

EXTERNAL FIXATION IN CALCANEUS FRACTURE: STATE OF ART AND REVIEW OF LITERATURE

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ABSTRACT

Fractures of the calcaneus represent a significant challenge for the orthopedic surgeon. The use of external fixators dedicated to the calcaneus has allowed in recent years a simpler and more intuitive approach to these fractures. The aim of our study is to review the literature to understand the state of the art of this surgical approach. Was conducted a literature review in PubMed, EMBASE and Google Scholar with the keywords "Fracture" "Calcaneus" "External fixation". 35 articles were reviewed by 3 authors. The exclusion criteria were: studies with less than 20 patients, articles published before 2000, and minimum follow up of 15 months. 267 FE-treated fractures were included. Of the 267 fractures, according to the Sanders classification, 1.26% were type I, 36.6% type II, 50.47% type III and 11.67% type IV. In the follow-up, 165 patients had excellent (> 90), 99 good (> 75), 27 good (> 50) and 16 poor (<50) Maryland Score. The mean pre-operative Bohler angle was 5.3 °, with a post-surgical mean of 24.11°. Internal fixation in calcaneus fractures has poor clinical outcome and is recommended to be performed by expert surgeon. The data that emerged from the review highlight how the FE of the calcaneus is an effective method with limited post-surgical complications. FE of the calcaneus seems to be an effective treatment method, it allows the reduction of complications and allows to obtain excellent functional results, resulting in a safe and easily reproducible surgical strategy.

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1. Introduction

Calcaneal fractures represent the 2% of all fractures and nearly 60% of tarsal bones fractures.(1) They usually occur after a high-energy axial trauma, as a fall from height or motor accidents. Such fractures afflict adults in their peak-working activity. (2)

Thus, they are regarded as a great economic and social burden for the society. The patients generally need from 5 to 10 months to resume working, and approximately 20% of them will be not able to return to work within one year.

In literature, the 60%–75% of these fractures are intra-articular making complex their treatment. The involvement of the posterior calcaneal articular surface is considered the most predictable factor of poor results, due to the more likely possibility to achieve a postoperative osteoarthritis and the following pain and chronic stiffness. (2,3)

The ideal treatment for displaced intra-articular calcaneal fractures remains controversial and outcome are often not brilliant. During the past decades, open reduction and internal fixation have been the most performed technique, and it is still the standard treatment option. The most common treatment for calcaneal fracture has been ORIF via a lateral extensile approach, but this technique is not without complications. Conventional techniques for ORIF can be hazardous in certain situations, such as fractures with soft tissue compromise and severely comminuted fractures. ORIF of these fractures is technically demanding and is associated with wound infection, wound dehiscence, flap devascularization, and injury to the sural nerve. Infection rate has been reported at 0.4%–27% with 15%–25% of general complication. There is a limited ability to restore anatomical reduction; combined medial and lateral approaches are often required and these are associated with a high risk of wound-healing problems. (4, 5)

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Conversely, conservative treatment usually leads to severe complaints and disabilities. In fact, these injuries can remain symptomatic for 1–2 years and can lead to the need for secondary arthrodesis in up to 16% of the non-operatively treated patients. The derangement in calcaneal morphology after a fracture can be significant and is often associated with severe soft tissue envelop problems.

In order to reduce wound complications several minimally invasive techniques has been performing in the last years. External fixation can successfully restore normal calcaneal height, length, width, and coronal plane alignment. For severely displaced joint depression and broken tongue–type calcaneus fractures where open treatment is the preferred strategy, early external fixation restores the normal soft tissue tension, allows a stable environment for soft tissue recovery, and facilitates the definitive operation by restoring and maintaining overall calcaneal architecture. (5)

Current literature suggest that in comparison to open reduction, a percutaneous reduction and fixation, achieved with an external fixator or with the employment of a balloon, K-wires and bone graft augmentation, leads to higher but not statistical functional scores minimizing the wound-healing complications. (6,7,8,9)

The treatment should be individualized based on the type of fracture, patient characteristics and the surgeon's experience. The aim of our study is to review the literature to understand the state of the art of this surgical approach and compare the results in the literature.

2. Material Methods

A literature review was conducted in PubMed, EMBASE and Google Scholar with the keywords "Fracture" "Calcaneus" "External fixation". As reported in table 1, the inclusion criteria were case series of calcaneus fracture treated with external fixation. 35 articles were reviewed by 3 authors and included 5 articles with 300 calcaneus fractures treated with external fixation (10, 11, 12, 13, 14, 15).

The exclusion criteria were: studies with less than 20 patients, articles published before 2000, and minimum follow up of 15 months. An article with 33 fractures were excluded because it was not possible to distinguish between those treated with FE and those treated with K-wire.

A total of 267 FE-treated fractures were included. For each studies was analyzed the age of patients, the type of fractures according to the sanders classification, the clinical outcome with rating scale, recovery and the variation of Bohler's angle. With analyzed the complication reported.

