

Best Evidence and Indications for Surgery with Different types of Displaced Os Calcis Fractures

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ABSTRACT

Who deserves surgery and is nonoperative care still reasonable in this decade? And what type of surgery? Full open approach through an extended lateral incision or limited incision surgery with a lower complication rate? Can we get the reduction of the posterior facet through small incision surgery, or must we use the larger more invasive extended lateral approach to ensure that the joint is truly reduced? And what about the Sanders 4 patient—when is primary fusion the best option for such a fracture? These questions are much closer to being fully answered now with good randomized controlled trials and careful attention to some specific problems like wound issues and foot shape—that are only present in this very special fracture.

Keywords: Best evidence, Nonoperative, Os calcis, Surgery.

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INTRODUCTION AND HISTORY OF CALCANEAL FRACTURE CARE

No fracture has had a more interesting history over the last century than the calcaneal fracture. From the very early part of the 20th century, it was determined that the future was very bad with little to be done after a calcaneal fracture.¹ But over the last few years, 3D printing, and careful surgical planning have allowed these fractures to be treated with limited incisions and reductions with percutaneous fixation.² The pendulum has swung many times with these fractures back and forth. Giants of orthopedics like Bohler had their opinions about nonoperative care in the 1940s,³ while new approaches from surgeons like Palmer and Essex-Lopresti added to the mix.^{4,5} Nonoperative care was the standard historically but limited interventions like the Gissane spike from the posterior aspect of the tongue-type fracture, helped us start to understand reductions and better calcaneal fracture care.⁵ Classifications of calcaneal fractures with plain radiographs and then computed tomography, gave us huge leaps in knowledge and led to better decisions for these fractures.^{5,6} But where are we recently? Who deserves surgery and is nonoperative care still reasonable in this decade? And what type of surgery? Full open approach through an extended lateral incision or limited incision surgery with a lower complication rate? Can we get the reduction of the posterior facet through small incision surgery, or must we use the larger more invasive extended lateral approach to ensure that the joint is truly reduced? And what about the Sanders 4 patient—when is primary fusion the best option for such a fracture? These questions are much closer to being fully answered now with good randomized controlled trials and careful attention to some specific problems like wound issues and foot shape—that are only present in this very special fracture.

What the Literature Says About Indications for Calcaneal Fracture Care in 2021

Randomized controlled trials from many countries over the last 20 years have set the stage for calcaneal care in 2021. Buckley et al., with the Canadian Orthopedic Trauma Society (COTS), in the

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1990s did the first large RCT with over 500 patients.⁷ It established some key facts about the displaced intra-articular calcaneal fracture. Younger patients with simpler, less displaced fractures that were not workers compensation patients, did the best with operative care using general and disease-specific outcome measures. Older, medically unwell patients with more displaced fractures did the worst with operative care but were even worse with nonoperative care. This landmark study showed that nonoperative care should be reserved for minimally displaced fractures in older patients or the medically unwell with no serious foot deformity.⁷ These same findings were discovered with two other RCTs^{8,9} from different countries. Nonoperative care was only slightly less good as far as 2-year outcomes compared to operative care but patients with operative care had the best chance for the best outcome.⁷⁻⁹ All prospective studies proved, however, that complications were devastating to these patients especially wound complications leading to infection and stiffness.¹⁰ Griffin repeated the nonoperative/operative RCT with results that were soundly on the side of stating that operative care was no better than nonoperative care and complications were very common with both types of treatment.¹¹ Csizy found that salvage of patients who had done poorly with both sides of treatment (ORIF or nonoperative) improved significantly with a subtalar fusion.¹² This was important because there was another option for treatment when care was not optimal after the first choice had been made for a displaced calcaneal fracture.

