Complication Rates Are Similar Between Patients Aged <50 and >50 Years in Calcaneus Fractures Treated With the Sinus Tarsi Approach

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Abstract

Background: The sinus tarsi (ST) approach for calcaneus fractures has gained popularity in recent years with an increased interest in shifting to less invasive approaches for calcaneal fracture fixation allowing for adequate fixation if complications do not arise. Although the ST approach has gained acceptance as standard for calcaneus fracture fixation, the literature surrounding early complication rates based on age differences for this specific approach and pathology is lacking. The objective of this study was to determine if rates of complications based on age varied for patients undergoing open reduction and internal fixation (ORIF) of closed calcaneus fractures using the ST approach.

Methods: A retrospective review of patients undergoing ORIF for closed calcaneus fractures from 2012 to 2020 was performed. Inclusion criteria were based on an age greater than 18 years, surgical management of a closed calcaneus fracture using a ST approach, requirement of a preoperative computed tomographic scan, and a minimum of 180 days’ follow-up. Patients were divided into 2 groups: those aged <50 years and those aged >50 years.

Results: A total of 196 fractures were included with 114 fractures in the <50-year age group and 82 fractures in the >50-year age group. Mean age was 34.2 and 59.7 years in the younger and older groups, respectively. The older group had similar rates of wound dehiscence (1.2% vs 4.4%, P = .204), superficial surgical site infection (1.2% vs 2.6%, P = .490), deep infection (9.8% vs 7.9%, P = .648), and nonunion (4.9% vs 3.5%, P = .633) compared with the younger group. Rates of 30-day readmission, unplanned reoperation, and symptomatic hardware were not significantly different. Postoperative Bohler and Gissane angles were not significantly different between both groups.

Conclusion: Older patients with intraarticular calcaneus fractures treated via the ST approach maintain complication rates similar to those in younger individuals.

Level of Evidence: Level III, retrospective study.

Keywords: calcaneus fracture, age, sinus tarsi, hindfoot, injury

Introduction

The calcaneus is the most commonly injured tarsal bone constituting approximately 60% of all tarsal fractures and 2% of all fractures in the body. The optimal management of displaced intraarticular calcaneal fractures remains controversial and surgical treatment of patients with this...
Injury is technically challenging. With the well-documented complications of nonoperative management (eg, malunion and subtalar arthritis), the advancement of surgical techniques over the years has led to an increased adoption of operative treatment.

If wound complications can be avoided, anatomical reduction and stable fixation of intraarticular calcaneal fractures leads to predictable improvement in functional outcomes. Previous investigations have suggested nonoperative management of these fractures may be preferred in patients aged >50 years as they are more likely to experience poor outcomes, but several more recent studies have put this perspective into question. The traditional surgical approach for operative fixation of calcaneal fractures has been the extensile lateral approach, yet this technique is often associated with increased rates of wound complications. As a result, there has been an increased interest in shifting to less invasive approaches for calcaneal fracture fixation. One such approach is the sinus tarsi approach, which has similar efficacy as the extensile lateral approach with a lower rate of wound complications. However, no study identifies the complications associated with the differences in age for this relatively new approach.

The purpose of the present study was to compare postoperative complication rates between younger and older patients with intraarticular calcaneus fractures undergoing open reduction and internal fixation (ORIF) via the sinus tarsi approach. We hypothesized that complication rates would be comparable between these 2 groups.

Methods

Study Design

After obtaining institutional review board approval, all patients undergoing ORIF for calcaneus fractures via the sinus tarsi approach from January 2012 to January 2020 at a single tertiary care institution were retrospectively identified. All patients were either treated by 2 fellowship-trained foot and ankle surgeon or 2 fellowship-trained orthopaedic trauma surgeons. The use of the sinus tarsi approach vs the extensile lateral approach was used at the discretion of the surgeon. After 2015, all 4 surgeons converted to using strictly sinus tarsi approaches for calcaneus fractures. Prior to 2015, extensile lateral approach was used as one of the approaches. Inclusion criteria consisted of patients aged ≥18 years who underwent ORIF of a closed calcaneus fracture with a minimum of 180 days’ follow-up. Patients with open calcaneal fractures or those without a preoperative computed tomographic scan were excluded from the study. Patients were separated into 2 groups based on age: patients aged <50 years and those aged ≥50 years. The age of 50 years was selected to create the age groups in order to be consistent with previous literature. Implants were selected at the discretion of the surgeon. All patients received boot immobilization for at least 8 weeks following surgery, with aspirin for antiocoagulation unless contraindicated.

