



Comparison of the efficacy of surgical and non-surgical treatments in intra-articular calcaneal fracture

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Calcaneal fracture accounts for 2% of all fractures and is the most common tarsal fracture. Regarding this, the present study was conducted to determine and compare the surgical and non-surgical treatments in adult patients with calcaneal fractures in terms of outcomes, patients' satisfaction level, and complications. This clinical trial was conducted on 63 patients with intraarticular fractures of calcaneus referring to the educational centers of Mazandaran University of Medical Sciences, Mazandaran, Iran, to assess the surgical and non-surgical methods. The patients' satisfaction level with the treatment was estimated based on the visual analog scale. In addition, pain, function, and organ alignment were evaluated by using the American Orthopedic Foot and Ankle Society Hind Foot Score (AOFAS). Out of the 63 patients, 26 (41.3%) and 37 (58.7%) cases were in the surgical and non-surgical groups, respectively. The mean score of AOFAS was obtained as 76.35 ± 17.19 (out of 0-100) with the minimum and maximum values of 22 and 100, respectively. The results revealed no significant difference between two treatment groups in terms of mean AOFAS. As the findings of the present study indicated, the surgical and non-surgical methods in patients with Essex grades III and IV calcaneal fractures did not affect their satisfaction after treatment and improvement. Therefore, given the higher number of the surgical treatment complications, it is recommended to adopt the non-surgical treatments.

Keywords: Surgical treatment, therapeutic complications, Intra-articular calcaneal fractures

Introduction

Calcaneal fracture accounts for 2% of all fractures and is one of the most common fractures in the tarsal region [1, 2]. This kind of fracture is divided into two types of major and minor. The major fractures are usually caused by height fall or road accidents. According to statistics, in 2010, these kinds of fractures accounted for the referral and admission of 2,721 and 17,274 people to hospital in England and USA, respectively [3,4]. However, there is no accurate statistics in this regard in Iran.

The intra-articular fractures of calcaneus mainly occur in the patients active in social and economic domains (i.e., those within the age range of 30-50 years). It often takes about 5-10 months for the patients to get back to their previous activity or work [5,6]. Moreover, the

majority of the patients are not able to resume their former activities up to 1 year [7,8]. The complications of this fracture can last 1-2 years, and result in the need for secondary arthrodesis in 16% of the cases undergoing non-surgical treatment [6,9].

In the Netherlands, the most common treatment method for these patients is open reduction and internal fixation (ORIF, 46%), followed by non-surgical treatments (39%) and percutaneous surgery (10%) [10]. Non-surgical measures include observation, using ice, casting, splinting, and moving as soon as possible. Surgeons prefer surgical interventions for major fractures to speed up recovery and reduce the associated pain and deformity [9].

The Essex-Lopresti technique was developed to overcome the surgical complications, such as infection and nerve injury, during calcaneus fracture repair and site problems of percutaneous approach. Percutaneous technique has been less frequently investigated in comparison to ORIF [11,12]. According to the mentioned studies, there

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is no evidence regarding the priority of these two methods in terms of their efficiency.

With this background in mind, the present study was conducted to determine and compare the outcomes, patients' satisfaction level, and complications of surgical and non-surgical treatments among adult patients with calcaneal fracture referring to the educational care centers of Sari city, Mazandaran, Iran during 2013-2015, using the Foot Function Index.

Materials & Methods

This retrospective study was conducted on the medical records of the patients with intra-articular fractures of calcaneus referring to the educational care centers affiliated to Mazandaran University of Medical Sciences, Mazandaran, Iran. The participants were investigated in two groups of surgical and non-surgical, each of which included 26 (41.3%) and 37 (58.7%) patients, respectively. The inclusion criteria were the age range of 16-70 years and Sanders types III and IV fractures. On the other hand, the exclusion criteria were: 1) primary arthrodesis, 2) Gustilo grade III open fracture, 3) diabetes mellitus, 4) alcohol consumption or drug abuse, and 4) heavy smoking. All participants were subjected to either surgical or non-surgical treatments. The non-surgical treatment includes daily non-weight bearing motion exercises and plaster of Paris cast, while the surgical treatment was ORIF. In this procedure, in most of the cases, a cut is created with an obtuse angle of 100-110°, and the fracture is fixed by a non-locking calcaneal plate [13]. The percutaneous method is the same as the Essex-Lopresti technique that is accomplished by inserting a 4.5-mm pin super lateral to the Achilles tendon during the decompression and reduction steps [10].