Two large Asian RCTs performed recently,^{13,14} looked at the next stage of decision tree analysis. If a patient was thought to do optimally with surgery, was it better to do an extended lateral approach or a limited sinus tarsi approach? It was determined in both studies that surgery could be done safely earlier in the small incision group and clinical outcomes seemed to be as good as with a fully open approach. Infective complications, unfortunately, were still more common in the patients who had larger extended approaches.^{13,14} Recently, Sanders has carefully looked at reductions postoperatively with CT scans in those patients who had had either an extended lateral approach or a sinus tarsi approach. His group found that the reductions of the posterior facet were much more accurate and adequate in Bohler's height with an extended lateral approach.¹⁵ It seems that we give up the quality of reduction with a sinus tarsi approach, but the complications are fewer.

Lastly, there has been some excellent research with the isolated Sanders 4 patients—those patients with a very comminuted and displaced posterior facet. Pennal had long ago espoused primary fusion for the serious calcaneal fracture.¹⁶ More recently, the COTS group did an RCT with Sanders 4 patients randomly assigned to either full open reduction and internal fixation or to a primary fusion after heel reconstruction.¹⁷ They found very equivalent medium-term clinical results as did a group with a recent retrospective review.¹⁸ So, with the help of good science, we have, over twenty years with the help of RCTs, put together evidence for the treatment of displaced intra-articular calcaneal fractures. Importantly, all papers point to the significance of avoiding complications to obtain the best outcomes for these patients.^{10,11,15}

Open Calcaneal Fractures

The open calcaneal fracture has earned a lot of respect because of the serious problems that develop if soft tissues are not dealt with appropriately. Early debridement of soft tissue and bone is mandatory with care to reduce the fracture to take pressure off the soft tissues such that they can heal quickly.¹⁹ Usually, the wound is over the medial side of the foot where the sharp edge of the broken sustentaculum breaks the taut medial soft tissues. Often K-wires are the best solution to temporize and keep the bony calcaneus reduced until the calcaneus can be approached definitively with an accurate reduction and fixation. A special type of open calcaneus fracture is the “beak” fracture which occurs at the back of the heel with an extra-articular tuberosity fracture which can compromise the special soft tissues posteriorly. Without urgent reduction, the soft tissues die and there is an open wound at the back of the heel which will require a flap to cover. Once soft tissues are protected with shape restoration, negative pressure wound dressings are utilized along with K-wires and then the soft tissues are usually ready for definitive surgery at about 7 days. At this time, an open approach is utilized (no approach has been proven to be more efficacious) with possible primary fusion, but complications may reach 25% with open calcaneal fractures despite aggressive care.¹⁹

Nonoperative Care—for Whom?

Research now suggests that there is a role for nonoperative care for this terrible fracture. Patients who are older (>than 60 years) with simple fractures (Bohler's angle >than 15 degrees) and good foot shape with medical disease or with recalcitrant smoking histories should be treated nonoperatively.^{7,20} Complications from surgery are too risky with this patient population to proceed with surgery and so nonoperative care with this patient cohort results in reasonable results but with a significant chance of late subtalar

fusion (5–20%).¹² An exception is the “beak” fracture,¹⁹ which puts posterior skin at risk—these fractures need urgent surgical reduction with a minimal approach. Another exception is the workers compensation patient (paid to be off while their fracture heals). These patients deserve surgery but their outcomes average about 10 points less on a 100-point clinical outcome scoring scale (7). Worker's compensation patients should not be treated nonoperatively as surgery will help them with foot shape and articular congruity but expect less good clinical outcomes on all scoring scales.²⁰

Extended Lateral Approach—for Whom?

The extended lateral approach has a 5–15% chance of at least some wound breakdown.^{11,21} This approach, however, is very appropriate to do for a patient if the quality of reduction for both the foot shape and the posterior facet is paramount. The population of patients that requires this is the young patient who has no medical problems and is healthy to withstand a second operation if the wound happens to break down. This population of patients has a single chance to get the reduction perfect and the extended lateral approach provides the best chance of a perfect reduction.¹⁵ The type of fracture is also important because the Sanders 2 or 3 fracture is much more amenable to a “perfect reduction” with the extended lateral approach as these are not the worst joint injuries. It is the best approach to see the true calcaneal anatomy as it is not a minimal approach like the sinus tarsi approach. This approach is too risky for the medically unwell patient or the recalcitrant smoker because of the high wound breakdown rate.^{20,21} But this approach often requires the patient to wait at least 10–14 days before the soft tissue demonstrates that it is safe to operate (wrinkle sign).

