

# Simulated CBDs for PAH SpRs Project



**Mr Kar H Teoh**

**F&A Trauma**

15<sup>th</sup> May 2020

Hosted on [www.school-of-Andry.com](http://www.school-of-Andry.com)



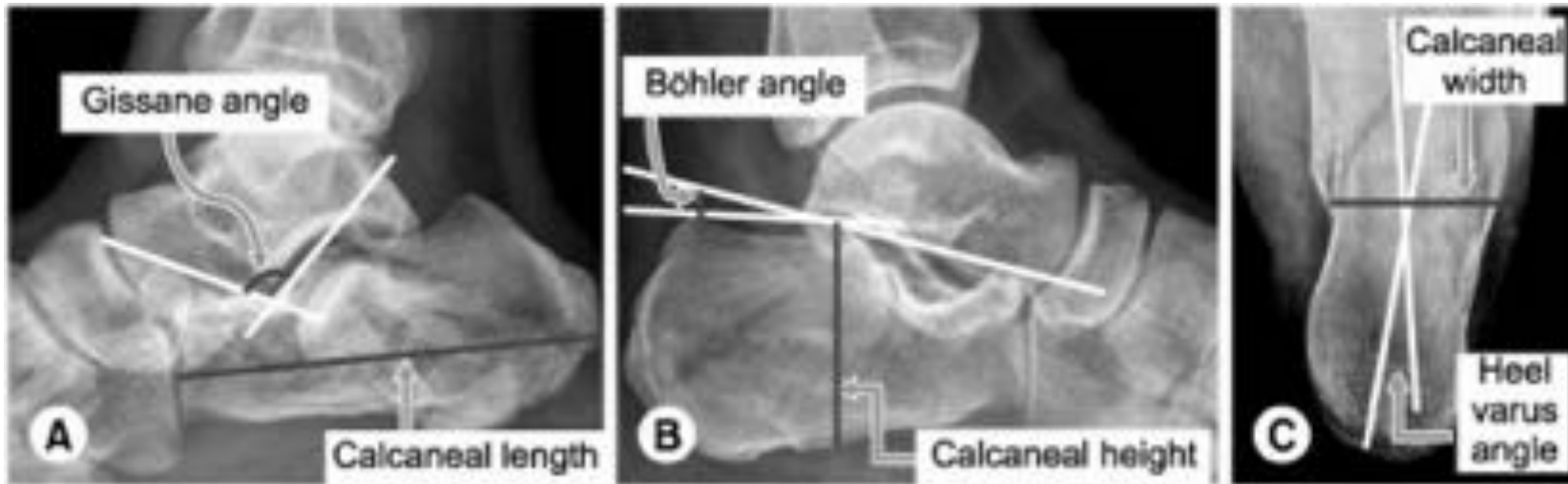
# CASE #1

- A 30-year-old man presented with severe left heel pain after jumping off a wall while running away from the police.
- Please comment on the radiograph.







