less invasive approaches and wire and screw fixation, which result in a lower incidence of soft-tissue complications [1, 2,7,8].

Based on these studies and our personal experience with several types of treatment, we chose a lateral approach and the minimal fixation technique [14], which focuses on the talocalcaneal joint without destroying soft tissue and fixes the joint using only wires and screws, not plates or grafts. This method is minimally invasive. We evaluated the functional results obtained using this technique to treat calcaneus fractures, emphasizing the incidence of soft-tissue complications.

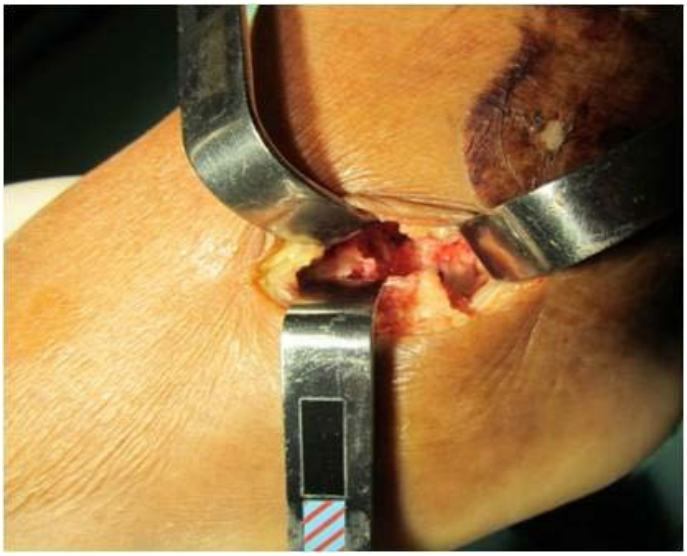

Figure 1. Lateral ankle approach – a minimally invasive technique.

Patients and Methods

This was a retrospective study conducted at the University Hospital of Campinas, São Paulo, Brasil. Twenty-seven patients (20 men and 7 women; mean age, 46.6 years) were diagnosed with calcaneus fractures between 2006 and 2010 and were treated with a minimally invasive surgical technique until 2 weeks after the trauma. Eighteen had right calcaneus fractures, seven had left calcaneus fractures, and two had both calcanei fractured.

Gissane's and Böhler's angles were measured and evaluated on pre- and postoperative X-rays and the American Orthopedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Scale questionnaire [16,18] was conducted.

Inclusion criteria were adult patients diagnosed with calcaneus fractures classified as Sanders types II or III [19], who submitted to a minimally invasive surgical treatment by the same surgeon, had at least 2 years of postoperative follow-up, and wanted to be included in the study.

Exclusion criteria were skeletally immature patients, patients treated with this technique with <2 years follow-up, and those who did not want to be a part of the study.

Patients were called to the Department of Orthopedics and Traumatology, evaluated according to the inclusion criteria, and invited to participate in the study. Patients who accepted the invitation signed a consent form. They were evaluated at our ambulatory center, and Böhler's and Gissane's angles were measured on pre- and postoperative X-rays. We used preoperative computed tomography (CT) to classify the fractures according to Sander's classification [2, 5, 16]. The patients also answered the AOFAS questionnaire [16,18].

Student's *t*-test was used for independent samples and the Mann–Whitney *U*-test was used for non-parametric data. A $p \leq 0.05$ was considered significant.

This study was approved on April 1, 2013, by the Research Ethics Committee of Plataforma Brasil, under number 233.735.

Results

At the end of the evaluation, 25 patients were able to walk without limitations, and two needed crutches. These two patients had bilateral calcanei fractures. All patients had difficulty in walking on irregular surfaces. A 78.5-point average postoperative result was obtained on the AOFAS scale.

The angles and measured values are listed in Table 1. Improvement was observed in 100% of the angles measured during the postoperative evaluation.

