ISSN 2307-8960 (online)

World Journal of *Clinical Cases*

World J Clin Cases 2020 October 6; 8(19): 4280-4687

Published by Baishideng Publishing Group Inc

World Journal of Clinical Cases

Contents

Semimonthly Volume 8 Number 19 October 6, 2020

OPINION REVIEW

4280 Role of monoclonal antibody drugs in the treatment of COVID-19

Ucciferri C, Vecchiet J, Falasca K

MINIREVIEWS

4286 Review of simulation model for education of point-of-care ultrasound using easy-to-make tools

Shin KC, Ha YR, Lee SJ, Ahn JH

4303 Liver injury in COVID-19: A minireview

Zhao JN, Fan Y, Wu SD

ORIGINAL ARTICLE

Case Control Study

4311 Transanal minimally invasive surgery *vs* endoscopic mucosal resection for rectal benign tumors and rectal carcinoids: A retrospective analysis

Shen JM, Zhao JY, Ye T, Gong LF, Wang HP, Chen WJ, Cai YK

4320 Impact of *mTOR* gene polymorphisms and gene-tea interaction on susceptibility to tuberculosis

Wang M, Ma SJ, Wu XY, Zhang X, Abesig J, Xiao ZH, Huang X, Yan HP, Wang J, Chen MS, Tan HZ

Retrospective Cohort Study

4331 Establishment and validation of a nomogram to predict the risk of ovarian metastasis in gastric cancer: Based on a large cohort

Li SQ, Zhang KC, Li JY, Liang WQ, Gao YH, Qiao Z, Xi HQ, Chen L

Retrospective Study

4342 Predictive factors for early clinical response in community-onset *Escherichia coli* urinary tract infection and effects of initial antibiotic treatment on early clinical response

Kim YJ, Lee JM, Lee JH

4349 Managing acute appendicitis during the COVID-19 pandemic in Jiaxing, China

Zhou Y, Cen LS

4360 Clinical application of combined detection of SARS-CoV-2-specific antibody and nucleic acid

Meng QB, Peng JJ, Wei X, Yang JY, Li PC, Qu ZW, Xiong YF, Wu GJ, Hu ZM, Yu JC, Su W

4370 Prolonged prothrombin time at admission predicts poor clinical outcome in COVID-19 patients

Wang L, He WB, Yu XM, Hu DL, Jiang H

World Journal of Clinical Cases

Semimonthly Volume 8 Number 19 October 6, 2020

Contents

4380 Percutaneous radiofrequency ablation is superior to hepatic resection in patients with small hepatocellular carcinoma

Zhang YH, Su B, Sun P, Li RM, Peng XC, Cai J

4388 Clinical study on the surgical treatment of atypical Lisfranc joint complex injury

Li X, Jia LS, Li A, Xie X, Cui J, Li GL

4400 Application of medial column classification in treatment of intra-articular calcaneal fractures

Zheng G, Xia F, Yang S, Cui J

Clinical Trials Study

4410 Optimal hang time of enteral formula at standard room temperature and high temperature

Lakananurak N, Nalinthassanai N, Suansawang W, Panarat P

META-ANALYSIS

4416 Meta-analysis reveals an association between acute pancreatitis and the risk of pancreatic cancer

Liu J, Wang Y, Yu Y

SCIENTOMETRICS

4431 Global analysis of daily new COVID-19 cases reveals many static-phase countries including the United States potentially with unstoppable epidemic

Long C, Fu XM, Fu ZF

CASE REPORT

4443 Left atrial appendage aneurysm: A case report

Belov DV, Moskalev VI, Garbuzenko DV, Arefyev NO

4450 Twenty-year survival after iterative surgery for metastatic renal cell carcinoma: A case report and review of literature

De Raffele E, Mirarchi M, Casadei R, Ricci C, Brunocilla E, Minni F

4466 Primary rhabdomyosarcoma: An extremely rare and aggressive variant of male breast cancer

Satală CB, Jung I, Bara TJ, Simu P, Simu I, Vlad M, Szodorai R, Gurzu S

4475 Bladder stones in a closed diverticulum caused by *Schistosoma mansoni*: A case report

Alkhamees MA

4481 Cutaneous ciliated cyst on the anterior neck in young women: A case report

Kim YH, Lee J

4488 Extremely rare case of successful treatment of metastatic ovarian undifferentiated carcinoma with high-dose combination cytotoxic chemotherapy: A case report

Kim HB, Lee HJ, Hong R, Park SG

World Journal of Clinical Cases

Semimonthly Volume 8 Number 19 October 6, 2020

Contents

4494 Acute amnesia during pregnancy due to bilateral fornix infarction: A case report

Cho MJ, Shin DI, Han MK, Yum KS

4499 Ascaris-mimicking common bile duct stone: A case report

Choi SY, Jo HE, Lee YN, Lee JE, Lee MH, Lim S, Yi BH

4505 Eight-year follow-up of locally advanced lymphoepithelioma-like carcinoma at upper urinary tract: A case report

Yang CH, Weng WC, Lin YS, Huang LH, Lu CH, Hsu CY, Ou YC, Tung MC

4512 Spontaneous resolution of idiopathic intestinal obstruction after pneumonia: A case report

Zhang BQ, Dai XY, Ye QY, Chang L, Wang ZW, Li XQ, Li YN

4521 Successful pregnancy after protective hemodialysis for chronic kidney disease: A case report

Wang ML, He YD, Yang HX, Chen Q

4527 Rapid remission of refractory synovitis, acne, pustulosis, hyperostosis, and osteitis syndrome in response to the Janus kinase inhibitor tofacitinib: A case report

Li B, Li GW, Xue L, Chen YY

4535 Percutaneous fixation of neonatal humeral physeal fracture: A case report and review of the literature

Tan W, Wang FH, Yao JH, Wu WP, Li YB, Ji YL, Qian YP

4544 Severe fundus lesions induced by ocular jellyfish stings: A case report

Zheng XY, Cheng DJ, Lian LH, Zhang RT, Yu XY

4550 Application of ozonated water for treatment of gastro-thoracic fistula after comprehensive esophageal squamous cell carcinoma therapy: A case report

Wu DD, Hao KN, Chen XJ, Li XM, He XF

4558 Germinomas of the basal ganglia and thalamus: Four case reports

Huang ZC, Dong Q, Song EP, Chen ZJ, Zhang JH, Hou B, Lu ZQ, Qin F

4565 Gastrointestinal bleeding caused by jejunal angiosarcoma: A case report

Hui YY, Zhu LP, Yang B, Zhang ZY, Zhang YJ, Chen X, Wang BM

4572 High expression of squamous cell carcinoma antigen in poorly differentiated adenocarcinoma of the stomach: A case report

