

Conservative treatment of intra-articular calcaneal fracture: a retrospective analysis

Tratamento conservador da fratura intra-articular do calcâneo: uma análise retrospectiva

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ABSTRACT

Objective: To evaluate patients who received conservative treatment for a displaced intra-articular calcaneal fracture and to correlate the clinical-functional outcomes with the calcaneus shape measured using radiographs at the last outpatient visit.

Methods: A retrospective study was performed with patients who suffered calcaneal bone fractures and were treated nonsurgically between 2006 and 2016. Radiographic (Böhler's and Gissane's angles, calcaneal width, talar declination angle, and calcaneal pitch) and clinical-functional parameters (American Orthopedic Foot and Ankle Society (AOFAS) and visual analog scale (VAS) pain scores and personal satisfaction) were evaluated.

Results: We found no relationship between the measured angles and the clinical-functional outcomes.

Conclusion: Despite the small number of cases evaluated in this study, the clinical-functional ankle and hindfoot AOFAS scale score was considered satisfactory in most cases. We found no relationship between the calcaneus shape measured using radiographic parameters and the clinical-functional outcome.

Level of Evidence IV; Therapeutic Studies; Case Series.

Keywords: Hallux rigidus; Hallux limitus; Osteoarthritis.

RESUMO

Objetivo: Avaliar os pacientes que receberam tratamento conservador para a fratura do calcâneo intra-articular desviada e correlacionar o resultado clínico funcional com o formato do calcâneo, medido utilizando-se radiografias do último atendimento ambulatorial.

Métodos: Estudo retrospectivo com pacientes que sofreram fratura do osso calcâneo e foram tratados de forma não cirúrgica no período compreendido entre 2006 e 2016. Foram avaliados parâmetros radiográficos (ângulos de Böhler e Gissane, alargamento do retropé, declinação do tálus, calcâneo-solo) e clínico-funcional (AOFAS, EVAD e satisfação pessoal).

Resultado: Não encontramos relação entre os ângulos mensurados e o resultado clínico funcional obtido.

Conclusão: Apesar do pequeno número de casos avaliados neste estudo, o resultado clínico-funcional segundo a escala da AOFAS para tornozelo e retropé foi considerado satisfatório na maioria dos casos. Não encontramos qualquer relação entre o formato do calcâneo, medido utilizando-se parâmetros radiográficos, e o resultado clínico funcional.

Nível de Evidência IV; Estudos Terapêuticos; Série de Casos.

Descritores: Calcâneo; Fraturas intra-articulares; Tratamento conservador.

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INTRODUCTION

Fracture of the calcaneus is the most common fracture of the tarsal bones and mainly affects economically active young adults. However, the indications for surgical and conservative treatment are still under discussion⁽¹⁻⁷⁾. Although surgical treatment can restore the calcaneal anatomy after surgery in most cases, the number of complications is higher than that of conservative treatment^(2,5,6), especially surgical wound complications. Adequate selection of patients for surgical treatment, such as indicating conservative treatment for those with a greater chance of surgical complications, is an object of study in the literature⁽⁸⁾. Smokers⁽⁹⁾ and patients who use illicit substances and do not follow medical instructions have a greater chance of surgical complications, and thus conservative treatment may be a better option for this group of patients^(3,10,11).

However, a report has indicated that preservation of the calcaneus shape is an important prognostic factor in these fractures⁽¹²⁾. The main indicator of shape preservation is Böhler's angle^(6,10,13,14), which is not restored with conservative treatment. In an attempt to avoid some surgical wound complications and improve the calcaneus shape, some authors have proposed surgery protocols to reduce and fix calcaneal fractures using small access incisions^(6,15) or even percutaneous surgeries^(6,16).

The objective of this study was to evaluate patients with a displaced intra-articular calcaneal fracture who received conservative treatment due to clinical contraindication and to assess the correlation of the clinical-functional outcome with the calcaneus shape measured using radiographs from the last outpatient visit. Our hypothesis is that patients with greater calcaneus deformity will have worse clinical-functional outcomes.

METHODS

This study was approved by the Research Ethics Committee with registration in the Brazil Platform under CAAE number: 08971018.4.0000.5479. This study was retrospective and observational and met the human and animal rights requirements.