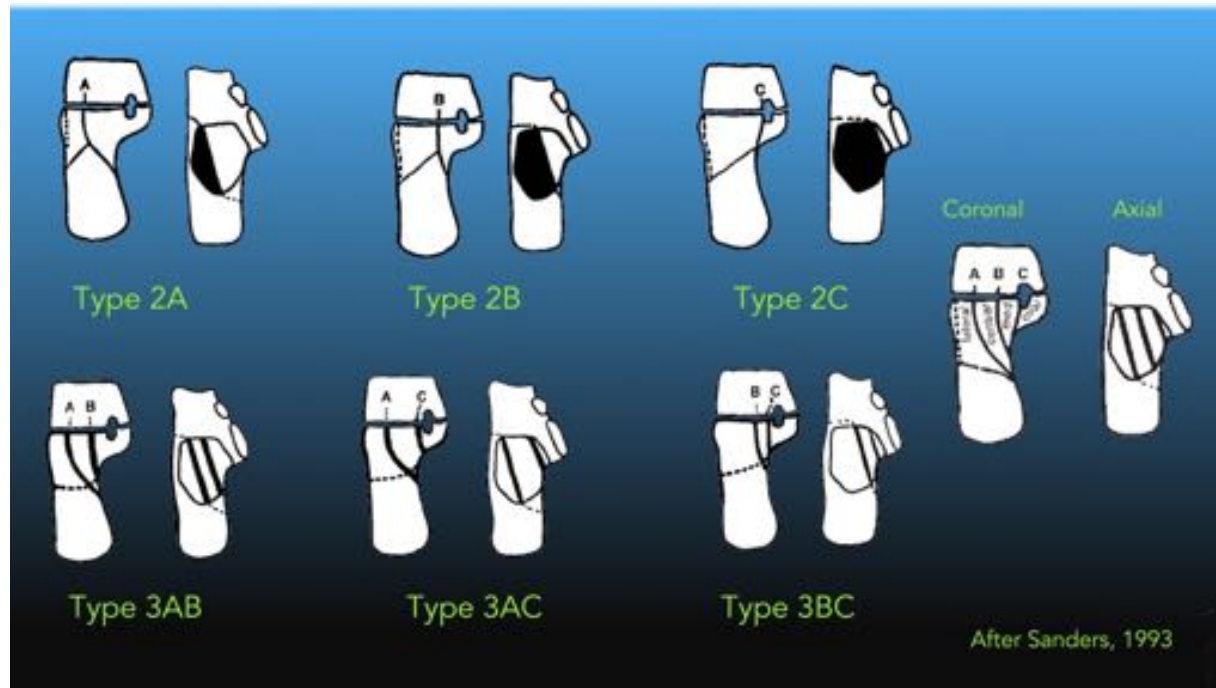




Loucks C, Buckley R. Bohler's angle: correlation with outcome in displaced intra-articular calcaneal fractures. *J Orthop Trauma* 1999;13(8):554-8.







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(10):551-63.





Classification	Description	Notes
Type 1	Nondisplaced	Regardless of the number of fracture fragments
Type 2	Two part fractures	A- Lateral third B- Central third C- Medial Third
Type 3	Three part fractures	Two of the above
Type 4	Highly comminuted	



## The extended lateral approach to the hindfoot

ANATOMICAL BASIS AND SURGICAL IMPLICATIONS

Brian J. C. Freeman, Sarah Duff, Patricia E. Allen,  
Helen D. Nicholson, Roger M. Atkins

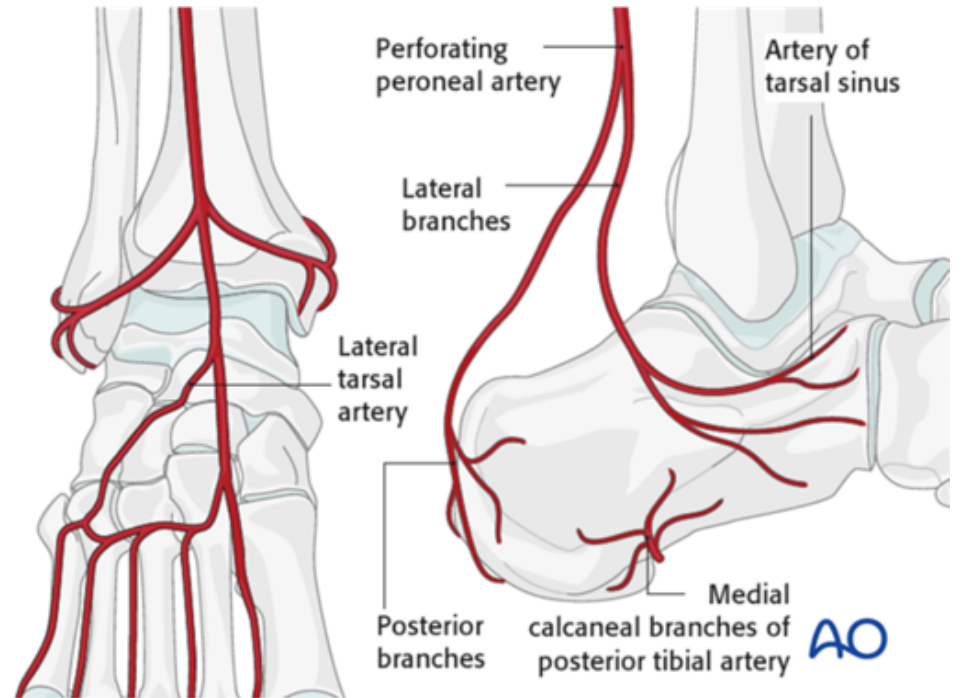
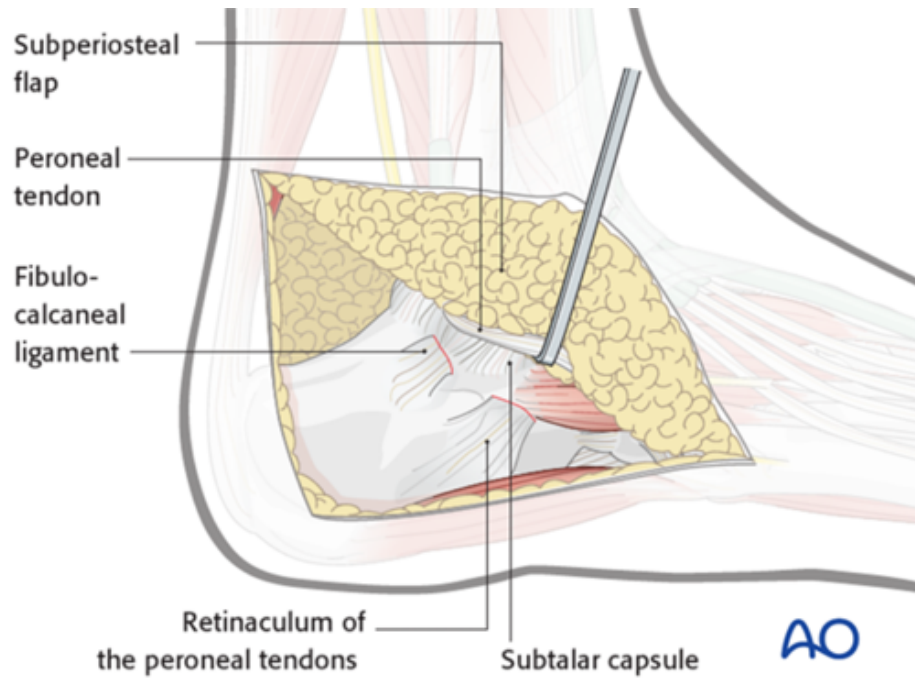
*From Bristol Royal Infirmary and the University of Bristol, England*