Wang L, Huang L, Xi L, Zhang SC, Zhang JX

4579 Therapy-related acute promyelocytic leukemia with FMS-like tyrosine kinase 3-internal tandem duplication mutation in solitary bone plasmacytoma: A case report

Hong LL, Sheng XF, Zhuang HF

4588 Metastasis of esophageal squamous cell carcinoma to the thyroid gland with widespread nodal involvement: A case report

Zhang X, Gu X, Li JG, Hu XJ

World Journal of Clinical Cases

Semimonthly Volume 8 Number 19 October 6, 2020

Contents

4595 Severe hyperlipemia-induced pseudoerythrocytosis - Implication for misdiagnosis and blood transfusion: A case report and literature review

Zhao XC, Ju B, Wei N, Ding J, Meng FJ, Zhao HG

4603 Novel brachytherapy drainage tube loaded with double 125I strands for hilar cholangiocarcinoma: A case report

Lei QY, Jiao DC, Han XW

4609 Resorption of upwardly displaced lumbar disk herniation after nonsurgical treatment: A case report

Wang Y, Liao SC, Dai GG, Jiang L

4615 Primary hepatic myelolipoma: A case report and review of the literature

Li KY, Wei AL, Li A

4624 Endoscopic palliative resection of a giant 26-cm esophageal tumor: A case report

Li Y, Guo LJ, Ma YC, Ye LS, Hu B

4633 Solitary hepatic lymphangioma mimicking liver malignancy: A case report and literature review

Long X, Zhang L, Cheng Q, Chen Q, Chen XP

4644 Intraosseous venous malformation of the maxilla after enucleation of a hemophilic pseudotumor: A case report

Cai X, Yu JJ, Tian H, Shan ZF, Liu XY, Jia J

4652 Intravesically instilled gemcitabine-induced lung injury in a patient with invasive urothelial carcinoma: A case report

Zhou XM, Wu C, Gu X

4660 Bochdalek hernia masquerading as severe acute pancreatitis during the third trimester of pregnancy: A case report

Zou YZ, Yang JP, Zhou XJ, Li K, Li XM, Song CH

4667 Localized primary gastric amyloidosis: Three case reports

Liu XM, Di LJ, Zhu JX, Wu XL, Li HP, Wu HC, Tuo BG

4676 Displacement of peritoneal end of a shunt tube to pleural cavity: A case report

Liu J, Guo M

4681 Parathyroid adenoma combined with a rib tumor as the primary disease: A case report

Han L, Zhu XF

World Journal of Clinical Cases

Semimonthly Volume 8 Number 19 October 6, 2020

Contents

ABOUT COVER

Peer-reviewer of *World Journal of Clinical Cases*, Prof. Adrián Ángel Inchauspe, obtained his MD in 1986 from La Plata National University (Argentina), where he remained as Professor of Surgery. Study abroad, at the Aachen and Tubingen Universities in Germany in 1991, led to his certification in laparoscopic surgery, and at the Louis Pasteur University in Strasbourg France, led to his being awarded the Argentine National Invention Award in 1998 for his graduate work in tele-surgery. He currently serves as teacher in the Argentine Acupuncture Society, as Invited Foreigner Professor at the China National Academy of Sciences and Hainan Medical University, and as editorial member and reviewer for many internationally renowned journals. (L-Editor: Filipodia)

AIMS AND SCOPE

The primary aim of *World Journal of Clinical Cases* (*WJCC*, *World J Clin Cases*) is to provide scholars and readers from various fields of clinical medicine with a platform to publish high-quality clinical research articles and communicate their research findings online.

WJCC mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

INDEXING/ABSTRACTING

The *WJCC* is now indexed in Science Citation Index Expanded (also known as SciSearch®), Journal Citation Reports/Science Edition, PubMed, and PubMed Central. The 2020 Edition of Journal Citation Reports® cites the 2019 impact factor (IF) for *WJCC* as 1.013; IF without journal self cites: 0.991; Ranking: 120 among 165 journals in medicine, general and internal; and Quartile category: Q3.

RESPONSIBLE EDITORS FOR THIS ISSUE

NAME OF JOURNAL
World Journal of Clinical Cases

ISSN
ISSN 2307-8960 (online)

LAUNCH DATE
April 16, 2013

FREQUENCY
Semimonthly

EDITORS-IN-CHIEF
Dennis A Bloomfield, Sandro Vento, Bao-Gan Peng

EDITORIAL BOARD MEMBERS
https://www.wjgnet.com/2307-8960/editorialboard.htm

PUBLICATION DATE
October 6, 2020

INSTRUCTIONS TO AUTHORS
https://www.wjgnet.com/bpg/gerinfo/204

GUIDELINES FOR ETHICS DOCUMENTS
https://www.wjgnet.com/bpg/GerInfo/287

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH
https://www.wjgnet.com/bpg/gerinfo/240

PUBLICATION ETHICS
https://www.wjgnet.com/bpg/GerInfo/288

PUBLICATION MISCONDUCT
https://www.wjgnet.com/bpg/gerinfo/208

ARTICLE PROCESSING CHARGE
https://www.wjgnet.com/bpg/gerinfo/242

STEPS FOR SUBMITTING MANUSCRIPTS
https://www.wjgnet.com/bpg/GerInfo/239

ONLINE SUBMISSION
https://www.f6publishing.com

World Journal of Clinical Cases

Submit a Manuscript: https://www.f6publishing.com

World J Clin Cases 2020 October 6; 8(19): 4400-4409

DOI: 10.12998/wjcc.v8.i19.4400

ISSN 2307-8960 (online)

ORIGINAL ARTICLE

Retrospective Study

Application of medial column classification in treatment of intra-articular calcaneal fractures

Gang Zheng, Fan Xia, Shuang Yang, Jun Cui

ORCID number: Gang Zheng 0000-0002-2885-0109; Fan Xia 0000-0002-1806-8674; Shuang Yang 0000-0001-9895-108X; Jun Cui 0000-0003-1679-0193.

Author contributions: Zheng G designed and performed the research and wrote the paper; Cui J designed the research and supervised the report; Yang S designed the research and contributed to the analysis; Xia F supervised the report.

