

## Review

# Comparison of Conservative and Surgical Treatment of Displaced Intra-Articular Calcaneal Fractures

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### Abstract

Calcaneal fractures are the most common tarsal bone fracture and approximately 75% of these fractures are intra-articular. The results of treatment of displaced intra-articular calcaneal fractures are usually not satisfactory. According to published data, there is no consensus on whether surgical treatment is superior to conservative treatment in displaced intra-articular calcaneal fractures (DIACF). In this study, the studies on the subject in the current literature were examined and the optimal treatment approach in displaced intra-articular calcaneus fractures was discussed.

**Keywords:** Calcaneus, conservative management, displaced fracture, surgical treatment

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Calcaneal fractures are the most common tarsal bone fracture and approximately 75% of these fractures are intra-articular.<sup>[1,2]</sup> The results of treatment of displaced intra-articular calcaneal fractures are usually not satisfactory. According to published data, there is no consensus on whether surgical treatment is superior to conservative treatment in displaced intra-articular calcaneal fractures (DIACF).<sup>[3,4]</sup>

Some retrospective studies suggest surgical treatment for DIACF. It is known that patients who underwent surgical treatment had better functional outcome scores and experienced less pain than conservatively treated patients.<sup>[5-9]</sup> However, many orthopedic surgeons have expressed concern that the benefits derived from surgery will be compensated by wound complications.<sup>[10]</sup> Several randomized controlled trials comparing conservative treatment with surgical treatment for DIACF are available in the literature. However, these randomized trials have yielded inconsistent results. Most of these studies are limited to a small sample size. There is also little statistical power to detect the differ-

ence between the groups compared. Some clinicians have concluded that current evidence is insufficient for proving that surgical treatment for DIACF is superior to non-surgical treatment, while other clinicians have reported that patients who are surgically treated tend to have better results.<sup>[3,11-15]</sup> Although the development of modern surgical techniques has improved clinical outcomes in many patients, a complete consensus has not been achieved in the classification, treatment, surgical technique and postoperative care.<sup>[10]</sup>

Therefore, the surgical method of choice for DIACF remains unclear. The aim of this study is to make an updated analysis on the surgical and conservative treatment of displaced intra-articular calcaneal fractures in adults.

### Imaging Studies

Radiological evaluation in a patient exposed to calcaneal trauma involves lateral image of the hindfoot, anterior-posterior view of the foot, and Harris' axial direct X-ray of the heel.<sup>[16]</sup> Harris axial radiography is a painful procedure and it

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is not routinely used today.<sup>[17]</sup> In lateral imaging, the current calcaneal fracture should be defined. Radiological imaging also reveals a loss of height in the posterior facet. The Böhler angle decreases, while the Gissane angle is increased. Broden X-ray is obtained when the x-ray is shoot on the lateral malleoli, while the foot is in the neutral flexed position and 30-40 degrees of internal rotation. Radiographs are obtained in such a way that the detector makes 10, 20, 30 and 40 degrees in the cephalic direction. With the widespread use of computed tomography, this radiographic technique has lost its importance. In order to better understand the calcaneal fractures, computed tomography images are obtained in most trauma centers in addition to the direct X-Ray.<sup>[18]</sup>

## Treatment Planning

In 1908, Cotton and Wilson stated that open reduction was contraindicated for calcaneal fractures. In fact, due to the high rate of complications and sequelae and even amputations after surgery, this view has been valid for many years.<sup>[19]</sup> Today, the development of surgical techniques and increasing quality of life and expectations have led to the emergence of surgical options in treatment planning. For surgical intervention, appropriate patient selection and good evaluation of the patient before surgery constitute the most important step in the treatment. In addition, the surgeon should be prepared for possible postoperative complications and should be part of the treatment plan. Since calcaneal fractures are high-energy trauma, all systems should be evaluated for fracture-dislocation or other damage before surgery. It should be kept in mind that vertebra fractures, which are frequently caused by falling from heights or suicides, cause fracture in the calcaneus due to axial load transmission.<sup>[20]</sup>

## Surgical Treatment

In a meta-analysis by Meena et al.,<sup>[21]</sup> a better functional outcome was achieved with the surgical treatment of displaced intra-articular calcaneal fractures compared to conservative treatment. However, the complication rate was higher in surgical treatment compared to conservative treatment. The patients who underwent surgical treatment were more likely to continue their life before the accident. Although mild to moderate workers can achieve better recovery after surgery, patients with severe work are unlikely to return to work, regardless of treatment option.<sup>[22]</sup> The duration of return to work of patients with surgical treatment is significantly shorter.<sup>[23]</sup> Also, when the angle of Bohler is restored and anatomic reduction is achieved, there is better functional outcome and less pain.<sup>[22-24]</sup> However, the anatomic restoration of the angle is not associated with the clinical outcome.<sup>[25]</sup> In operated patients (possibly due

to restoration of calcaneal width), less problems are experienced in wearing shoes and less pain (although not statistically significant) is experienced. Painless walking distances (1 km versus 4 km) are much longer and have a wider range of subtalar motion.