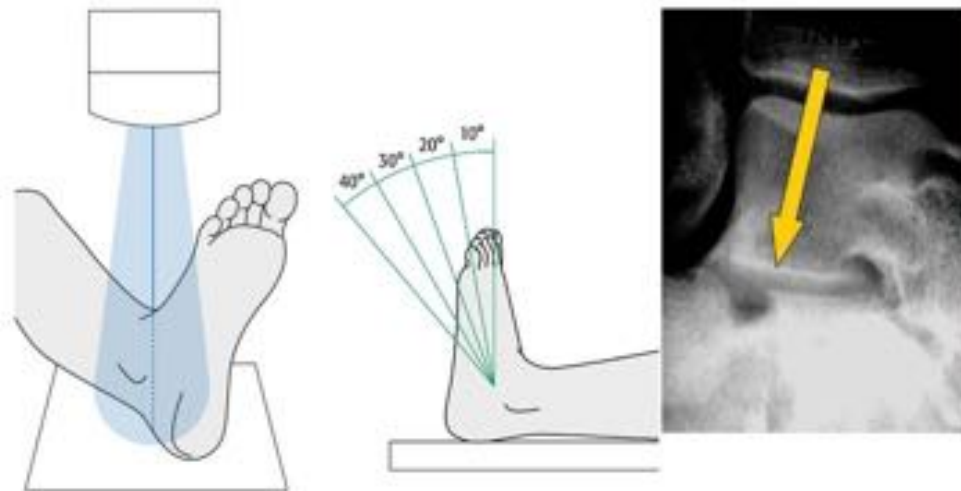
**Operative technique.** The skin incision is made by two straight cuts which meet at the lateral side of the heel at an angle of not less than  $100^\circ$ . The distal arm starts over the base of the fifth metatarsal and passes directly posteriorly at

the upper edge of the thick, specialised heel skin to meet the proximal arm. In patients with a calcaneal fracture, the incision is approximately 1 cm below the maximally bruised skin.

The proximal part of the incision begins in the posterior midline, at about 12 cm above the level of the sole and passes in a straight line distally and anteriorly to meet the distal arm about 2 cm anterior to the line of the heel. The incision is carried directly through the deep fascia with no undermining of skin. For the full extended lateral approach the incision is most easily deepened at its angle, where the calcaneum is readily palpable. The horizontal part of the incision is below the calcaneum and is deepened to the bone. In the distal part, the fascia over the abductor digiti minimi is opened longitudinally and the muscle incised in the line of its fibres. Deep dissection of the proximal arm passes anterior to the calcaneal tendon, and care is taken not to open the paratenon. At its uppermost end the dissection passes around the calcaneal tendon and the lower fibres of gastrocnemius. Since the main trunk of the sural nerve is just anterior to this part of the incision care is required to avoid it.



## Fractures of the calcaneus



Broden's view

AO



# OPERATIVE COMPARED WITH NONOPERATIVE TREATMENT OF DISPLACED INTRA-ARTICULAR CALCANEAL FRACTURES

A PROSPECTIVE, RANDOMIZED, CONTROLLED MULTICENTER TRIAL

BY RICHARD BUCKLEY, MD, FRCSC, SUZANNE TOUGH, PhD, ROBERT MCCORMACK, MD, FRCSC, GRAHAM PATE, MD, FRCSC,  
ROSS LEIGHTON, MD, FRCSC, DAVE PETRIE, MD, FRCSC, AND ROBERT GALPIN, MD, FRCSC

*Investigation performed at the Calgary General Hospital, Calgary, Alberta; the Royal Columbia Hospital, New Westminster, British Columbia;  
the Royal Victoria Hospital, Halifax, Nova Scotia; and The Victoria Hospital, London, Ontario, Canada*

**Background:** Open reduction and internal fixation is the treatment of choice for displaced intra-articular calcaneal fractures at many orthopaedic trauma centers. The purpose of this study was to determine whether open reduction and internal fixation of displaced intra-articular calcaneal fractures results in better general and disease-specific health outcomes at two years after the injury compared with those after nonoperative management.

**Methods:** Patients at four trauma centers were randomized to operative or nonoperative care. A standard protocol, involving a lateral approach and rigid internal fixation, was used for operative care. Nonoperative treatment involved no attempt at closed reduction, and the patients were treated only with ice, elevation, and rest. All fractures were classified, and the quality of the reduction was measured. Validated outcome measures included the Short Form-36 (SF-36, a general health survey) and a visual analog scale (a disease-specific scale).