Institutional review board statement: This study was reviewed and approved by the Ethics Committee of the Central Hospital Affiliated to Shenyang Medical College.

Informed consent statement: The analysis used anonymous clinical data that were obtained after each patient agreed to treatment by written consent.

Conflict-of-interest statement: We have no financial relationships to disclose.

Data sharing statement: No additional data are available.

Gang Zheng, Fan Xia, Shuang Yang, Jun Cui, Department of Foot and Ankle Surgery, Central Hospital Affiliated to Shenyang Medical College, Shenyang 110024, Liaoning Province, China

Corresponding author: Jun Cui, MD, Associate Chief Physician, Department of Foot and Ankle Surgery, Central Hospital Affiliated to Shenyang Medical College, No. 5 Nanqi West Road, Tiexi District, Shenyang 110024, Liaoning Province, China. 925791667@qq.com

Abstract

BACKGROUND

There are many types of treatments for calcaneal fractures, including conservative treatment, conventional surgical treatment, and minimally invasive surgery. The choice of specific treatment options is still controversial. Open reduction and internal fixation are currently the most commonly used surgical procedures in the clinic. A good fracture reduction effect can be achieved by using the lateral extension incision of the calcaneus; however, many studies have reported a high incidence of postoperative incision complications. Although there are many methods for the classification of intra-articular calcaneal fractures, it is generally believed that the computed tomography (CT) classification proposed by Sanders has high application value in the selection of treatment methods and evaluation of prognosis of calcaneal fractures. However, this method has no clear guiding significance for the choice of surgical incision and surgical plan.

AIM

To explore the application and clinical efficacy of medial column classification in the treatment of intra-articular calcaneal fractures.

METHODS

From July 2017 to July 2018, 91 patients, including 60 males and 31 females aged 27 to 60 years, were enrolled. All participants had closed intra-articular calcaneal fracture, and their surgical options were selected under the guidance of medial column classification. The patients' fractures were classified according to the Sanders classification: Type II, 35 cases; Type III, 33 cases; and Type IV, 23 cases. Among them, 53 patients had medial column displacement (shortened varus) and underwent open reduction and internal fixation with L-lateral incision of the calcaneus; 38 patients had no displacement of the medial column and underwent open reduction and internal fixation with tarsal sinus incision. The calcaneus Böhler angle, Gissane angle, length, width, height, and step thickness of the

Manuscript source: Unsolicited manuscript

Received: May 6, 2020
Peer-review started: May 6, 2020
First decision: May 21, 2020
Revised: June 3, 2020
Accepted: August 26, 2020
Article in press: August 26, 2020
Published online: October 6, 2020

P-Reviewer: Kim ES
S-Editor: Wang JL
L-Editor: Wang TQ
P-Editor: Wu YXJ

articular surface were evaluated by X-ray and three-dimensional CT before and after surgery and at the last follow-up. Foot function recovery was assessed by the Maryland foot scoring criteria.

RESULTS

All patients were followed for 5 to 14 mo, with an average of 10.5 ± 2.9 mo. The fractures of all patients healed, and the healing time was 10 to 19 wk, with an average of 10.8 ± 1.5 wk. One patient developed wound infection 1 wk after surgery and was actively debrided and implanted with antibiotic calcium sulfate to control the infection. The patient's fracture healed 5 mo after surgery. One patient developed a sural nerve injury, and the symptoms disappeared 3 mo after surgery. The patients were assessed according to the Maryland foot scoring system: Excellent in 77 cases, good in 10, and fair in 4. The excellent and good rate was 95.6%.

CONCLUSION

Medial column classification can effectively guide the surgical selection for intra-articular fractures of the calcaneus.

Key Words: Calcaneus; Fracture; Medial side; Surgical treatment; Classification

Core Tip: This is a retrospective study to evaluate the application and clinical efficacy of medial column classification in the treatment of intra-articular calcaneal fractures. A total of 91 participants were selected under the guidance of medial column classification: 53 patients had medial column displacement and underwent open reduction and internal fixation with L-lateral incision of the calcaneus; 38 patients had no displacement of the medial column and underwent open reduction and internal fixation with tarsal sinus incision. According to the Maryland foot scoring system, the excellent and good rate was 95.6%. Medial column classification can effectively guide the surgical selection for intra-articular fractures of the calcaneus.

Citation: Zheng G, Xia F, Yang S, Cui J. Application of medial column classification in treatment of intra-articular calcaneal fractures. *World J Clin Cases* 2020; 8(19): 4400-4409
URL: https://www.wjgnet.com/2307-8960/full/v8/i19/4400.htm
DOI: https://dx.doi.org/10.12998/wjcc.v8.i19.4400

INTRODUCTION

Calcaneal fractures are the most common tarsus fractures, accounting for 2% of body fractures. Twenty-six percent of calcaneal fractures are combined with contralateral limb injuries, 10% are combined with spinal fractures, and approximately 60%-75% are intra-articular fractures[1]. At present, the lateral L incision open reduction and internal fixation technique is the most common and effective method for the treatment of displaced calcaneal fractures. However, the surgical operation causes great damage to soft tissue. Therefore, there has been much controversy about postoperative complications, such as wound infection and nonhealing[2]. With the in-depth development of minimally invasive treatment of calcaneal fractures, many doctors use the tarsal sinus approach to fix calcaneal fractures. However, this method is not effective for the reduction of the medial column, and if necessary, a medial auxiliary incision is required. At present, the choice of surgical incision is still extremely challenging and controversial, and there is currently no uniform standard for the choice of surgical approach[3]. To further improve the overall reduction effect and to explore the surgical options and individualized treatment for intra-articular calcaneal fractures, we selected 91 patients who underwent treatment from July 2017 to July 2018 at the Department of Foot and Ankle Surgery, Central Hospital Affiliated to Shenyang Medical College. According to the displacement of the patient's medial column, they were divided into two types: Medial column displacement (shortened varus, 53 cases) and nondisplacement (38 cases). Patients with medial column

displacement underwent open reduction and internal fixation with an L-lateral incision of the calcaneus; patients with medial column nondisplacement underwent open reduction and internal fixation with a tarsal sinus incision. A satisfactory effect was obtained, and the report is as follows.

MATERIALS AND METHODS

Study design

The inclusion criteria were: (1) Closed fresh calcaneus fracture; and (2) Calcaneus internal fixation. The exclusion criteria were: (1) Tongue-shaped fracture; or (2) Open fracture.