Pacients	Age (years)	Gender (Male M; Female F)	Surgery date	Side of fracture (Right R; Left L)	Sanders classification	Böhler angle pre op.	Gissane angle pre op.	Böhler angle pos op.	Gissane angle pos op.	AOFAS
M.C.C.	53	M	22/01/2008	R	2 C	12	60	34	101	77
M.A.P.S.	48	F	15/09/2006	L	2 B	10	65	34	102	72
N.J.S.	57	M	05/08/2009	R	3 AB	8	54	20	105	58
L.C.P.	25	M	22/01/2007	R	3 AC	15	86	26	102	82
H.N.P.	71	M	02/03/2009	R	3 BC	6	62	20	100	81
C.P.C.	33	M	20/10/2010	R	3 AC	10	74	21	100	83
A.R.	47	M	03/06/2009	L	3 AC	4	82	22	108	87
A.S.	55	F	23/09/2009	R	2 B	12	88	21	100	87
A.F.S.	68	M	10/09/2009	R	3 BC	14	86	20	110	90
A.F.D.S.	39	F	12/05/2008	R and L	3 AC	6	92	21	100	57
A.M.S.	50	M	10/02/2010	R	3 BC	12	90	40	100	73
M.C.C.	53	M	24/04/2010	R and L	3 AC	10	72	21	104	82
S.J.B.	41	F	11/07/2008	L	3 AB	16	84	23	103	60

E.N.S.	33	M	13/06/2009	R	3 AC	8	78	22	102	71
E.B.C.	47	M	04/04/2008	R	3 AB	8	70	23	108	82
J.C.A.	55	M	26/02/2009	L	2 B	12	86	24	110	70
C.R.G.	42	M	08/07/2009	R	3 AC	10	86	24	102	74
CWT	40	F	13/09/2009	R	2 A	12	60	34	101	90
CDN	42	M	20/11//2006	R	2 A	10	65	34	100	88
AD	49	M	05/08/2006	R	2B	8	54	21	109	80
GBN	55	M	22/02/2009	L	3 AC	15	86	26	102	75
SGS	25	F	24/11/2006	R	2A	6	62	20	101	85
IS	45	M	20/10/2010	R	2B	10	74	21	101	83
LP	40	F	03/06/2007	L	2C	4	82	23	101	87
NC	55	M	23/04/2009	R	2 B	12	88	23	100	87
VC	42	M	10/09/2006	R	3 AC	14	86	20	106	75
JVT	50	M	28/03/2008	L	2B	6	92	23	100	85

Table 1. Evaluation of patients with calcaneus fractures.

The average angles measured postoperatively were 31.8° for Böhler's, and 102.8° for Gissane's (reference values: 20–40° Böhler, and about 100° Gissane) [11]. No early or late post-operative complications were observed.

Figure 2. Measurement of Böhler's (B) and Gissane's (G) angles. Böhler, 26°; Gissane, 102°