**Results:** Between April 1991 and December 1997, 512 patients with a calcaneal fracture were treated. Of those patients, 424 with 471 displaced intra-articular calcaneal fractures were enrolled in the study. Three hundred and nine patients (73%) were followed and assessed for a minimum of two years and a maximum of eight years of follow-up. The outcomes after nonoperative treatment were not found to be different from those after operative treatment; the score on the SF-36 was 64.7 and 68.7, respectively ( $p = 0.13$ ), and the score on the visual analog scale was 64.3 and 68.6, respectively ( $p = 0.12$ ). However, the patients who were not receiving Workers' Compensation and were managed operatively had significantly higher satisfaction scores ( $p = 0.001$ ). Women who were managed operatively scored significantly higher on the SF-36 than did women who were managed nonoperatively ( $p = 0.015$ ). Patients who were not receiving Workers' Compensation and were younger (less than twenty-nine years old), had a moderately lower Böhler angle ( $0^\circ$  to  $14^\circ$ ), a comminuted fracture, a light workload, or an anatomic reduction or a step-off of  $\leq 2$  mm after surgical reduction ( $p = 0.04$ ) scored significantly higher on the scoring scales after surgery compared with those who were treated nonoperatively.

**Conclusions:** Without stratification of the groups, the functional results after nonoperative care of displaced intra-articular calcaneal fractures were equivalent to those after operative care. However, after unmasking the data by removal of the patients who were receiving Workers' Compensation, the outcomes were significantly better in some groups of surgically treated patients.



**Buckley *et al.* JBJS 2002.<sup>8</sup> Operative compared with non-operative treatment of displaced intra-articular calcaneal fractures: a prospective randomized controlled multicentre trial:**

**Study Findings:**

- Large, multicenter trial with good follow-up
- Similar functional results (without sub-stratification) of calcaneal fractures treated operatively *versus* non-operatively
- More favourable outcomes in patients without worker's compensation, women, and younger patients

**Study Critique:**

- Randomised before allocation
- Smoking and co-morbidities not accounted for
- Limited number of surgeons so difficult to generalise findings
- Sub-stratification appeared to be done retrospectively after no difference found between groups





## RESEARCH

# Operative versus non-operative treatment for closed, displaced, intra-articular fractures of the calcaneus: randomised controlled trial

 OPEN ACCESS

Damian Griffin *professor of trauma and orthopaedic surgery*, Nick Parsons *senior research fellow in medical statistics*, Ewart Shaw *associate professor in statistics*, Yuri Kulikov *clinical research fellow*, Charles Hutchinson *professor of clinical imaging*, Margaret Thorogood *professor of epidemiology*, Sarah E Lamb *professor of rehabilitation*, for the UK Heel Fracture Trial (UK HeFT) investigators

Warwick Medical School and Department of Statistics, University of Warwick, and University Hospital of Coventry and Warwickshire NHS Trust, Coventry, UK



**Griffin *et al.* BMJ 2014. Operative *versus* non-operative treatment for closed, displaced, intra-articular fractures of the calcaneus. "UK Heel Fracture Trial":**

This study appeared on the cover page of the BMJ with a tabloid-type heading 'Calcaneal fracture: surgery provides no benefit'. This statement has received a lot of criticism by generalising management of all calcaneal fractures.

**Study Findings:**

- Prospective, multicentre trial (22 centres), parallel groups, assessor blinded with 95% follow-up
- Extended lateral approach for surgery
- Gross deformity excluded (fibular impingement)
- No difference at 2 years (in either PROMs or symptoms)
- Operative group had 20% wound complication rate

**Study Critique:**

- 500 eligible patients, but only 151 enrolled – potential bias?
- 27 surgeons, 2-7 cases over 2 years – what was the surgeon expertise?
- Follow-up of 2 years only – longer term studies have shown difference in subtalar fusion rates between groups at 10 years





# Key points

- Radiographic analysis
- Saunders CT classification
- Know your winners
- Know your approach
- Know the seminal RCTs and criticism of the papers



# Simulated CBDs for PAH SpRs Project



**Please submit your CBD  
assessments on ISCP now.**

Hosted on [www.school-of-Andry.com](http://www.school-of-Andry.com)



# CASE #2

- A 35-year old builder presents to A&E with a painful swollen foot following an accident at work.
- Comment on the clinical picture.