In this study, 91 patients were enrolled, including 60 males and 31 females, aged 27 to 60. The patients' fractures were classified according to the Sanders classification: 35 cases of Type II, 33 cases of Type III, and 23 cases of Type IV. After admission, the patients were treated by limb elevation to reduce swelling. Lateral and axial calcaneus X-ray examination, parallel computed tomography (CT) scan, and three-dimensional reconstruction were performed. Patients were grouped according to X-ray and CT examination results. There were 53 cases of medial column displacement (short inversion), and open reduction and internal fixation through an L-lateral incision was planned for these patients. Surgery is acceptable when the skin on the outer heel is wrinkled, and the average time is 1-2 wk after the injury. There were 38 cases of medial column nondisplacement. Open reduction and internal fixation through the tarsal sinus incision was planned, and the operation was performed 3-7 d after the injury. Cefazolin (2.0 g) was used to prevent infection 30 min before surgical anesthesia. The study was approved by the Ethics Committee of Central Hospital Affiliated to Shenyang Medical College.

Medial column displacement (shortened varus) type

The patient was placed in the lateral position. The operation was performed with general anesthesia or subarachnoid block anesthesia. A conventional tourniquet was inflated on the thigh, and the lower limbs were sterilized and draped in a sterile manner. A traditional L-shaped incision from the lower part of the lateral malleolus was made. The incision reached the periosteum of the calcaneus. The subperiosteal soft tissue flap was separated sharply and turned up. The sural nerve was separated to protect it. The ligamenta calcaneofibulare calcaneus insertion was cut off sharply. Kirschner wires were inserted at the lateral malleolus, the lower part of the talus, and the tibia to protect the flap. The calcaneal posterior articular surface was exposed upwards, and the calcaneus protrusion and the Achilles tendon were exposed forward. The lateral or lateral posterior articular surface of the calcaneus was turned over. The posterior nodules were pulled with point-resetting forceps or a transverse Kirschner wire, and the freely collapsed posterior articular surface was removed to see the overlap and displacement of the sustentaculum tali bone block and the posterior nodule bone block and the deformation of the posterior nodule varus. Checking the stability of the sustentaculum tali bone block indicated that in some patients, the displacement of the sustentaculum tali bone block should be reset. The main fracture line was released from the external upper to the internal lower region. The posterior nodule was towed, turned over, and moved inward. Reset was performed under direct vision to restore the length, width, and force line of the calcaneus. Kirschner wires were used to fix the sustentaculum tali and posterior nodule bone blocks. After C-arm X-ray confirmation, the articular surface and the lateral wall were restored from the inside to the outside. The C-arm X-ray machine showed that the reset was satisfactory. The calcaneus plate screws were placed on the lateral wall of the calcaneus to fix it, and the sustentaculum tali screws were also implanted. During the operation, the C-arm X-ray machine showed good fracture reduction and fixation, and the position of the steel plate and the lengths of the screws were suitable. The wound was thoroughly rinsed, and bleeding was stopped; moreover, the equipment and gauze were counted. Negative pressure drainage was placed, and the subcutaneous tissue and skin were sequentially sutured. The dressing was valgus and pressure-wrapped, and the operation was completed (Figure 1).

Medial column nondisplacement

The preparation before cutting the skin was the same as described above. The external malleolus tip was placed at the base of the 4th tibia, and an incision approximately 5.0 cm long was made. The sural nerve was carefully identified and protected when