Variables

Medical records were reviewed for demographic data including age, gender, race, body mass index, tobacco use, diabetes, and American Society of Anesthesiologists (ASA) grade. Using preoperative imaging, each fracture was categorized according to the Sanders classification. Additional preoperative variables recorded included mechanism of injury and surgical time. The primary outcomes included development of wound dehiscence, superficial surgical site infection, deep infection requiring operative incision and drainage, and nonunion. Nonunion was defined as subsequent healing on radiographic imaging with at least 3 months of follow-up. Secondary outcomes included postoperative Bohler angles, postoperative Gissane angles, painful implants that required removal, any readmission within 30 days of discharge, or unplanned return to the operating room.

Statistical Analysis

Data were extracted and aggregated in Microsoft Excel (v.16). Statistical analysis was performed with IBM SPSS 27. Normality of continuous variables was assessed via the Shapiro-Wilk test. Numerical values were reported as mean ± SD, and proportions were reported as percentages. Continuous variables were assessed using Mann-Whitney U tests, whereas categorical variables were assessed via chi-square or Fisher exact tests. P values of <.05 were considered statistically significant.

Results

Patient Characteristics

A total of 426 patients were originally identified with the following exclusions: 116 were treated with the extensile lateral approach, 18 patients had open fractures, 58 patients had inadequate follow-up, and 27 patients lacked preoperative computed tomographic scan. A total of 207 patients were included in the study, with 108 patients in the <50-year age group and 78 patients in the >50-year age group. Eleven (5.3%) patients had bilateral calcaneal fractures. Average follow-up for this study was 546 ± 220 days (range 180-2742). Baseline characteristics of this study cohort are summarized in Table 1. The <50-year age group had a mean age of 34.2 (18-49) years and consisted of 75 (65.8%) males, whereas the >50 age group had a mean age of 59.7 (50-91) years with 60 (73.2%) males. The <50-year age
group had a higher proportion of patients with ASA class I and II (8.8% vs 3.7% and 57.0% vs 25.6%, respectively), whereas the >50-year age group had a higher proportion of ASA class III patients (68.3% vs 31.6%), which was statistically significant (\(P < .001\)). The younger group also had a significantly higher proportion of active smokers compared to the older group (57.9% vs 34.1%, \(P = .001\)). There were no statistically significant differences in race, sex, body mass index, or diabetes between the 2 groups.

**Injury and Operative Characteristics**

The most common mechanism of injury was motor vehicle accident in the <50-year age group (52.8%), whereas the most common mechanism was fall from height in the >50-year age group (52.6%), which was statistically significant (\(P < .001\)). The most common type of calcaneal fracture in both groups was Sanders type II, with 55 (48.2%) of the fractures in the <50-year age group and 39 (50.0%) in the >50-year age group (\(P = .573\)). Average time to surgery (10.0 vs 8.8 days, \(P = .412\)), the proportion of patients receiving preoperative nerve blocks (44.7% vs 40.2%, \(P = .531\)), and rates of placement of external fixation (14.9% vs 12.2%, \(P = .592\)) were not statistically different between the younger and older groups. Outcomes can be found in Table 2.

**Outcomes**

Primary outcomes for this study can be found in Table 3. The younger group had a higher rate of wound dehiscence (4.4% vs 1.2%, \(P = .204\)) and superficial infection (2.6% vs 1.2%, \(P = .490\)); however, they were not statistically significant. The older group had a higher rate of deep infections (9.8% vs 7.9%, \(P = .648\)) compared to the younger group but this was not statistically significant. Fourteen (12.3%) fractures in <50-year age group had implant removal compared to 15 (18.2%) fractures in the >50-year age group (\(P = .631\)). Gissane and Bohler Angles did not significantly differ on postoperative radiographs. Average length of stay was 1 day longer in the >50-year age group, but this was not statistically significant (7.3 vs 6.2 days, \(P = .313\)). There were no differences in 30-day readmission rates and reasons for unplanned reoperation between the 2 groups. Lastly, 1 patient (0.9%) in the younger group had sepsis (none in the >50-year-old group) and 2 patients (2.6%) in the older group developed deep vein thrombosis (none in the <50-year-old group); neither of these findings were significant.