Study	Author	Place and year of publication	Enroller Patients	N° of fractures (%)
I	M. Githens et al.	USA 2017	21	21 (7.9%)
II	L.Emanuele et al.	ITALY 2016	30	30 (11.2%)
III	G. Vincenti et al.	ITALY 2019	162	164 (72.6%)
IV	B.Magnan et al.	ITALY 2006	50	52 (19.5%)
TOT				267

Table 1. Systematic Literature Review and fractures included

3. Results

The average age of the patients is 50.3 years and male/female ratio was 3:1. 267 fractures was analyzed. According to the Sanders classification, 4 (1.26%) were type I, 106 (36.6%) type II, 124 (50.47%) type III and 33 (11.67%) type IV. The mean pre-operative Bohler angle was 5 °, with a post-surgical mean of 23.86°. In the follow-up, 145 (54%) patients had excellent (> 90), 83 (32%) good (> 75), 25 (9%) good (> 50) and 14 (5%) poor (<50) Maryland Score.

The mean Maryland foot score was: for type I fractures, 88 (good) (min.84-max.90); for type II fractures, 83.03 (good)(min.65-max.91); for type III fractures, 82.08 (good)(min.55-max.99); and for type IV fractures, 84.1 (good)(min.34-max.99).

The minimum result is 34 for a type 4 fracture, 55 for a type 3, 65 for a type 2 and 84 for a type 1. The three poor results were observed in non-compliant patients in whom collapse of the calcaneal body was caused by early weight-bearing against medical instruction.

Was reported 16 cases of superficial pin infection (5.04%), 30 cases of mild algodystrophy and 2 severe cases treated with arthrodesis are reported. No deep infection. The fixators were removed after 12 weeks on average.

Study	N° of fractures (%)	SANDERS I	SANDERS II	SANDERS III	SANDERS IV
I	21 (7.9%)	0	6	13	2
II	30 (11.2%)	0	4	22	2
III	164 (72.6%)	4	81	58	21
IV	52 (19.5%)	0	15	31	8
TOT	267	4	106	124	33

Table 2. Type of fractures (Sanders Classification).

Study	N° of fractures (%)	EXCELLENT (>90)	GOOD (75/89)	FAIR (50/74)	POOR (<50)
I	21 (7.9%)	8	6	5	2
II	30 (11.2%)	7	11	8	3
III	164 (72.6%)	104	44	10	6
IV	52 (19.5%)	26	22	2	3
TOT	267	145	83	25	14

Table 3. Clinical results according with Maryland Score.

Study	N° of fractures (%)	BOHLER'S ANGLE PRE	BOHLER'S ANGLE POST
I	21 (7.9%)	2	22
II	30 (11.2%)	6	23
III	164 (72.6%)	5.02	28.5
IV	52 (19.5%)	6.98	21.94
MEDIA		5	23.86

Table 4. Bohler's angle variation pre and post treatment.

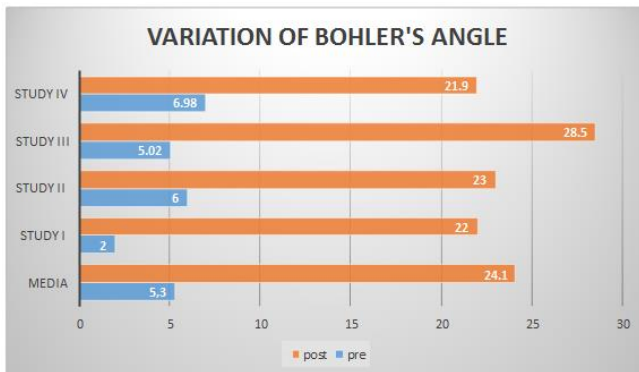


Figure 1. Bohler's angle variation pre and post treatment.

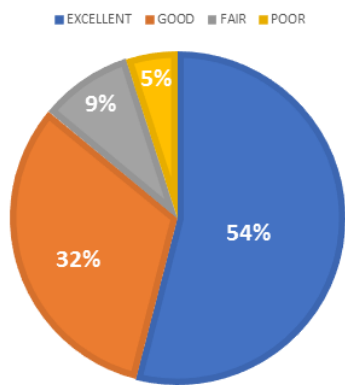


Figure 2. Maryland score for 267 fractures treated with FE

4. Discussion

Internal fixation in calcaneus fractures in the literature has poor clinical outcome and is recommended to be performed by surgeons experienced in this surgery. The data that emerged from the review highlight how the FE of the calcaneus is an effective method with limited post-surgical complications. The clinical and radiological results obtained with FE are substantially similar in all the studies analyzed.

The results of this review shows how is good and safe the treatment by external fixation. The data shows that the results are good for each type of fracture, underlining how the worst results are obtained in the case of more complex fractures, where any therapeutic choice would probably have been unsuccessful.

To proceed with internal fixation requires a much more invasive intervention, which presents greater technical difficulties, fewer clinical advantages and greater skin care. The possibility that there are complications at the level of the surgical wound are very probable in the case of ORIF, while they are practically absent in the case of FE. (5,8,16,17,18)

The aim of the study is not to establish which is the best technique between ORIF and FE, the choice of treatment will be based on the experience of the surgeon and the patient's condition, but the results of the review confirm that FE is a rapid surgical technique, practically without contraindications, if not patient compliance, almost no complications, with excellent clinical and radiological results and easily reproducible.

It is clear from the data analysis that the possibility of choosing for an FE intervention is to be considered always and in any case.

5. Conclusions

Displaced intra-articular calcaneal fractures are still technically demanding injuries to manage. The external fixation of calcaneus is an excellent treatment method in all calcaneus fracture, it allows the reduction of complications, such as infections, and allows to obtain excellent functional results, resulting in a safe and easily reproducible surgical strategy. All studies have same results, this aspect is very important because it underlines how the results are similar regardless of the experience of the center and of the individual orthopedic surgeon.

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