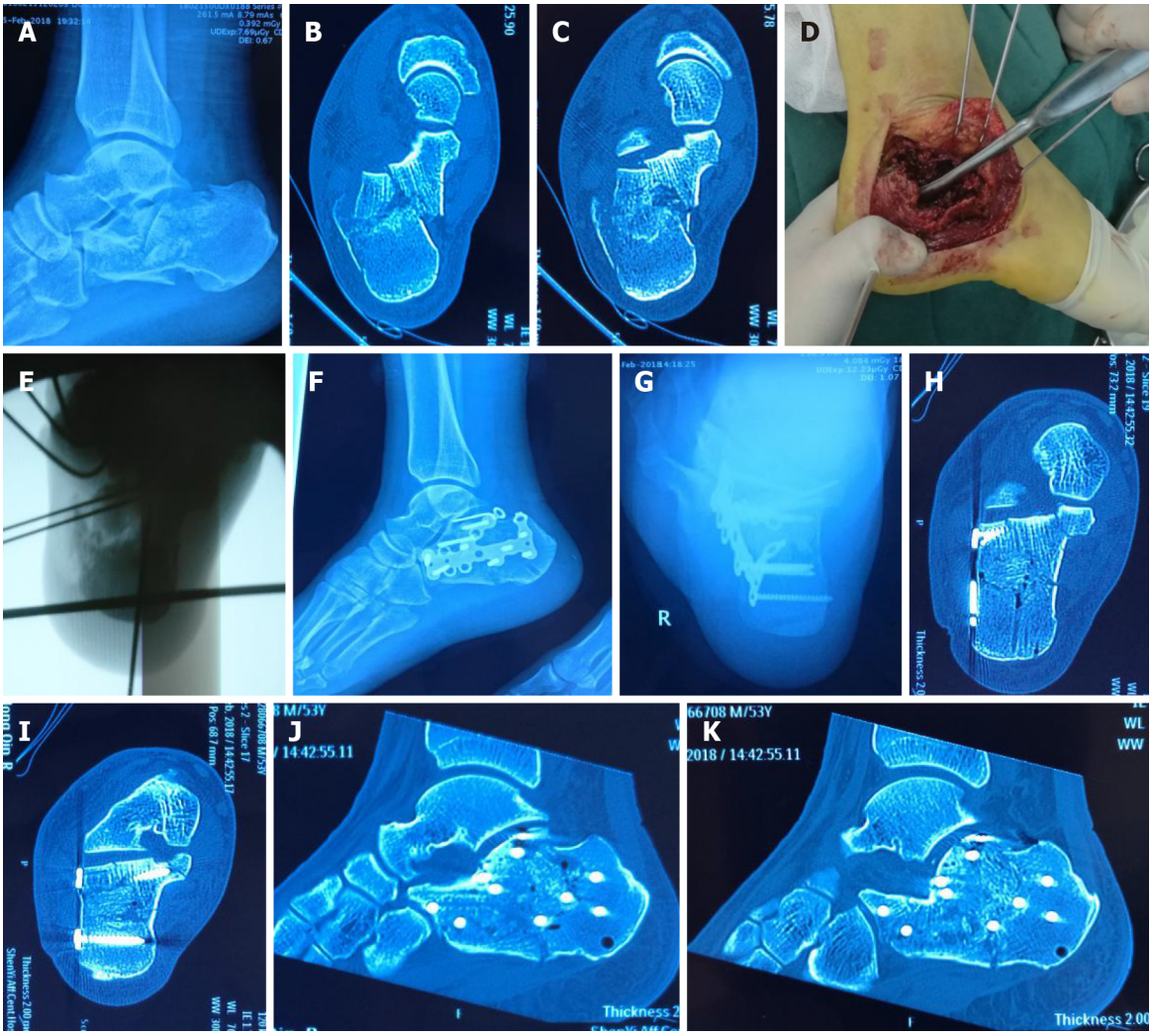

Figure 1 A 53-year-old man with fall injury and right calcaneal fracture, Sanders type II. A-C: Preoperative images showing that the medial column was shortened, and the sustentaculum tali bone block and posterior nodule were tangled, which affected the reduction in the articular surface; D and E: The main fracture line was released during the operation, the medial column was reset, and the articular surface was reset after fixing with Kirschner wires; F-K: Postoperative images indicating that the medial column reduction was satisfactory, and the length, width, and force line of the calcaneus were effectively restored.

cutting into the subcutaneous tissue. The peroneus longus and brevis were pulled to the metatarsal side, and the extensor muscle of the toes was partially removed and pulled to the dorsal side according to the exposure requirements. The tarsal sinus fat pad was bluntly isolated until the talus sinus was exposed. The lateral wall of the calcaneus was appropriately removed under the periosteum and opened outward. At the same time, the articular surface bone block was pulled to the outside to check whether the sustentaculum tali bone block had a displacement. If so, it was reset. The broken bone fragments in the fracture space were cleaned, and the articular surface was restored from the inside to the outside and temporarily fixed. A C-arm X-ray machine showed that the reset was satisfactory. A calcaneus plate screw was placed on the lateral wall of the calcaneus to fix it, and the screw was implanted percutaneously. The rest of the operation was the same as described above (Figure 2).

The affected foot was raised after surgery. Patients with significant pain were given analgesics. Antibiotics were routinely applied for 1 to 3 d. The incision drainage was removed 24 to 72 h after surgery. The incision was kept dry, and sutures were removed 12 to 14 d after surgery. Active toe exercise was started 24 h after surgery, and active flexion and extension exercises of the ankle joint began 1 wk later.

The calcaneus Böhler angle, Gissane angle, length, width, height, and step thickness of the articular surface were evaluated by X-ray and three-dimensional CT before and after surgery and at the last follow-up. Foot function recovery was assessed by the Maryland[4] foot scoring criteria. The score is 100 points, consisting of a 45-point pain assessment, a 40-point functional assessment, a 10-point appearance assessment, and a 5-point mobility assessment. Among them, functional assessment includes gait,

Figure 2 A 35-year-old man with fall injury and right calcaneal fracture, Sanders type III. A-C: Preoperative images showing that the medial column was not shortened, and sustentaculum tali bone block and posterior nodule were not tangled, which would not affect the reduction of the articular surface; D and E: The articular surface bone block was reset from the inside to the outside during operation through the tarsal sinus incision; F-I: Postoperative images showing articular surface smoothing; J-N: Fractures healed at 4 mo after operation and function recovery was satisfactory.

walking distance, stability, support tools, limp, shoes, stairs, and ground requirements when walking.

Evaluation criteria

The outcome of foot function recovery was evaluated as follows: Excellent (90 to 100 points), good (75 to 89 points), acceptable (50 to 74 points), and poor (< 50 points).

Statistical analysis

SPSS 16.0 was used to establish a database for parallel statistical analysis. The quantitative data are expressed as the mean and standard deviation. Two independent samples *t*-tests or *t*-tests (when the homogeneity of variance test was not homogeneous) were used to compare the preoperative and postoperative results. $P < 0.05$ was considered statistically significant, and the homogeneity test level was set at 0.1.

RESULTS

All patients were followed for 5 to 14 mo, with an average of 10.5 ± 2.9 mo. The fractures of all patients healed, and the healing time was 10 to 19 wk, with an average of 10.8 ± 1.5 wk. One patient developed wound infection 1 wk after surgery and was actively debrided and implanted with antibiotic calcium sulfate to control the infection. The patient's fracture healed 5 mo after surgery. One patient developed sural nerve injury, and the symptoms disappeared 3 mo after surgery. The average Bohler angle was 13.3 ± 2.3° preoperatively and 31.5 ± 3.5° postoperatively. The average Gissane angle was 93.8 ± 3.5° preoperatively and 126.5 ± 10.3° postoperatively. The average calcaneal length was 79.5 ± 5.5 mm preoperatively and 77.8 ± 5.5 mm postoperatively; the average calcaneal width was 55.0 ± 10.0 mm preoperatively and 39.5 ± 8.8 mm postoperatively. The average calcaneal height was 32.5 ± 6.0 mm preoperatively and 45.8 ± 4.1 mm postoperatively. The average step thickness of the

articular surface was 6.0 ± 3.0 mm preoperatively and 0.4 ± 0.5 mm postoperatively (Table 1). The patients were assessed according to the Maryland foot scoring system: Excellent in 77 cases, good in 10 cases, and acceptable in 4 cases. The excellent and good rate was 95.6%. The Department of Foot and Ankle Surgery, Central Hospital Affiliated with Shenyang Medical College, divides intra-articular calcaneal fractures into two types: Medial column displacement and non-displacement. In this study, there were 53 cases of medial column displacement, and the L-lateral incision of the calcaneus was used. There were 38 cases of medial column nondisplacement. The tarsal sinus incision was used to treat the articular surface and complete fixation (Figure 2). Satisfactory results were obtained. Therefore, this study confirmed that medial column classification can effectively guide the selection of surgical approaches for intra-articular calcaneal fractures, and the clinical efficacy of this classification in the treatment of intra-articular calcaneal fractures is positive.