**Discussion**

In this study, we found that complications rates for calcaneus fractures treated via a sinus tarsi approach are comparable between patients older than the age of 50 and patients under the age of 50. In patients of any age, displaced intraarticular calcaneal fractures managed nonoperatively, commonly lead to malunion, subtalar osteoarthritis, and poor functional outcomes. Although the extensile lateral approach has historically been used for the operative treatment of displaced intraarticular calcaneal fractures, it requires a larger incision and has higher rates of wound complications when compared to less invasive approaches such as the sinus tarsi approach.13,15,30 Although the use of the lateral extensile was not investigated in this study, the

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### Table 1. Patient Demographics.

|                        | Age <50 y (n=114 Fractures) | Age >50 y (n=82 Fractures) | P Valuea |
|------------------------|-----------------------------|-----------------------------|-----------|
| Age, mean ± SD         | 34.2 ± 8.5                  | 59.7 ± 7.1                  | <.001     |
| BMI, mean ± SD         | 27.6 ± 5.4                  | 28.2 ± 6.1                  | .500      |
| Sex, males, n (%)      | 75 (65.8)                   | 60 (73.2)                   | .271      |
| Race                   |                             |                             | <.001     |
| White                  | 79 (69.3)                   | 55 (69.3)                   | .259      |
| African American       | 22 (29.3)                   | 22 (26.8)                   |           |
| Other                  | 13 (11.4)                   | 5 (8.1)                     |           |
| ASA classification     |                             |                             |           |
| 1                      | 10 (8.8)                    | 3 (3.7)                     |           |
| 2                      | 65 (57.0)                   | 21 (25.6)                   |           |
| 3                      | 36 (31.6)                   | 56 (68.3)                   |           |
| 4                      | 3 (2.6)                     | 2 (2.4)                     |           |
| Diabetes mellitus      | 7 (6.1)                     | 13 (15.9)                   | .027      |
| Current tobacco use    | 66 (57.9)                   | 28 (34.1)                   | .001      |

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index. *Bolded P values indicate statistical significance (\(P < .05\)).
use of the sinus tarsi approach allows for minimally invasive treatment of displaced calcaneal fractures with low rates of wound complications.

Studies have suggested that patients aged >50 years are more likely to experience poorer outcomes after operative treatment of calcaneal fractures, with some with limited evidence for such claims. More recent studies have shown that operative management can be safely performed in the elderly with satisfactory outcomes, particularly in patients without comorbidities, but none of these investigations assessed the sinus tarsi approach in this patient population. A 2005 study by Herscovici et al reviewed 35 patients aged >65 years who underwent operative treatment of calcaneal fractures, with an average follow-up of 44 months and all but 1 patient being treated via the lateral extensile approach. In this study, the average American Orthopaedic Foot & Ankle Society (AOFAS) score was 82.4 and 97% of patients achieved union; however, 43% of patients developed at least 1 complication, with subtalar osteoarthritis being most common (34%). Despite these findings, the authors concluded that age did not play a role in soft tissue complications or infections and

### Table 2. Injury and Operative Characteristics

| Mechanism of injury                  | Age <50 y (n=114 Fractures) | Age >50 y (n=82 Fractures) | P Value |
|--------------------------------------|------------------------------|-----------------------------|---------|
| Motor vehicle accident               | 57 (52.8)                    | 25 (32.1)                   | <.001   |
| Motorcycle accident                  | 2 (1.9)                      | 1 (1.3)                     |         |
| Pedestrian vs automobile             | 1 (0.9)                      | 5 (6)                       |         |
| Fall from standing                   | 6 (5.2)                      | 9 (11.5)                    |         |
| Fall from height                     | 42 (38.9)                    | 41 (52.6)                   |         |
| Other                                | 6 (5.6)                      | 1 (1.3)                     |         |
| Sanders classification               |                              |                             |         |
| I                                    | 3 (2.6)                      | 2 (2.4)                     | .941    |
| II                                   | 55 (48.2)                    | 43 (52.4)                   |         |
| III                                  | 38 (33.3)                    | 26 (31.7)                   |         |
| IV                                   | 18 (15.8)                    | 11 (13.4)                   |         |
| Time to surgery, d, mean ± SD       | 10.0 ± 8.0                   | 8.8 ± 11.8                  | .412    |
| Preoperative nerve block             | 51 (44.7)                    | 33 (40.2)                   | .531    |
| Use of external fixation             | 17 (14.9)                    | 10 (12.2)                   | .592    |
| Surgical time, min                   | 167.9 ± 85.9                 | 155.2 ± 90.3                | .318    |

*Unless otherwise noted, values are n (%).