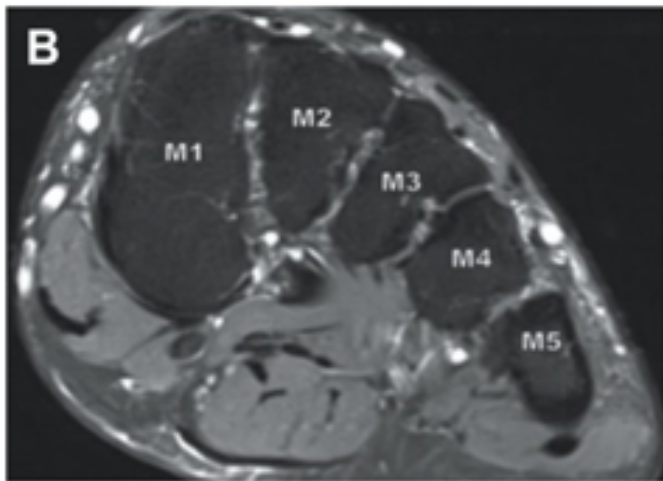
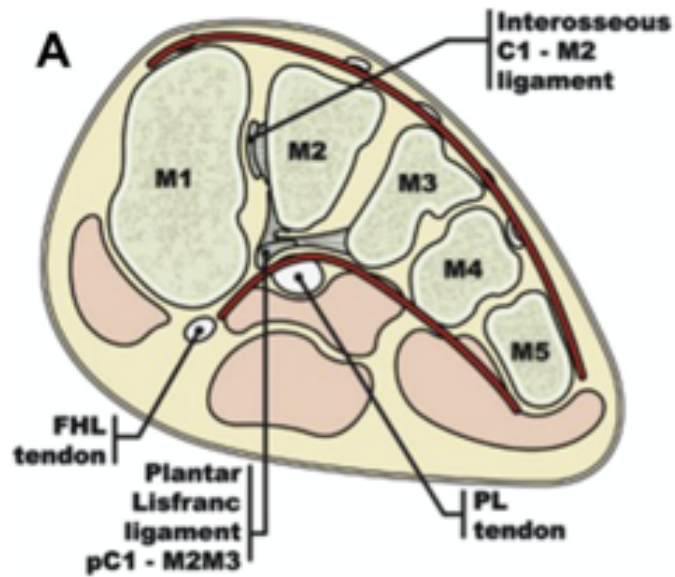


# GMFCS

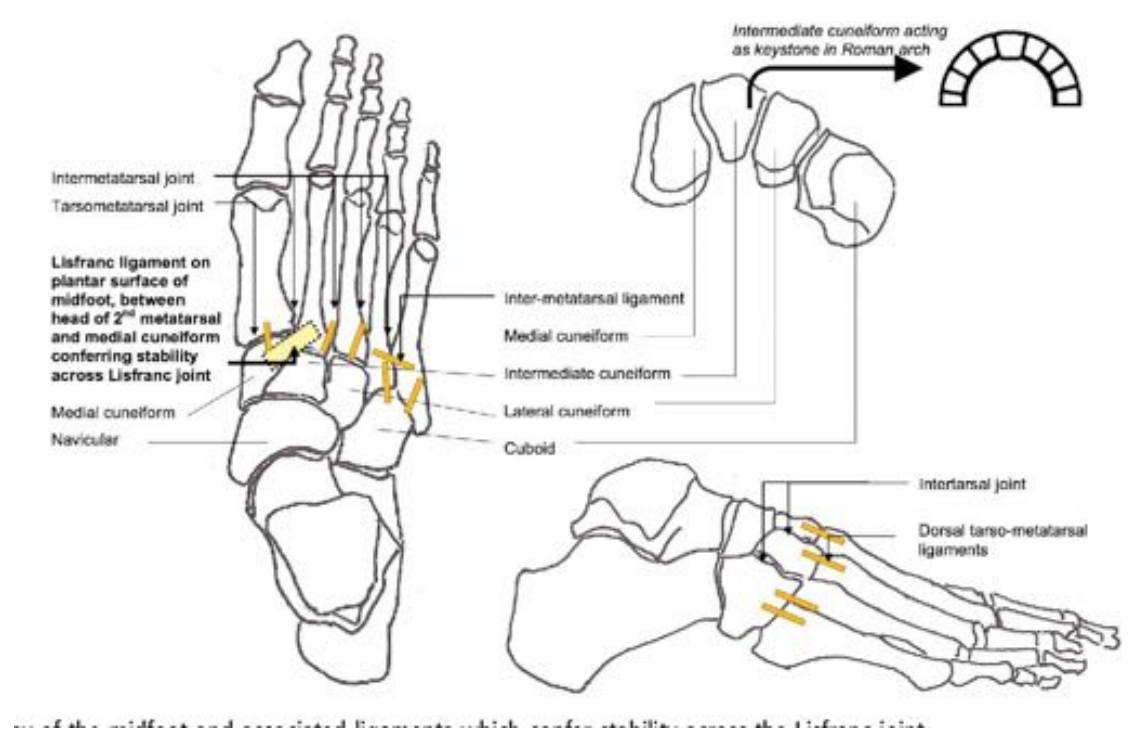
- **G** ap M1/M2 (AP)
- **M** edial 4<sup>th</sup>/Medial Cuboid (Oblique) or medial 2<sup>nd</sup>/medial middle cuneiform (AP)
- **F** leck sign (AP)
- medial **C** olumn line - medial Nav/medial cuneiform intersected the base of the first metatarsal (AP)
- **S** ubluxation (Lateral)











# Lis Franc joint complex

- **Bony** and **ligamentous** element
- Combine to provide structural support to the **transverse arch**
- **Recessed** 2nd Tarsometatarsal (TMT) joint forms the “**keystone**” of the transverse arch.
- **Lisfranc ligament** is a plantar interosseous ligament that runs from medial cuneiform to base of 2nd metatarsal - strongest ligament in the complex and is critical to stabilizing and maintenance of the midfoot arch.
- Other ligaments which contribute to this complex includes **plantar and dorsal tarsometatarsal ligament** and **intermetatarsal ligament**.