DISCUSSION

There are many types of treatments for calcaneal fractures, including conservative treatment, conventional surgical treatment, and minimally invasive surgery. The choice of specific treatment options is still controversial[5-9]. Open reduction and internal fixation are currently the most commonly used surgical procedures in the clinic. A good fracture reduction effect can be achieved by using the lateral extension incision of the calcaneus; however, many studies have reported a higher incidence of postoperative incision complications[10-14]. Some scholars[15,16] analyzed 21 studies including a total of 2046 patients with calcaneal fractures who underwent open reduction and internal fixation, and the average incidence of incision complications was 13.6%. We believe that incision complications depend on a number of factors, especially the surgeon's treatment experience[17]. The Department of Foot and Ankle Surgery, Central Hospital Affiliated to Shenyang Medical College, counted 101 patients with closed intra-articular calcaneal fractures who underwent L-incision treatment from January 2017 to July 2018. Only one case developed skin edge necrosis and was treated by flap transfer. One case developed wound infection and was actively debrided and implanted with antibiotic calcium sulfate to control the infection. The patient's fracture healed 5 mo after surgery.

In recent years, the minimally invasive concept has become a hot issue in the international surgical field. The use of the tarsal sinus incision as a surgical approach for the treatment of calcaneal fractures will become one of the popular trends[18,19].

The approach can effectively avoid damage to the related arteries and their branches[20], has less local damage to the skin, and thereby can reduce the risks of skin necrosis, wound infection, or flap pain after surgery[21] because its position is closer to the dorsum of foot, which has a richer blood supply for the soft tissues and looser surrounding skin. After the injury, it is usually not necessary to wait a long time to reduce swelling to perform surgery. Most patients can undergo surgery within 1 wk after the injury[22].

However, the focus of treatment for intra-articular calcaneal fractures is still the accurate reduction in fractures. Most scholars[23-25] believe that regardless of which treatment plan is adopted, the treatment goal needs a good recovery of the calcaneal anatomy. In most cases, poor calcaneus reduction results from poor reduction in the medial wall (column). Yao *et al*[26] reported that the poor reduction in the medial column after calcaneus fracture first caused unevenness of the subtalar articular surface. Whether the height of the medial column is lost or the width is not reset, the linear and positional alignment of the subtalar articular surface will be poor, and the biomechanical relationship between the talus and the calcaneus will be changed. Temporary reduction without firm fixation will result in insufficient stability of the medial column force line, often causing secondary reduction loss of the calcaneal medial column and resulting in varus deformity. The medial column is a component of the calcaneal height, width, and length, which also indirectly affects the Bohler angle and the Gissane angle of the calcaneus. Anatomic reduction and firm internal fixation of the medial column can reduce the incidence of varus deformity and facilitate the recovery of the width of the calcaneus. Compared with the height recovery of the lateral wall, the height recovery of the medial wall significantly reduces the incidence of varus deformity. Domestic scholars[27,28] used the medial auxiliary incision and distraction technique to improve the calcaneus width and further improve the postoperative outcome.

The *AO Course* and *Mann's Surgery of the Foot and Ankle* clearly indicate the order of

Table 1 Comparison of Böhler angle, Gissane angle, calcaneus length, width, height, and articular surface step height in 91 patients before and after surgery and at the last follow-up (mean ± SD, *n* = 91)

Timing	Böhler angle (°)	Gissane angle (°)	Calcaneal length (mm)	Calcaneal width (mm)	Calcaneal height (mm)	Step thickness of articular surface (mm)
Preoperative	13.3 ± 2.3	93.8 ± 3.5	79.5 ± 5.5	55.0 ± 10.0	32.5 ± 6.0	6.0 ± 3.0
Postoperative	31.5 ± 3.5	126.5 ± 10.3	77.8 ± 5.5	39.5 ± 8.8	45.8 ± 4.1	0.4 ± 0.5
Test statistics	-38.123	-25.175	1.532	10.222	-15.134	17.257
P value	< 0.001	< 0.001	0.095	< 0.001	< 0.001	< 0.001

reduction during surgical treatment of intra-articular calcaneal fractures (Figure 3): Remove or open the lateral articular surface bone block, loosen the main fracture line from the external upper to the internal lower part, pull the posterior nodule, reset and temporarily fix the posterior nodule and the sustentaculum tali bone block (accurate restoration of the medial column structure: Force line, calcaneus length, and width), and reset the articular surface (Figure 1). If the patient with a shortened medial column first undergoes articular surface reduction, the overall structural reduction is often poor, and this operation is difficult to achieve in the tarsal sinus incision. For patients with no displacement of the medial column, the articular surface can be directly restored, and the tarsal sinus incision is feasible.

Although there are many methods for the classification of intra-articular calcaneal fractures, it is generally believed that[17] the CT classification proposed by Sanders has high application value in the selection of treatment methods and prognosis of calcaneal fractures. However, this method has no clear guiding significance for the choice of surgical incision and surgical plan. At present, most scholars[14] suggest that the tarsal sinus incision can be used for Sanders Types II and III fractures. However, for Sanders Types II and III fractures with medial column shortening, the use of the tarsal sinus incision cannot effectively release the main fracture line and accurately restore the positional relationship between the sustentaculum tali bone block and the posterior nodule backbone.

CONCLUSION

In view of the above issue, the Department of Foot and Ankle Surgery, Central Hospital Affiliated with Shenyang Medical College preliminarily divided intra-articular calcaneal fractures into two types: Medial column displacement (shortened varus) and nondisplacement. In this study, there were 53 cases of medial column displacement (shortened varus), and the L-lateral incision of the calcaneus was used. First, the main fracture line was released, the posterior nodule and the sustentaculum tali bone block were reset to restore the medial wall (column), and then the articular surface was restored (Figures 1 and 3). There were 38 cases of medial column nondisplacement. The tarsal sinus incision was used to treat the articular surface and complete fixation (Figure 2), because there was no need to remove the articular surface bone block and to release the main fracture line. Satisfactory results were obtained. The patients were followed after initial use of this type of treatment. X-ray and CT examinations showed that the Böhler angle recovered to 31.5 ± 3.5°, the Gissane angle recovered to 126.5 ± 10.3°, the calcaneal length recovered to 77.8 ± 5.5 mm, the width recovered to 39.5 ± 8.8 mm, the height recovered to 45.8 ± 4.1 mm, and the step thickness of the articular surface recovered to 0.4 ± 0.5 mm. The good and excellent rate was 95.6% according to the Maryland foot scoring system. Therefore, medial column classification can effectively guide the surgical selection of intra-articular fractures of the calcaneus.