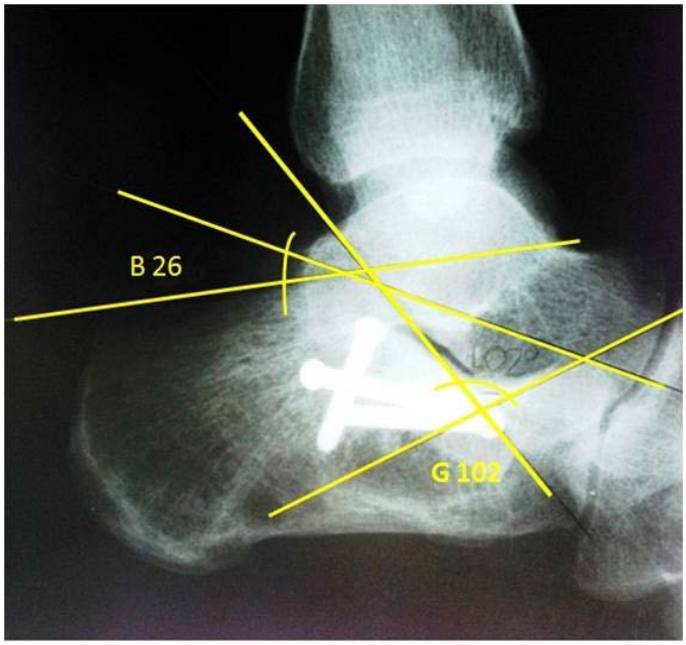

Figure 3. Postoperative lateral-view X-ray of the subtalar joint.

Discussion

There was a predominance of male patients with an average age of 46.6 years, similar to previous reports [4,14,16,17]. The mechanism of trauma was axial trauma in all cases due to a high fall. Sander's CT classification was adopted, which evaluates the number of fragments and deviations between the fragments. According to the inclusion criteria, the patients selected for the study were classified as Sanders II and III (fractures in two or three parts with intra-articular deviation). No immobilization was necessary during postoperative care. After the procedure, it was possible to ensure earlier mobility of the ankle, which provided better quality of life for the patients.

Böhler's and Gissane's angles were measured on preoperative and postoperative X-rays to evaluate the results, and the data were linked to the answers on the AOFAS questionnaire. The Böhlers's and Gissane angles of all patients were measured during the postoperative evaluation. Although the measurements were standardized and obtained by experienced professional, few differences were detected between observers; however, rotation during the X-ray exam may have influenced the values obtained, as well as the precision of goniometry used.

We did not observe any soft-tissue complications such as necrosis, tendonitis of peroneal tendons, wound dehiscence, or neurovascular lesions. These complications have reached rates of 27–33% in previous studies [10, 11,17].

Figure 4. Postoperative axial-view X-ray of the screws.

The AOFAS questionnaire is a good way to evaluate strength, function, pain, and calcaneus alignment. In the present study, 7.4% of patients had excellent results, 51.85% had good results, 29.63% had regular results, and 11.10% had poor results. Hence, 59.25% had good or excellent results. Previous studies have reported good or excellent results in 42–62% of cases [7, 12, 13, 15].

Patients who presented with bilateral fractures were surgically treated for only one calcaneus fracture. The other foot of each patient was treated without surgery; because they had Sanders I fracture (extra-articular fractures without deviations).

Previous studies have found that 80% of patients can return to work after surgical treatment of calcaneus fractures under the conventional lateral "L" approach [11,12,15,16]. In the present study, 100% of patients returned to their occupational activities after treatment. Only one patient reported some difficulty in readapting to routine, due to pain because of a bilateral fracture.

Owing to the socioeconomic situation of our patients (mostly laborers) with functions that demand bearing weight and climbing up and down stairs, we consider our return-to-work percentage a success. We found discrepant results in the literature when comparing the minimally invasive and the conventional lateral "L" approaches for treating calcaneus fractures, which can be explained by the fact that a minimally invasive technique causes less morbidity to the patient and is less aggressive to soft tissues.

In recent researches we didn't found studies or technique about arthroscopic and laser surgery for calcaneal fractures.

Conclusion

The use of a minimally invasive technique is a good alternative for treating calcaneus fractures, as it reestablishes the talocalcaneal intra-articular surface, recovers Böhler's and Gissane's angles, and provides better soft tissue conditions and quicker mobility for patients.

References

1. Rodríguez SR, Garduño RB, Raygoza CO. Surgical treatment of calcaneal fractures with a special titanium AO plate. Acta Ortop Mex. 2004, 18(1): 34-38.

2. Essex-Lopresti P. The mechanism, reduction technique, and results in fractures of the os calcis. Br J Surg. 1952, 39(157): 395-419.

3. Prado JR I. Tratamento cirúrgico das fraturas intra-articulares desviadas do calcâneo, através de osteossíntese interna, sem enxerto ósseo. Rev Bras Ortop. 1999, 34(7).