According to the Cochrane review, it is not clear whether the potential advantages of surgical treatment are greater than the risks. Compared with conservative treatment, patients who underwent operative treatment had a better physical score, but had similar values in mental and AOFAS scores.<sup>[26, 27]</sup> However, patients who underwent operative treatment had a higher complication rate up to 54%.<sup>[28]</sup>

Operative treatment may not be appropriate for patients with comorbidities such as peripheral vascular disease, diabetes, smoking habit, blisters in the fracture site, neglected fractures and serious other system injuries.<sup>[29]</sup> Excellent results are obtained with percutaneous screw application for displaced intra-articular calcaneal fractures.<sup>[30,31]</sup> Percutaneous distractive reduction and fixation is a safe technique and provides a good outcome and acceptable complication rate.<sup>[32]</sup> Percutaneous approach reduces soft tissue complications and is a good alternative to moderately displaced fractures.<sup>[33]</sup> It provides adequate control with subtalar arthroscopy or high resolution fluoroscopy during anatomic joint reduction.<sup>[34]</sup>

The rate of surgical intervention in non-operative patients is higher but not significant. The most common surgical procedure is subtalar arthrodesis.<sup>[35]</sup> Operative treatment to correct the anatomy of the calcaneus makes subsequent surgery less challenging.

Crosby and Fitzgibbons began to operate displaced fractures due to poor outcomes of conservative treatment in displaced and fractured fractures.<sup>[36]</sup> They then compared the surgical treatment results of these patients with those treated conservatively and found superior results in those treated surgically. The difference was found to be statistically significant.

## Conservative Treatment

Non-surgical treatment of fractures of the calcaneus requires a multidisciplinary study and the team should consist of a physical therapist, an experienced orthopedic surgeon and an orthosis specialist familiar with such injuries. Most of the extra-articular fractures are conservatively treated since the injury does not change the load-bearing surface of the foot and the biomechanics of the joint are not affected.<sup>[37]</sup> In addition, multiple part intra-articular fractures can be treated conservatively when reconstruction cannot be very successful.<sup>[38]</sup> Reduction must be ensured before conservative treatment begins. Indications for

**Table 1.** Conservative treatment indications and treatment methods**Cast + 6 weeks of non weight-bearing**

Calcaneal Stress Fractures

**Cast + 10-12 weeks of non weight-bearing**

Small, extra articular fractures (&lt;1 cm), Achilles tendon intact, fractures &lt;2 mm

Sanders type 1 (undisplaced)

Anterior facet fracture involving less than 25% of the calcaneocuboid joint

Comorbidities affecting the outcome of surgery (smoking habit, diabetes, peripheral arterial disease)

conservative treatment are shown in Table 1.

Closed reduction is achieved with plantar flexion of the hindfoot and forefoot arch and by the elevation of the posterior facet. However, it is not possible to maintain the reduction after providing the reduction.

Most authors recommend short-leg cast and exercises for joint range of motion after 2 weeks of non-weight bearing. Progressive weight-bearing starts at 8th week and at the 12<sup>th</sup> week, full weight-bearing takes place.

Technically, exercises for joint range of motion should be started from when swelling is resolved.<sup>[39]</sup> In the conservative treatment, once the support splint allows the fracture hematoma and swelling to disappear, the ankle is locked in neutral flexion in order to prevent the equin contracture, and the orthosis is used with the elastic compression stockings inside. Subtalar joint and ankle range of motion exercises are started early and weight-bearing restriction is continued for 10-12 weeks until radiographic union is seen.

Conservative treatment is ideal for non-displaced fractures that are essentially non-displaced in CT (Sanders Type 1). Conservative treatment gives the patient a small chance of return to normal function, because the articular anatomical reduction cannot be achieved by this method. As a result of treatment, heel shortens and expands, loss of calcaneal height leaves the talus relatively dorsiflexed in the ankle and persistent expansion of the lateral wall causes peroneal tendon impingement.

In the study of Crosby and Fitzgibbons, there were 13 type 1 fracture, 10 type 2 fractures and 7 had 3 types of fractures and all of them reduced without manipulation. The best results were obtained in type 1 fractures, and the results were not satisfactory in Type 2 and 3 fractures and they recommended surgical treatment for such fractures.<sup>[36]</sup>

Other specific indications for non-operative management include fractures in patients with severe peripheral vascular disease or those with uncontrolled type 1 diabetes, other medical comorbidities that inhibit surgery, and fractures of

elderly patients with minimal (in-house) ambulators. Age itself is not necessarily one of the contraindications of surgical treatment; because many elderly patients are healthy and active until their seventies.

Conservative treatment may also be necessary in some cases where early surgical intervention is prevented, such as severe edema, fractures with large open wounds and fractures with life-threatening injuries.

Another problem in calcaneal fractures is blister formation. The contents of the blister can be filled with a clear liquid or blood. The blister is the result of the cleavage in the dermal-epidermal junction and the fluid is sterile transudate. The appropriate time for surgical intervention is when the skin is rewrapped and surgery should be postponed in the presence of blister. Otherwise, it is possible to observe circulatory and skin problems in the postoperative period.<sup>[40]</sup> In such cases, the patient should wait until wrinkles are reformed and the final cast treatment must be postponed.

## Conclusion

Surgical treatment of intra-articular calcaneal fractures has a higher rate of return to pre-injury work, however complication rates are higher. Surgical treatment of this type of fractures, which is mostly conservatively treated in the past years, is more prominent compared to conservative treatment despite of possible complications. However, there is no clear consensus on this issue, further studies are needed.

## Disclosures

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