Medical records of patients who suffered displaced intra-articular calcaneal fractures and were treated conservatively (without surgery) between 2006 and 2016 were analyzed. We used the last outpatient evaluation performed and the respective radiographs as the outcome. The inclusion criteria were patients aged 18 years or older with a displaced intra-articular calcaneal fracture without spinal cord injury who were nondiabetic, underwent conservative

treatment with a short leg cast, and attended outpatient follow-up for at least two years.

During the cited period, 200 patients were registered in our institution with an intra-articular calcaneal fracture, but only 11 of these patients (14 feet, including 9 males and 2 females with a mean age of 48 years) met the selection criteria and had sufficient data for analysis (protocols and radiographs). Nine fractures occurred on the right side, and five fractures occurred on the left side. The trauma mechanism of all fractures was a fall from height, on average from three meters. The average follow-up period was five years (range from two to 10 years). The indication for conservative treatment in this sample was smoking and/or drug use, patients who attempted suicide, and patients who did not follow medical recommendations. The patients used a short leg cast for six weeks without weight bearing, followed by partial weight bearing protected with the same type of cast for six weeks. After this period, the cast was removed, and the patient was referred to physical therapy for gait training, increased mobility, and strengthening.

To evaluate the clinical-functional outcomes, we collected the AOFAS (American Orthopedic Foot and Ankle Society) hindfoot and ankle score⁽¹⁷⁾, which is routinely collected at the outpatient clinic. We also used the visual analog scale for pain (VAS pain); a score of zero indicated that the patient had no pain, and a score of 10 indicated the worst pain possible. We evaluated the patients' personal satisfaction with the outcome based on four possible answers: completely satisfied, satisfied with minor restrictions, satisfied with major restrictions, and dissatisfied.

To evaluate the anatomical deformity produced by the fracture, we used the following parameters in the dorso-plantar, profile, and axial radiographs of the leg-foot with weight bearing performed at the last documented outpatient visit: Gissane's angle, Böhler's angle, talar declination angle, calcaneal pitch, and calcaneal width in the leg-foot axial radiograph⁽¹⁸⁾.

The leg-foot radiograph was taken with both feet on the same radiographic film in all cases, which allowed us to use the contralateral side as the normal standard. However, for several patients, we did not obtain the radiographs in the profile view with weight bearing on the contralateral side; therefore, we decided to use the parameters described in the literature as the normal standard for comparison. We considered the following ranges described in the literature as normal: Böhler's angle from 20 to 40 degrees, Gissane's angle from 120 to 145 degrees, talar declination angle from 95 to 105 degrees, and calcaneal pitch from 15 to 25 degrees.

To analyze the effect of the residual calcaneal anatomy deformity on the clinical-functional outcome following conservative treatment, we compared the AOFAS scale hindfoot and ankle and VAS Pain scores and the level of personal satisfaction of the patients at the last outpatient visit with the obtained angles, which were classified into the following two groups: angle values considered normal (without angular deformity) and outside of the normal range (with angular deformity). We considered patients who obtained an AOFAS score greater than or equal to 70 points to have achieved a good clinical-functional outcome. A score below this threshold was considered poor by the authors. We also divided the patients into two groups using the VAS pain score (scores equal to or less than 5 points and greater than 5 points). We compared these results with the aforementioned radiographic values and analyzed the associations using Student's t-test.

RESULTS

The mean Böhler's angle measured on the radiograph with weight bearing was 13 degrees (standard deviation=3.24; median=13.5). Gissane's angle and the calcaneal pitch had mean values of 125 (standard deviation=10.32; median=122) and 20 (standard deviation=3.09; median=17.5) degrees, respectively. The mean talar declination angle was 95 degrees (standard deviation=4.84; median=93). The mean AOFAS score for the ankle and hindfoot was 73.8 points (standard deviation=7.13; median=71.5). All patients reported being satisfied, albeit with some restrictions. Residual pain was a frequent complaint and had a mean score of 3.6 points (standard deviation=1.01; median=3.5) on the VAS Pain.

Böhler's angle was altered in all cases; however, even with this altered angle, 10 of the 14 feet had AOFAS hindfoot and ankle scores greater than or equal to 70 points (Table 1). Therefore, we did not find a relationship between an altered Böhler's angle and a better clinical-functional outcome according to the AOFAS score (P=1.62; Student's t-test). Table 2 shows the results obtained for Gissane's angle, which was considered normal in 11 of the 14 cases. We also found no relationship between the measured angle values and the clinical-functional outcome (P=1.24; Student's t-test). None of the other studied parameters, including the calcaneal pitch, talar declination angle, and calcaneal width, was directly correlated with the AOFAS score.