Patients' information (e.g., gender, age, time of incidence, and accompanying diseases), fracture-related information (e.g., fracture treatment, and duration of using non-weight-bearing and plaster), and complications were collected and recorded in the information form of each patient. The American Orthopedic Foot and Ankle Society Hind Foot Score (AOFAS) was used to determine the functional outcomes (5). Furthermore, patient satisfaction was assessed using the Visual Analog Scale (VAS) (5), and anatomical changes in the foot shape were determined by direct observation.

Statistical analysis

The data were recorded in SPSS software (version 18.0). The quantitative data were described using mean and median, while the non-quantitative on were presented as frequency. Student's test and ANOVA were used to examine the quantitative variables in the two treatment groups, and Chi-squared test was utilized to analyze the non-quantitative data. P-value less than 0.05 was considered statistically significant.

Results

Table.1 presents the demographic information of the patients. According to the results, 51 patients (81%) were male. The two groups were comparable in terms of gender distribution (p=0.84). Furthermore, 13 and 11 patients in the surgical and non-surgical groups suffered from the right calcaneus injury, respectively (Table 1), and the two groups were not significantly different in this regard (p>0.05; Table 1). In terms of the difficulty of occupation prior to the injury, 30.6% (n=19), 51.6% (n=32), and 17.5% (n=12) of the patients had simple, moderate, and hard jobs, respectively. The results revealed no significant difference between the two groups considering job difficulty (p=0.50).

Table 1. Demographic information of the patient

		Surgical group Frequency (%)	Non-surgical group Frequency (%)	P-value
Gender	Male	20 (31.7%)	31 (49.2%)	0.53
	Female	6 (9.5%)	6 (9.5%)	
Side of injury	Right	13 (21%)	11 (17.7%)	0.32
	Left	11(17.7%)	19 (30.6%)	
	Both sides	1 (1.6%)	7 (11.3%)	
Pre-injury occupation	Simple	4 (7.1%)	6 (10.7%)	0.72
	Moderate	15 (26.8%)	19 (33.9%)	
	Hard	4 (7.1%)	8 (14.3%)	
Age		40.8±9.37	43.67±11.36	0.3

The mechanisms of injury were low-energy trauma (LET), high-energy trauma (HET) caused by height fall, and HET due to other causes in 8.2% (n=4), 81.7% (n=49), and 11.7% (n=7) of the patients, respectively. There was no significant difference between the two groups regarding the mechanism of injury (Table 2).

Table 2. Frequency distribution of different mechanisms of injury in the two study groups

	Surgical group Frequency (%)	Non-surgical group Frequency (%)
Low-energy trauma	2 (10%)	2 (3.3%)
High-energy trauma(Fall)	20 (33.3%)	29 (48.3%)
High-energy trauma(Others)	4 (6.7%)	4 (6.7%)
	p=0.93	

The mean smoking rate in the smoker patients was 11 ± 7 cigarettes per day, which was not significantly different between the two groups ($p=0.62$). In the present study, the patients' satisfaction rate with the type of treatment was estimated using the VAS (ranging from 0 to 10) (Table 3). Furthermore, the pain, function, and alignment of the organ were evaluated based on AOFAS criteria (in a range of 0-100). The mean score of AOFAS was obtained as 76.35 ± 17.19 with the minimum and maximum values of 22 and 100, respectively. This variable was not significantly different between the two treatment groups ($p=0.12$). Similarly, each of the AOFAS sub-sections, including pain, function, and alignment, did not differ significantly between the two groups (Table 3)

Table 3. Mean satisfaction, AOFAS, and AOFAS sub-sections in the two study groups

	Surgical group Mean \pm SD	Non-surgical group Mean \pm SD	P-value
Satisfaction (VAS)	7.36 \pm 1.46	7.21 \pm 1.65	0.9
AOFAS (total)	77.57 \pm 19.38	75.91 \pm 15.26	0.7
Pain(AOFAS)	27 \pm 12.18	30 \pm 6.4	0.44
Function(AOFAS)	39.85 \pm 10.8	42.30 \pm 10.14	0.19
Alignment(AOFAS)	8.40 \pm 2.21	10.45 \pm 7.72	0.35