### Table 3. Primary Outcomes

| Primary Outcomes                  | Age <50 y (n=114 Fractures) | Age >50 y (n=82 Fractures) | P Value |
|-----------------------------------|------------------------------|-----------------------------|---------|
| Wound dehiscence                  | 5 (4.4)                      | 1 (1.2)                     | .204    |
| Superficial infection             | 3 (2.6)                      | 1 (1.2)                     | .490    |
| Deep infection                    | 9 (7.9)                      | 8 (9.8)                     | .648    |
| Nonunion                          | 4 (3.5)                      | 4 (4.9)                     | .633    |
| 30-day readmission                | 2 (1.8)                      | 5 (6.2)                     | .102    |
| Unplanned reoperation             | 18 (15.8)                    | 2 (25.6)                    | .089    |
| Symptomatic hardware              | 19 (16.7)                    | 18 (22.0)                   | .351    |
| Reason for return to OR           |                              |                             | .631    |
| I&D                               | 4 (22.2)                     | 5 (23.8)                    |         |
| Implant removal                   | 14 (77.8)                    | 15 (71.4)                   |         |
| Other                             | 0 (0.0)                      | 1 (4.8)                     |         |
| Bohler angle, degrees, mean ± SD  | 28.9 ± 7.4                   | 28.4 ± 8.1                  | .619    |
| Gissane angle, degrees, mean ± SD | 129.8 ± 8.4                  | 128.8 ± 7.6                 | .406    |

*Unless otherwise noted, values are n (%).
that these complications were mainly in patients with multiple comorbidities. In a similar study, Gaskill et al.\textsuperscript{10} compared patients aged \textgreater 50 years to patients aged \textless 50 years who underwent operative fixation of displaced intraarticular calcaneal fractures with an average follow-up of approximately 9 years. No patients in this study were treated via the sinus tarsi approach. The authors found that patient-reported outcomes were significantly better in the older group and that complication rates were comparable between the younger and older age groups (35\% vs 38\%, \(P = .18\)).\textsuperscript{10} In their 2017 study, Su and Cao\textsuperscript{28} compared operative vs nonoperative treatment in 60 patients over the age of 60 years with Sanders II-III calcaneal fractures. The authors concluded that ORIF can be safely performed in elderly patients who lack surgical contraindications.\textsuperscript{28} In the present study, we found that rates of surgical site infections, wound dehiscence, painful hardware, length of stay, 30-day readmissions, and unplanned reoperations were similar between patients younger and older than the age of 50. All patients were treated via the sinus tarsi approach, which may explain the lower complication rate in the present study (16.1\%) as compared to the reported rates as high as 54\% in previous literature.\textsuperscript{6,10,11,28} Interestingly, the rate of infections was nonsignificantly higher in the younger group which may be accounted for by the increased incidence of smokers in this population as well as in the present study.

The present study is not without limitations. First, our study is limited by the inherent weaknesses of its retrospective design, such as relying on the accuracy of previously collected data and the inability to assess patient-reported outcomes as is seen in prior investigations. Second, there was a significantly higher proportion of active smokers in the younger group, which may contribute to the comparable complication rates between the 2 groups. Third, we were unable to perform regression modeling to control for potential confounders because of too few complication events. Fourth, our study was performed at a single level 1 trauma center, which may reduce the external validity of our findings and may also be compromised by surgeon bias. Further, the specific approach used by the surgeon also can contribute to surgeon bias. At our specific institution, surgeons use the sinus tarsi approach as the standard approach for calcaneal fractures except for rare cases of significant soft tissue damage, which included significant fracture blisters and open injuries requiring flap coverage. Lastly, in order to assess early complication rates, we decided to keep our minimum follow-up at 180 days. However, this short follow-up time does not allow us to address the longer-term outcomes and further longer-term studies are needed to address patients with calcaneal fractures.