Moreover, we did not find any direct relationship between pain measured with the VAS pain as a comparison parameter and the obtained angle values.

When we asked the patients about personal satisfaction with the treatment performed, all 12 patients said they were satisfied but had minor restrictions. Again, this response had no direct relationship with the angle values measured on the final radiograph.

DISCUSSION

Treatment of displaced intra-articular calcaneal fractures is controversial⁽¹⁹⁾. Although some studies have shown some superiority of surgical treatment, especially with regard to early return to work and a lower chance of developing talocalcaneal arthritis, the worst results are also related to this treatment modality when complications arise in the surgical wound, such as infection^(1-3,11,12,15,20). Studies comparing the outcomes of conservative and surgical treatment, including some meta-analyses, suggest that surgery is not the most appropriate treatment for patients with comorbidities, such as diabetes or peripheral vascular disease, smokers, and patients who most likely will not follow medical recommendations during the postoperative period, due to an increased risk of complications^(2,8,11,18,21). This recommendation was adopted in the protocol for the treatment of displaced intra-articular calcaneal fractures in our hospital. We also included those who attempted suicide in this category, because we considered that this group had little chance of following the medical recommendations

Table 1. Measurement of Böhler's angle on the profile radiograph of the calcaneal fracture at the last visit and the clinical-functional outcome according to the AOFAS ankle and hindfoot score.

	AOFAS >70 points	AOFAS <70 points	Total
Normal Böhler's angle	0	0	0
Altered Böhler's angle	10	4	14
Total	10	4	14

Source: Prepared by the author based on the results of the research.

Table 2. Measurement of Gissane's angle values on the profile radiograph of the calcaneal fracture at the last visit and the clinical-functional outcome according to the AOFAS ankle and hindfoot score.

	AOFAS >70 points	AOFAS <70 points	Total
Normal Gissane's angle	8	3	11
Altered Gissane's angle	2	1	3
Total	10	4	14

Source: Prepared by the author based on the results of the research.

Table 3. Sample of patients included in the study with the analyzed variables.

	Gender	Age	Trauma	Laterality	Böhler's angle	Gissane's angle	Calcaneal width	Talar declination angle	Calcaneal pitch
Patient 1 (R)	M	56	Fall from height (7m)	Bilat.	14	108	2	98	16
Patient 1 (L)	M	56	Fall from height (7m)	Bilat.	17	107	2.4	92	15
Patient 2 (R)	M	58	Fall from height (3m)	Bilat.	10	134	1.6	91	17
Patient 2 (L)	M	58	Fall from height (3m)	Bilat.	11	126	1.8	92	14
Patient 3	M	48	Fall from height (2m)	Right	7	124	1.7	98	21
Patient 4	F	55	Fall from height (2m)	Right	13	133	2	92	18
Patient 5	F	67	Fall from height (2m)	Left	12	142	1.8	108	20
Patient 6	M	51	Fall from height (3m)	Right	10	140	1.7	94	16
Patient 7	M	36	Fall from height (5m)	Right	14	122	2	102	22
Patient 8	F	62	Fall from height (5m)	Left	14	132	1.8	95	23
Patient 9	M	60	Fall from height (4m)	Left	18	125	2.2	95	18
Patient 10 (R)	F	42	Fall from height (3m)	Bilat.	12	121	2.3	91	24
Patient 10 (L)	M	65	Fall from height (1.5m)	Bilat.	18	123	2.4	94	21
Patient 11	M	72	Fall from height (5m)	Left	16	119	2	92	20

Source: Prepared by the author based on the results of the research.

necessary for surgical success. In the group of 11 patients evaluated in this article, five (42%) had attempted suicide, six (50%) reported using illicit drugs, and six (50%) reported being smokers. Interestingly, our records indicated that approximately 200 patients with intra-articular calcaneal fracture underwent conservative treatment. However, when evaluating the medical records of these patients, we found that many patients only attended the first visit (time of fracture) and never returned to our hospital. Although we tried to contact the patients by telephone or electronic communication to schedule a follow-up visit, we were able to reach only a few patients, and most refused to participate in the study. In our opinion, this result demonstrates the low adherence to treatment of this special group and further reinforces our choice of conservative treatment in these cases.