VAS: visual analog scale, AOFAS: American Orthopedic Foot and Ankle Society Hindfoot Score

Based on the results, the rate of satisfaction with the treatment type showed no significant relationship with age, body mass index, smoking, and duration of wearing the plaster cast ($P>0.05$). Nonetheless, this variable demonstrated an indirect relationship with latency to treatment and post-treatment non-weighting period. In this regard, more delay in treatment was accompanied by a lower satisfaction rate, while shorter post-treatment non-weighting period was accompanied by a higher rate of satisfaction. Post-operative infections were observed only in the surgical group ($n=4$, 6.5%) and were superficial in all cases

Discussion

The present study aimed to investigate two treatment methods of displaced intra-articular calcaneal fractures. This study involved the comparison of the surgical and non-surgical therapies in terms of satisfaction, pain, function, foot alignment (based on AOFAS scores), complications, and deformity. The findings revealed no significant difference between the two groups subjected to surgical and non-surgical treatments in terms of the satisfaction rate.

Likewise, the two groups showed no significant difference regarding the pain, function, and alignment. Therefore, none of the two methods were superior to the other one in this regard.

The surgical procedures for the treatment of intra-articular calcaneus fractures have been recently given more attention and associated with better outcomes and lower morbidities [14-18]. However, the majority of the surgeons still prefer to use conservative treatments for the management of these fractures, probably due to such complications as post-operative infection, wound secretion, improper correction of displacement, and osteoarthritis in the long run. Most of the calcaneal fractures are intra-articular and accompanied with displacement. Moreover, they usually co-occur with ecchymosis, swelling, and blisters that increase the risk of surgery [19,20].

However, researchers in various studies have shown that in case of proper correction, ORIF results in a better prognosis in displaced intra-articular calcaneal fractures, compared to the conservative treatment and is superior in this regard [16]. It has been also demonstrated that the patients undergoing surgical treatment have significantly lower prevalence and severity of pain in their daily activities and showed a more acceptable range of motion in the ankle and subtalar joint [21,22].

Additionally, surgical procedures have been reported to result in fewer complications. In a study performed in the United States, Heckman et al., [23] reported fewer long-term complications for surgery than for the conservative methods. However, they noted that the postoperative radiographic confirmation of displacement correction, appropriate anatomical correction, and timely surgery has a significant role in the reduction of complications, such as peroneal tenosynovitis. In a study conducted by Bahari et al., in Mashhad, Iran, the incidence of peroneal tenosynovitis was significantly lower in patients undergoing ORIF surgery, compared to that in the patients subjected to non-surgical treatments (9.5% versus 39.3%) [24].

On the other hand, some scholars have reported different findings in this regard. Per Henrick Agren et al., (2013) demonstrated that the ORIF method showed no superiority over the conservative treatment in a one-year follow-up. However, they reported that this method was associated with benefits over a period of 8-11 years. They also noted that the surgical procedure was associated with more complications. In the mentioned study, radiographic follow-up revealed

a lower prevalence of post-trauma arthritis in the patients undergoing surgery as compared to those receiving conservative treatments [25].

In a study carried out in the United Kingdom in 2014, the comparison of two methods, namely open surgery and ORIF, with the conservative method indicated more complications in patients undergoing surgery. In the mentioned study, the prevalence rates of post-surgical infection and need for the re-surgical removal of the dead or infected tissue were obtained as 19% and 11%, respectively [1].

In the current study, there was no significant difference between the patients subjected to surgical intervention and those receiving the conservative methods in terms of the objective outcomes, general health status, return to work, and quality of life. Even the width of the heel (which is a reason for surgery to make it easier to wear shoes) was not significantly different between the two groups. Furthermore, walking speed and other walking indicators did not differ significantly between the two groups after 2 years

Conclusion

The comparison of the non-surgical method with the surgical technique in patients with Sanders grades III and IV calcaneal fractures demonstrated that the selected treatment method did not affect the patients' satisfaction after treatment and improvement. Regarding this and given the more complications of surgical treatment, the non-surgical therapies seem to be more appropriate for these patients.

Conflicts of interest

None declared.

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