The main shortcomings of this study are that the number of cases is small and the follow-up time is short. The early efficacy is satisfactory; however, the long-term efficacy needs further follow-up. Second, the authors were good at using the tarsal sinus incision, and the Sanders Types III and IV fractures without medial column displacement were all treated with this incision. Moreover, the classification is only an initial attempt and has not been refined. We will accumulate additional cases, improve the controlled study, and continue to follow the patients to obtain relatively scientific conclusions.

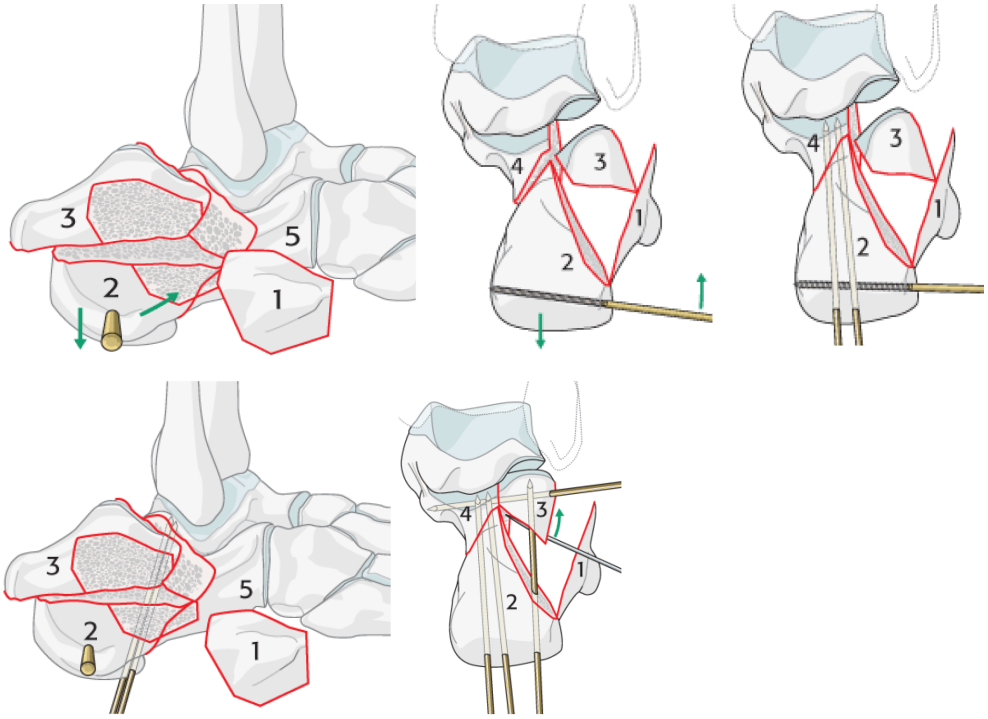

Figure 3 Reduction procedure for calcaneal fractures recommended by *AO Course*.

ARTICLE HIGHLIGHTS

Research background

The Sanders computed tomography classification of calcaneal fractures cannot guide the surgical treatment.

Research motivation

We tried to study a new classification to guide the surgical treatment of calcaneal fractures.

Research objectives

In this study, we aimed to explore the application and clinical efficacy of medial column classification in the treatment of intra-articular calcaneal fractures.

Research methods

We divided intra-articular calcaneal fractures into two types: Medial column displacement (shortened varus) and nondisplacement. There were 53 cases of medial column displacement, and the L-lateral incision of the calcaneus was used. First, the main fracture line was released, the posterior nodule and the sustentaculum tali bone block were reset to restore the medial wall (column), and then the articular surface was restored.

Research results

The incidence of tarsal sinus incision failure in this type of calcaneal fracture is high. There were 38 cases of medial column nondisplacement, and the tarsal sinus incision was used. Satisfactory results were obtained.

Research conclusions

Medial column classification can effectively guide the surgical selection of intra-articular fractures of the calcaneus.

Research perspectives

We will accumulate additional cases, improve the controlled study, and continue to follow the patients to obtain relatively scientific conclusions.