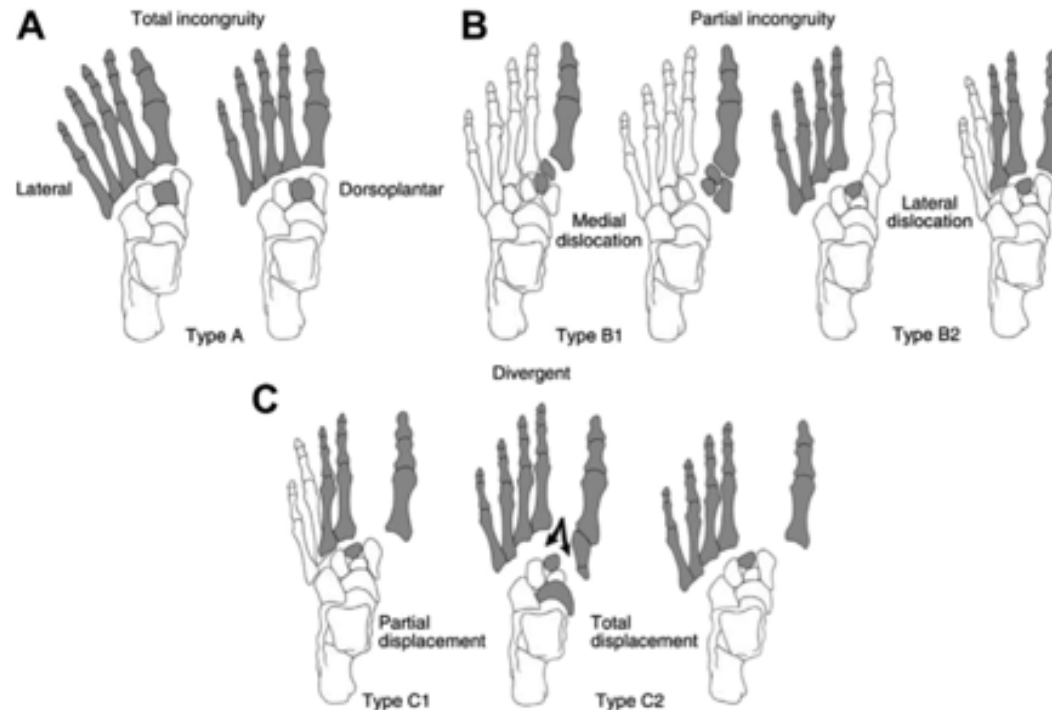


# 3 column theory

- The medial and middle columns function as a unit with very little motion seen across these articulations during gait
- The lateral column is mobile and essential for shock absorption when the foot strikes an uneven surface
- The articulations of the medial and middle column are nonessential and can be sacrificed yet still maintain the function of the midfoot



# Myerson



**Fig. 8.** Classification of tarsometatarsal joint injury. The shaded areas represent the injured or displaced portion of the foot. (A) Type A, total incongruity, which involves displacement of all 5 metatarsals with or without fracture at the base of the second MT. The usual displacement is lateral or dorsolateral. These injuries are "homolateral." (B) In type B injuries, 1 or more articulations remain intact. Type B1 represents partial incongruity with medial dislocation. Type B2 represents partial incongruity with lateral dislocation; the first TMT joint maybe involved. (C) Divergent injury pattern, with either partial (C1) or total (C2) displacement. The arrows in C2 represent the forces through the foot leading to a divergent pattern. (From Myerson MS, Fisher RT, Burgess AR, et al. Fracture-dislocations of the tarsometatarsal joints: end results correlated with pathology and treatment. Foot Ankle 1986;6:228; with permission.)



# TREATMENT OF PRIMARILY LIGAMENTOUS LISFRANC JOINT INJURIES: PRIMARY ARTHRODESIS COMPARED WITH OPEN REDUCTION AND INTERNAL FIXATION

A PROSPECTIVE, RANDOMIZED STUDY

BY THUAN V. LY, MD, AND J. CHRIS COETZEE, MD, FRCSC

*Investigation performed at the Department of Orthopaedic Surgery, University of Minnesota, Minneapolis, Minnesota*

**Background:** Open reduction and internal fixation is currently the accepted treatment for displaced Lisfranc joint injuries. However, even with anatomic reduction and stable internal fixation, treatment of these injuries does not have uniformly excellent outcomes. The objective of this study was to compare primary arthrodesis with open reduction and internal fixation for the treatment of primarily ligamentous Lisfranc joint injuries.