The proportion of elderly individuals in the United States is steadily increasing with predictions that the number of Americans aged 65 years and older will reach 88.5 million by 2050.\textsuperscript{29} As the population continues to age, calcaneal fractures in the elderly population will continue to increase, and optimal management of these patient populations should be clearly delineated. The current study found that early complication rates following operative fixation of closed, intraarticular calcaneal fractures via the sinus tarsi approach are similar between younger and older individuals. These findings suggest that older patients with calcaneal fractures may safely undergo surgical fixation via this approach. The authors do not believe that age should be used as a variable that impacts the decision to treat calcaneal fractures surgically when the sinus tarsi approach can be used to surgically treat calcaneal fractures. Future studies with larger sample sizes and that are prospective in nature may be helpful in further assessing the association between age and postoperative complications after operative treatment of calcaneal fractures.

**Ethical Approval**

Ethical approval for this study was obtained from The University of Alabama at Birmingham Institutional Review Board (IRB-300000265)

**Declaration of Conflicting Interests**

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**References**

1. Agren PH, Wretenberg P, Sayed-Noor AS. Operative versus nonoperative treatment of displaced intra-articular calcaneal fractures: a prospective, randomized, controlled multicenter trial. J Bone Joint Surg Am. 2013;95(15):1351-1357. doi:10.2106/JBJS.L.00759

2. Banerjee R, Saltzman C, Anderson RB, Nickisch F. Management of calcaneal malunion. J Am Acad Orthop Surg. 2011;19(1):27-36. doi:10.5435/00124635-201101000-00004

3. Barei DP, Bellabarba C, Sangeorzan BJ, Benirschke SK. Fractures of the calcaneus. Orthop Clin North Am. 2002;33(1):263-85. x. doi:10.1016/s0030-5898(03)00084-1

4. Bremer AK, Kraler L, Frauchiger L, Krause FG, Weber M. Limited open reduction and internal fixation of calcaneal fractures. Foot Ankle Int. 2020;41(1):57-62. doi:10.1177/1071100719873273