Sinus Tarsi Approach—for Whom?

The sinus tarsi approach is a very useful approach for the Sanders 2 or 3 fractures where the risk of wound breakdown is very high. The literature is clear that the quality of reduction of the posterior articular surface and the height of Bohler's angle is not as satisfactory as when an extended lateral approach is utilized.¹⁵ For these reasons, the sinus tarsi approach is much better for the older, medically unwell patient or the patient with a long smoking history but misshapen foot. However, sinus tarsi approaches do not allow for as good a view at the level of the posterior facet. Inaccurate joint reductions can occur, and the body of the calcaneus is also only seen in part so accurate reductions of foot shape are also harder to judge and maintain.¹⁵ But this approach is perfect for most displaced intra-articular calcaneal fractures as patient demographics (older, medically suspect, smokers, compliance issues, and soft tissue problems) denotes that most of these fractures fit into this group.^{13,14} Surgery in this group is also best done and is safe within the first few days after injury before the fracture starts to heal and the fracture pieces are mobile.¹⁵ This surgical timing is contrary to most teaching that has gone on over the last 3 decades when using the extended lateral approach.

Primary Fusion for a Calcaneal Fracture—for Whom?

The Sanders 4 patient continues to be a difficult patient dilemma. Historically, over the last 30 years, surgeons have tried to save the posterior facet by operating upon it but with great difficulty. Comminution of both the posterior facet and of the body of the calcaneus has made subsequent surgery extremely challenging and with marginal results. Sanders 4 patients demonstrate the collapse of the body, foot shape issues, and significant malunions and arthritis

because of their fracture despite surgical efforts to correct the problem. Buckley and the COTS group did an RCT which can answer the problem of whether it is better to do a subtalar reconstruction and primary fusion for Sanders 4 patients.¹⁷ They argue that patients should have reconstructions and primary fusions for this fracture because equivalent medium-term outcomes can be obtained with primary fusions while late secondary fusions are eliminated, and patients do not need two operations.¹⁷ This was reinforced by a recent 2021 paper by Schipper.¹⁸ Timing for this operation is not as important as for fracture reduction purposes as the joint is being removed. But to do this operation satisfactorily, first a reduction of foot shape must be performed and then this is followed by elimination of the destroyed posterior facet.¹⁷ *In situ* fusions alone for Sanders 4 patients do not reconstruct foot height, width, and length so foot shape is a real problem if the calcaneus is at first not reconstructed before fusion.²²

CONCLUSION

In 2021, we now have 4 directions for displaced intra-articular calcaneal fracture care.^{7,20} Nonoperative care is useful for the older, inactive, medically unwell patient who is low demand that has good foot shape and a Bohler's angle of 15 degrees or greater. The extended lateral approach is useful for the displaced Sanders 2 or 3 fracture in young healthy individuals who have the best chance at having a good recovery with one big operation where foot shape and articular congruity are of prime importance. This patient group could withstand a second operation if a complication such as infection or wound compromise was to occur. The sinus tarsi approach should be utilized for the medically suspect patient with a Sanders 2 or 3 displaced fracture but who is not able to withstand the risk of severe complications with a bigger approach and where foot shape really needs to be addressed. Joint congruity can be improved with this approach as can the joint reduction, but risks are too great for an extended lateral approach. Because of the significantly lower complication rate with the sinus tarsi approach, it has become the most popular approach based upon the typical calcaneal patient profile. Lastly, calcaneal reconstruction and primary subtalar fusion is a very good choice for Sanders 4 patients, especially where one operation is deemed best for the patient who presents with this life-changing injury.

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