**Methods:** Forty-one patients with an isolated acute or subacute primarily ligamentous Lisfranc joint injury were enrolled in a prospective, randomized clinical trial comparing primary arthrodesis with traditional open reduction and internal fixation. The patients were followed for an average of 42.5 months. Evaluation was performed with clinical examination, radiography, the American Orthopaedic Foot and Ankle Society (AOFAS) Midfoot Scale, a visual analog pain scale, and a clinical questionnaire.

**Results:** Twenty patients were treated with open reduction and screw fixation, and twenty-one patients were treated with primary arthrodesis of the medial two or three rays. Anatomic initial reduction was obtained in eighteen of the twenty patients in the open-reduction group and twenty of the twenty-one in the arthrodesis group. At two years postoperatively, the mean AOFAS Midfoot score was 68.6 points in the open-reduction group and 88 points in the arthrodesis group ( $p < 0.005$ ). Five patients in the open-reduction group had persistent pain with the development of deformity or osteoarthritis, and they were eventually treated with arthrodesis. The patients who had been treated with a primary arthrodesis estimated that their postoperative level of activities was 92% of their preinjury level, whereas the open-reduction group estimated that their postoperative level was only 65% of their preoperative level ( $p < 0.005$ ).

**Conclusions:** A primary stable arthrodesis of the medial two or three rays appears to have a better short and medium-term outcome than open reduction and internal fixation of ligamentous Lisfranc joint injuries.

**Level of Evidence:** Therapeutic Level I. See Instructions to Authors for a complete description of levels of evidence.

- ORIF (n = 20) vs PA (n = 21) for primarily ligamentous injury patterns with a minimum 2-year follow-up.
- The arthrodesis group had significantly improved functional outcomes, higher returns to preinjury activity levels, lower rates of reoperation, and less pain at final follow-up.
- In the group that underwent open reduction, 15 (75%) of 20 patients developed radiographic arthritis and 5 patients (25%) required conversion to arthrodesis for symptomatic posttraumatic arthritis.





## Does Open Reduction and Internal Fixation versus Primary Arthrodesis Improve Patient Outcomes for Lisfranc Trauma? A Systematic Review and Meta-analysis

Nicholas Smith MD, MSc, Craig Stone MD, MSc, FRCSC,  
Andrew Furey MD, MSc, FRCSC

Published online: 29 May 2015  
© The Association of Bone and Joint Surgeons® 2015

### Abstract

**Background** Although Lisfranc injuries are uncommon, representing approximately 0.2% of all fractures, they are complex and can result in persistent pain, degenerative arthritis, and loss of function. Both open reduction and internal fixation (ORIF) and primary fusion have been proposed as treatment options for these injuries, but debate remains as to which approach is better.

**Questions/purposes** We asked whether ORIF or primary fusion led to (1) fewer reoperations for hardware removal; (2) less frequent revision surgery; (3) higher patient outcome scores; and (4) more frequent anatomic reduction.

**Methods** A systematic review was performed using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Three trials met the criteria for inclusion within the meta-analysis. Qualifying

articles for the meta-analysis had data extracted independently by two authors (NS, AF). The quality of each study was assessed using the Center for Evidence Based Medicine's evaluation strategy; data were extracted from articles rated as good and fair: two and one article, respectively.

**Results** The risk ratio for hardware removal was 0.23 (95% confidence interval [CI], 0.11–0.45;  $p < 0.001$ ) indicating more hardware removal for ORIF than fusion. For other revision surgery, the risk ratio for ORIF was 0.36 (95% CI, 0.08–1.59;  $p = 0.18$ ) favoring neither. Similarly, neither was favored using patient-reported outcomes; the standard mean difference was calculated to be 0.50 (95% CI, –2.13 to 3.12;  $p = 0.71$ ). When considering the risk of nonanatomic alignment, neither was favored (risk ratio, 1.48; 95% CI, 0.34–6.38;  $p = 0.60$ ).

**Conclusions** The surgeon should consider the increased risk of hardware removal along with its associated morbidity and discuss this with the patient preoperatively when considering ORIF of Lisfranc injuries. Because no new trials have been performed since 2012, further randomized controlled trials will be needed improve our understanding of these interventions.

**Level of Evidence** Level I, therapeutic study.

Each author certifies that he or she, or a member of his or her immediate family, has no funding or commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research*® editors and board members are on file with the publication and can be viewed on request.

*Clinical Orthopaedics and Related Research*® neither advocates nor

- The risk ratio for hardware removal was 0.23 (95% confidence interval [CI], 0.11–0.45;  $p < 0.001$ ) indicating more hardware removal for ORIF than fusion.
- For other revision surgery, the risk ratio for ORIF was 0.36 (95% CI, 0.08–1.59;  $p = 0.18$ ) favoring neither.
- Similarly, neither was favored using patient-reported outcomes; the standard mean difference was calculated to be 0.50 (95% CI, –2.13 to 3.12;  $p = 0.71$ ).
- When considering the risk of nonanatomic alignment, neither was favored (risk ratio, 1.48; 95% CI, 0.34–6.38;  $p = 0.60$ ).