4. Carr JB. Surgical treatment of the intra-articular calcaneus fracture. Orthop Clin North Am. 2005, 19(2): 109-117.

5. Herscovici D Jr, Widmaier J, Scaduto JM, Sanders RW, Walling A et al. Operative treatment of calcaneal fractures in elderly patients. J Bone Joint Surg Am. 2005, 87(6): 1260-1264.

6. Harvey EJ, Grujic L, Early JS, Benirschke SK, Sangeorzan BJ et al. Morbidity associated with ORIF of intra-articular calcaneus fractures using a lateral approach. Foot Ankle Int. 2001, 22(11): 868-873.

7. Fernandez DL, Koella C. Combined percutaneous and "minimal" internal fixation for displaced articular fractures of the calcaneus. Clin Orthop Relat Res. 1993, (290): 108-116.

8. Moraes Filho DC, Provenzano E, Mattos JR, Batista LC, Galbiatti JA et al. Avaliação preliminar do tratamento cirúrgico de fraturas intra-articulares do calcâneo. Rev Bras Ortop. 1998, 33(7): 511-518.

9. B Magnan, R Bortolazzi, A Marangon, M Marino, C Dall'Oca et al. External fixation for displaced intra-articular fractures of the calcaneus. J Bone Joint Surg Br. 2006, 88(11): 1474-1479.

10. Lopez-Oliva F, Forriol F, Sanchez-Lorente T, Aldomar Sanz Y. Vira system—A minimally invasive technique for severe fractures of the calcaneus treatment with primary subtalar fusion: A preliminary report. Foot and Ankle Surg. 2011, 17(2): 68–73.

11. Lopez-Oliva F, Forriol F, Sanchez-Lorente T, Aldomar Sanz Y. Treatment of severe fractures of the calcaneus by reconstruction arthrodesis using the Vira1 System: Prospective study of the first 37 cases with over 1 year follow-up. Injury. 2010, 41(8): 804–809.

12. Schuberth JM, Cobb MD, Talarico RH. Minimally Invasive Arthroscopic-Assisted Reduction with Percutaneous Fixation in the Management of Intra-Articular Calcaneal Fractures: A Review of 24 Cases. American College of Foot and Ankle Surgeons. 2009, 48(3): 315–322.

13. Walde TA, Sauer B, Degreif J, Walde HJ. Closed reduction and percutaneus Kirschner wire Wxation for the treatment of dislocated calcaneal fractures: surgical technique, complications, clinical and radiological results after 2–10 years. Arch Orthop Trauma Surg. 2008, 128(6): 585–591.

14. Rammelt S, Amlang M, Barthel S, Zwipp H. Minimally-invasive treatment of calcaneal fractures. Injury. 2004, 35(2): SB56-63.

15. Zwipp H, Rammelt S, Barthel S. Calcaneal fractures – open reduction and internal fixation. Injury. 2004, 35(2): SB46-54.

16. Kitaoka HB, Alexander IJ, Adelaar RS, Nunley JA, Myerson MS et al. Clinical rating systems for the ankle-hindfoot, midfoot, hallux and lesser toes. Foot Ankle Int. 1994, 15 (7): 349-353.

17. Pelliccioni AAA, Bittar CK, Zabeu JLA. Tratamento cirúrgico de fraturas intra-articulares de calcâneo Sanders II e III. revisão sistemática. Acta Ortop Bras. 2012, 20(1): 39-42.

18. RODRIGUES, Reynaldo Costa. Tradução, adaptação cultural e validação do American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Scale. Acta ortop bras. 2008, 16(2).

19. Sanders R, Fortin P, DiPasquale T, Walling A. Operative treatment in 120 displaced intraarticular calcaneal fractures: results using a prognostic computed tomography scan classification. Clin Orthop Relat Res. 1993, 290: 87-95.