Despite the small number of cases, eight of the 11 patients (10/14 feet) (71%) had a clinical-functional outcome that we considered satisfactory (AOFAS ankle and hindfoot score greater than or equal to 70 points), and all patients were satisfied with the final treatment outcome with minor restrictions after the mean follow-up time of five years. These results demonstrated that conservative treatment seemed to be a good choice in these cases, although this result might worsen with a longer follow-up period. Allmacher et al.⁽²²⁾ reported the outcome of conservative treatment of displaced intra-articular calcaneal fractures in 19 patients. After 10 years of follow-up, the outcome of 63% of cases was considered good or excellent.

However, after 20 years of follow-up, the outcome was considered excellent or good only in 47% of the feet. According to the authors, the outcome of conservative calcaneal fracture treatment seems to worsen with longer follow-up, and the main cause of this worsening is painful talocalcaneal arthritis.

According to Clare et al.⁽¹²⁾, although conservative treatment is advocated in the literature as acceptable due to the increased risk of surgical treatment complications in a specific group of patients, the technical difficulties are challenging in cases requiring surgical reconstruction of the calcaneus after conservative treatment failure, and the final outcome will not be as good as that in cases in which surgery was performed at the time of fracture. Some authors have found that surgical treatment of a displaced intra-articular calcaneal fracture by an experienced surgeon who can not only reconstruct the talocalcaneal joint but can also restore the anatomical shape of the bone will lead to a better long-term clinical outcome^(12,23).

Publications describing minimally invasive techniques for reconstruction of this fracture^(15,24-26) led us to consider changing the protocol to conservative treatment. We propose approaching this group of patients, who are candidates for conservative treatment, during the acute phase using percutaneous techniques or small incisions mainly to recover the anatomical shape of the calcaneus and reduce the talocalcaneal joints; this protocol will reduce the size of correction surgery if it becomes necessary. However, before

we changed our protocol, we decided to retrospectively evaluate the outcome of our treatment.

Because computed tomography⁽²⁷⁾ to evaluate the calcaneus shape was not available for all of the analyzed cases, we used radiographic parameters. Some angle measurements to measure the calcaneus anatomy are described in the literature, such as Böhler's angle, Gissane's angle, calcaneal width, talar declination angle, and calcaneal pitch^(5,6). Böhler's angle seems to be the most important prognostic

parameter^(3,11,13,28,29), although some authors disagree with this assertion^(7,22,30). In our study, despite the small sample size, we observed no correlation between preservation of Böhler's angle and the clinical-functional prognosis according to the AOFAS ankle and hindfoot score. We considered an AOFAS ankle and hindfoot score greater than or equal to 70 to represent a good or excellent clinical-functional outcome. However, when we compared this outcome with radiographic parameters, we did not find any relationship between the measured angle values and the clinical-functional outcome. In other words, in the small sample analyzed here, a better clinical-functional outcome had no relationship with a better calcaneal bone shape after an average follow-up time of five years, as exemplified in figure 3. These results further reinforce the hypothesis that adequate treatment of calcaneal fractures depends on each patient's profile^(2,3,11).

This study has limitations. This study was retrospective and evaluated a small number of cases, which represented a small percentage of the cases treated in this hospital. This small number may be a bias if we consider that only the cases that are clinically healthy return to the outpatient clinic. However, as explained above, the profile of the pa-



Figure 1. Radiograph showing Böhler's angle subtended by a line drawn from the superior aspect of the posterior tuberosity of the calcaneus to the superior subtalar articular surface and a line drawn from the superior aspect of the anterior process of the calcaneus.

Source: Ankle and Foot Surgery Group.



Figure 2. Radiograph showing Gissane's angle subtended by a line drawn from the superior aspect the descending portion of the posterior facet and another line drawn from the superior aspect of the ascending portion of the posterior facet.

Source: Ankle and Foot Surgery Group.



Figure 3. Profile radiograph. A: Patient 1 (L) with an altered Böhler's angle and AOFAS >70; B: patient 10 (L) with an altered Böhler's angle and AOFAS <70.

Source: Ankle and Foot Surgery Group.

tients evaluated here reveals little adherence to the medical recommendations, because few patients had regular consultations in the outpatient clinic after the fracture, and many of them did not return after the first treatment. The lack of computed tomography to assess the shape of the calcaneus is also a limitation of this study, but this exam was available for only a few cases.

CONCLUSION

Despite the small number of cases evaluated in this study, the clinical-functional score according to the AOFAS ankle and hindfoot scale was considered satisfactory in most cases. We found no relationship between the calcaneus shape measured using radiographic parameters and the clinical-functional outcome.

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