REFERENCES

1 **Clare MP**, Sanders RW. [Calcaneus fractures]. *Unfallchirurg* 2011; **114**: 869-876 [PMID: 21979889 DOI: 10.1007/s00113-011-2076-9]
2 **Spierings KE**, Sanders FRK, Nosewicz TL, Schepers T. Risk factors for surgical site infections with the Sinus Tarsi Approach in displaced intra-articular calcaneal fractures; a prospective cohort study with a minimum of one year follow-up. *Injury* 2020; **51**: 1676-1680 [PMID: 32471686 DOI: 10.1016/j.injury.2020.05.004]
3 **Shi ZM**, Gu WQ. Surgical management of intra-articular calcaneal fractures: our misunderstandings. *Zhonghua Yixue Zazhi* 2019; **99**: 1604-1607 [DOI: 10.3760/cma.j.issn.0376-2491.2019.21.002]
4 **Sanders R**, Fortin P, DiPasquale T, Walling A. Operative treatment in 120 displaced intraarticular calcaneal fractures. Results using a prognostic computed tomography scan classification. *Clin Orthop Relat Res* 1993; 87-95 [PMID: 8472475]
5 **Giannini S**, Cadossi M, Mosca M, Tedesco G, Sambri A, Terrando S, Mazzotti A. Minimally-invasive treatment of calcaneal fractures: A review of the literature and our experience. *Injury* 2016; **47** Suppl 4: S138-S146 [PMID: 27492063 DOI: 10.1016/j.injury.2016.07.050]
6 **Yu X**, Pang QJ, Chen L, Yang CC, Chen XJ. Postoperative complications after closed calcaneus fracture treated by open reduction and internal fixation: a review. *J Int Med Res* 2014; **42**: 17-25 [PMID: 24326953 DOI: 10.1177/0300060513495626]
7 **Guerado E**, Bertrand ML, Cano JR. Management of calcaneal fractures: what have we learnt over the years? *Injury* 2012; **43**: 1640-1650 [PMID: 22664393 DOI: 10.1016/j.injury.2012.05.011]
8 **Cao L**, Weng W, Song S, Mao N, Li H, Cai Y, Zhou Q Jr, Su J. Surgical treatment of calcaneal fractures of Sanders type II and III by a minimally invasive technique using a locking plate. *J Foot Ankle Surg* 2015; **54**: 76-81 [PMID: 25441282 DOI: 10.1053/j.jfas.2014.09.003]
9 **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**: 1351-1357 [PMID: 23925738 DOI: 10.2106/JBJS.L.00759]
10 **Luo X**, Li Q, He S, He S. Operative Versus Nonoperative Treatment for Displaced Intra-Articular Calcaneal Fractures: A Meta-Analysis of Randomized Controlled Trials. *J Foot Ankle Surg* 2016; **55**: 821-828 [PMID: 27150233 DOI: 10.1053/j.jfas.2016.01.035]
11 **Benirschke SK**, Kramer PA. Wound healing complications in closed and open calcaneal fractures. *J Orthop Trauma* 2004; **18**: 1-6 [PMID: 14676549 DOI: 10.1097/00005131-200401000-00001]
12 **Zhang G**, Ding S, Ruan Z. Minimally invasive treatment of calcaneal fracture. *J Int Med Res* 2019; **47**: 3946-3954 [PMID: 31315493 DOI: 10.1177/0300060519853402]
13 **Haapasalo H**, Laine HJ, Mäenpää H, Wretenberg P, Kannus P, Mattila VM. Epidemiology of calcaneal fractures in Finland. *Foot Ankle Surg* 2017; **23**: 321-324 [PMID: 29202996 DOI: 10.1016/j.fas.2016.10.004]
14 **Sanders R**, Vaupel ZM, Erdogan M, Downes K. Operative treatment of displaced intraarticular calcaneal fractures: long-term (10-20 Years) results in 108 fractures using a prognostic CT classification. *J Orthop Trauma* 2014; **28**: 551-563 [PMID: 25243849 DOI: 10.1097/BOT.0000000000000169]
15 **Rubino R**, Valderrabano V, Sutter PM, Regazzoni P. Prognostic value of four classifications of calcaneal fractures. *Foot Ankle Int* 2009; **30**: 229-238 [PMID: 19321100 DOI: 10.3113/FAI.2009.0229]
16 **Caranci F**, Briganti F, La Porta M, Antinolfi G, Cesarano E, Fonio P, Brunese L, Coppolino F. Magnetic resonance imaging in brachial plexus injury. *Musculoskelet Surg* 2013; **97** Suppl 2: S181-S190 [PMID: 23949940 DOI: 10.1007/s12306-013-0281-0]
17 **Cui J**, Zheng G, Li X. The tarsal sinus incision reduction and percutaneous plate internal fixation for Sanders II, III calcaneal fractures. *Zhongguo Linchuang Yisheng Zazhi* 2019; **47**: 319-320 [DOI: 10.3969/j.issn.2095-8552.2019.03.023]
18 **Di Zazzo E**, Porcile C, Bartollino S, Moncharmont B. Critical Function of PRDM2 in the Neoplastic Growth of Testicular Germ Cell Tumors. *Biology (Basel)* 2016; **5**: 54 [PMID: 27983647 DOI: 10.3390/biology5040054]
19 **Yu T**, Xiong Y, Kang A, Zhou H, He W, Zhu H, Yang Y. Comparison of sinus tarsi approach and extensile lateral approach for calcaneal fractures: A systematic review of overlapping meta-analyses. *J Orthop Surg (Hong Kong)* 2020; **28**: 2309499020915282 [PMID: 32314645 DOI: 10.1177/2309499020915282]
20 **Ronco V**, Potenza DM, Denti F, Vullo S, Gagliano G, Tognolina M, Guerra G, Pinton P, Genazzani AA, Mapelli L, Lim D, Moccia F. A novel Ca^{2+}-mediated cross-talk between endoplasmic reticulum and acidic organelles: implications for NAADP-dependent Ca^{2+} signalling. *Cell Calcium* 2015; **57**: 89-100 [PMID: 25655285 DOI: 10.1016/j.ceca.2015.01.001]
21 **Seat A**, Seat C. Lateral Extensile Approach Versus Minimal Incision Approach for Open Reduction and Internal Fixation of Displaced Intra-articular Calcaneal Fractures: A Meta-analysis. *J Foot Ankle Surg* 2020; **59**: 356-366 [PMID: 32131003 DOI: 10.1053/j.jfas.2019.08.007]
22 **Lin J**, Xie C, Chen K, Sun S, Zhou K, Zhou C, Shui X, Kong J. Comparison of sinus tarsi approach versus extensile lateral approach for displaced intra-articular calcaneal fractures Sanders type IV. *Int Orthop* 2019; **43**: 2141-2149 [PMID: 30903254 DOI: 10.1007/s00264-019-04318-w]
23 **Dürr C**, Apinun J, Mittlmeier T, Rammelt S. Foot Function After Surgically Treated Intraarticular Calcaneal Fractures: Correlation of Clinical and Pedobarographic Results of 65 Patients Followed for 8 Years. *J Orthop Trauma* 2018; **32**: 593-600 [PMID: 30277980 DOI: 10.1097/BOT.0000000000001325]
24 **Biz C**, Barison E, Ruggieri P, Iacobellis C. Radiographic and functional outcomes after displaced intra-articular calcaneal fractures: a comparative cohort study among the traditional open technique (ORIF) and percutaneous surgical procedures (PS). *J Orthop Surg Res* 2016; **11**: 92 [PMID: 27550340 DOI: 10.1186/s13018-016-0426-6]
25 **Kiewiet NJ**, Sangeorzan BJ. Calcaneal Fracture Management: Extensile Lateral Approach Versus Small Incision Technique. *Foot Ankle Clin* 2017; **22**: 77-91 [PMID: 28167066 DOI: 10.1016/j.fcl.2016.09.013]
26 **Yao GJ**, Shang J, Wang W. Effect of inadequate reduction of medial wall on the postoperative varus deformity following calcaneal fracture surgery and other influencing factors of varus deformity. *Zhonghua*

Chuangshang Guke Zazhi 2016; **18**: 465-469 [DOI: 10.3760/cma.j.issn.1671-7600.2016.06.002]
27 **Yu T**, Yang Y, Li B, Sah S, Chen K, Yu G. Importance of assistant intra-operative medial distraction technique for intraarticular calcaneus fractures. *Acta Orthop Belg* 2019; **85**: 130-136 [PMID: 31023210]
28 **Chen J**, Yang Z, Kong C, Wei S. Minimally invasive dual incision with mini plate internal fixation improves outcomes over 30 months in 20 patients with Sanders type III calcaneal fractures. *J Orthop Surg Res* 2020; **15**: 167 [PMID: 32370799 DOI: 10.1186/s13018-020-01644-3]

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: bpgoffice@wjgnet.com
Help Desk: https://www.f6publishing.com/helpdesk
https://www.wjgnet.com