5. Buckley R, Tough S, McCormack R, et al. Operative compared with nonoperative treatment of displaced intra-articular
calcaneal fractures: a prospective, randomized, controlled multicenter trial. J Bone Joint Surg Am. 2002;84(10):1733-1744. doi:10.2106/00004623-200210000-00001
6. Buckley RE, Meek RN. Comparison of open versus closed reduction of intraarticular calcaneal fractures: a matched cohort in workmen. J Orthop Trauma. 1992;6(2):216-222. doi:10.1097/00005131-199206000-00014
7. Carr JB. Surgical treatment of intra-articular calcaneal fractures: a review of small incision approaches. J Orthop Trauma. 2005;19(2):109-117. doi:10.1097/00005131-20050200-000007
8. Epstein N, Chandran S, Chou L. Current concepts review: intra-articular fractures of the calcaneus. Foot Ankle Int. 2012;33(1):79-86. doi:10.1177/1071100712030218
9. Essex-Lopresti P. The mechanism, reduction technique, and results in fractures of the os calcis. Br J Surg. 1952;39(157):395-419. doi:10.1002/bjs.18003915704
10. Gaskill T, Schweitzer K, Nunley J. Comparison of surgical outcomes of intra-articular calcaneal fractures by age. J Bone Joint Surg Am. 2010;92(18):2884-2889. doi:10.2106/JBJS.J.00089
11. Herscovici D Jr, Widmaier J, Scaduto JM, Sanders RW, Walling A. Operative treatment of calcaneal fractures in elderly patients. J Bone Joint Surg Am. 2005;87(6):1260-1264. doi:10.2106/JBJS.D.01765
12. Kannus P, Niemi S, Palvanen M, Sievanen H, Parkkari J, Jarvinen M. Rising incidence of low-trauma fractures of the calcaneus and foot among Finnish older adults. J Gerontol A Biol Sci Med Sci. 2008;63(6):642-645. doi:10.1093/gerona/63.6.642
13. Kline AJ, Anderson RB, Davis WH, Jones CP, Cohen BE. Minimally invasive technique versus an extensile lateral approach for intra-articular calcaneal fractures. Foot Ankle Int. 2013;34(6):773-780. doi:10.1177/1071100713477607
14. Koutserimpas C, Magarakis G, Kastanis G, Kontakis G, Alpantaki K. Complications of intra-articular calcaneal fractures in adults: key points for diagnosis, prevention, and treatment. Foot Ankle Spec. 2016;9(6):534-542. doi:10.1177/1938640616668030
15. Kwon JY, Guss D, Lin DE, et al. Effect of delay to definitive surgical fixation on wound complications in the treatment of closed, intra-articular calcaneal fractures. Foot Ankle Int. 2015;36(5):508-517. doi:10.1177/1071100714567187
16. Leung KS, Yuen KM, Chan WS. Operative treatment of displaced intra-articular fractures of the calcaneum: Medium-term results. J Bone Joint Surg Br. 1993;75(2):196-201. doi:10.1302/0301-620X.75B2.844936
17. Mitchell MJ, McKinley JC, Robinson CM. The epidemiology of calcaneal fractures. Foot (Edinb). 2009;19(4):197-200. doi:10.1016/j.jfoot.2009.05.001
18. Nosewicz TL, Dingemans SA, Backes M, Luijte J, Goslings JC, Schepers T. A systematic review and meta-analysis of the sinus tarsi and extended lateral approach in the operative treatment of displaced intra-articular calcaneal fractures. Foot Ankle Surg. 2019;25(5):580-588. doi:10.1016/j.fas.2018.08.006
19. Paley D, Hall H. Intra-articular fractures of the calcaneus. A critical analysis of results and prognostic factors. J Bone Joint Surg Am. 1993;75(3):342-354. doi:10.2106/00004623-199303000-00005
20. Peng C, Yuan B, Guo W, Li N, Tian H. Extensive lateral versus sinus tarsi approach for calcaneal fractures: a meta-analysis. Medicine (Baltimore). 2021;100(31):e26717. doi:10.1097/MD.0000000000026717
21. Potter MQ, Nunley JA. Long-term functional outcomes after operative treatment for intra-articular fractures of the calcaneus. J Bone Joint Surg Am. 2009;91(8):1854-1860. doi:10.2106/JBJS.H.01475
22. Radnay CS, Clare MP, Sanders RW. Subtalar fusion after displaced intra-articular calcaneal fractures: does initial operative treatment matter? Surgical technique. J Bone Joint Surg Am. 2010;92(suppl 1, pt 1):32-43. doi:10.2106/JBJS.I.01267
23. Rammelt S, Swords MP. Calcaneal fractures-which approach for which fracture? Orthop Clin North Am. 2021;52(4):433-450. doi:10.1016/j.ocl.2021.05.012
24. Rammelt S, Zwipp H. Corrective arthrodeses and osteotomies for post-traumatic hindfoot malalignment: indications, techniques, results. Int Orthop. 2013;37(9):1707-1717. doi:10.1007/s00264-013-0103-3
25. Randle JA, Kreder HJ, Stephen D, Williams J, Jaglal S, Hu R. Should calcaneal fractures be treated surgically? A meta-analysis. Clin Orthop Relat Res. 2000;377:217-227. doi:10.1097/00003086-200008000-00029
26. Romash MM. Minimal dual-incision ORIF of the calcaneus. In: Scuderi GR, Tria AJ, eds. Minimally Invasive Surgery in Orthopedics. Springer; 2010:487-500.
27. Sanders R. Intra-articular fractures of the calcaneus: present state of the art. J Orthop Trauma. 1992;6(2):252-265. doi:10.1097/00005131-199206000-00022
28. Su J, Cao X. Can operations achieve good outcomes in elderly patients with Sanders II-III calcaneal fractures? J Bone Joint Surg Am. 2009;91(8):1854-1860. doi:10.2106/JBJS.H.01475
29. Vincent GK. The Next Four Decades: The Older Population in the United States: 2010 to 2050. U.S Department of Commerce: U.S Census Bureau; 2010.
30. Yao H, Liang T, Xu Y, Hou G, Lv L, Zhang J. Sinus tarsi approach versus extensile lateral approach for displaced intra-articular calcaneal fracture: a meta-analysis of current evidence base. J Orthop Surg Res. 2017;12(1):43. doi:10.1186/s13018-017-0545-8
31. Zeng Z, Yuan L, Zheng S, Sun Y, Huang F. Minimally invasive versus extensile lateral approach for Sanders type II and III calcaneal fractures: a meta-analysis of randomized controlled trials. Int J Surg. 2018;50:146-153. doi:10.1016/j.ijssu.2017.12.034