# Compartment syndrome incisions

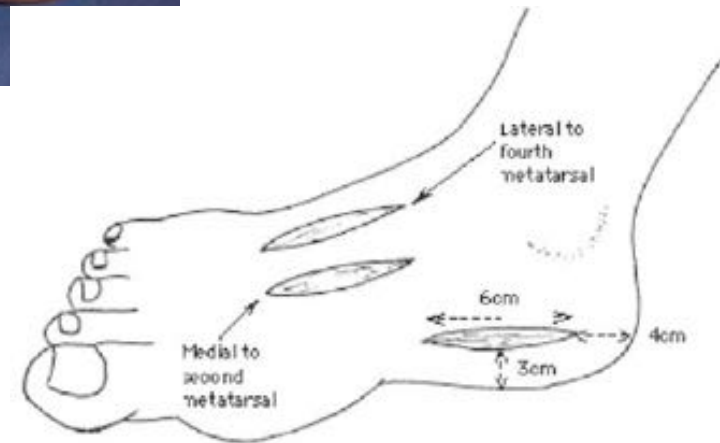
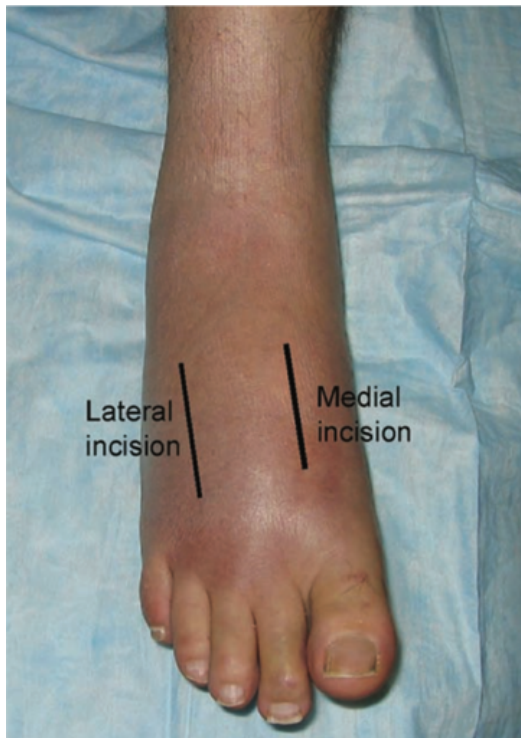
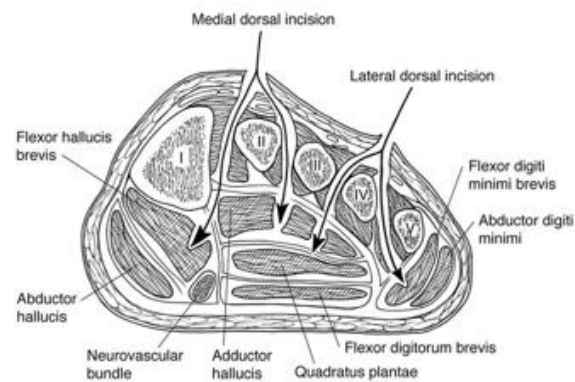
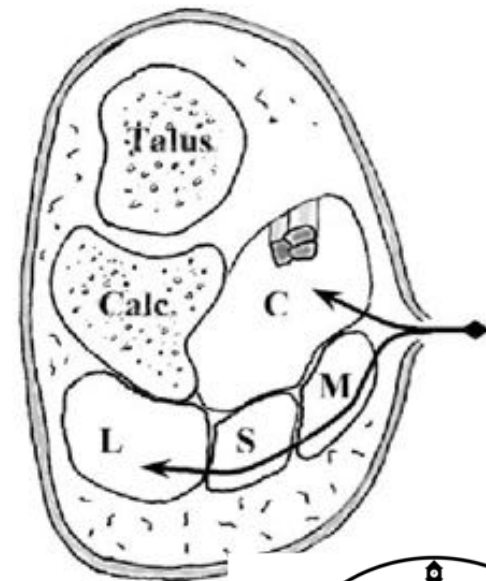
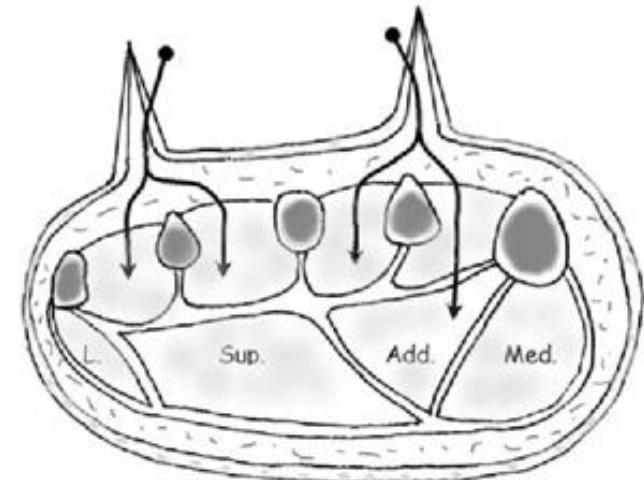
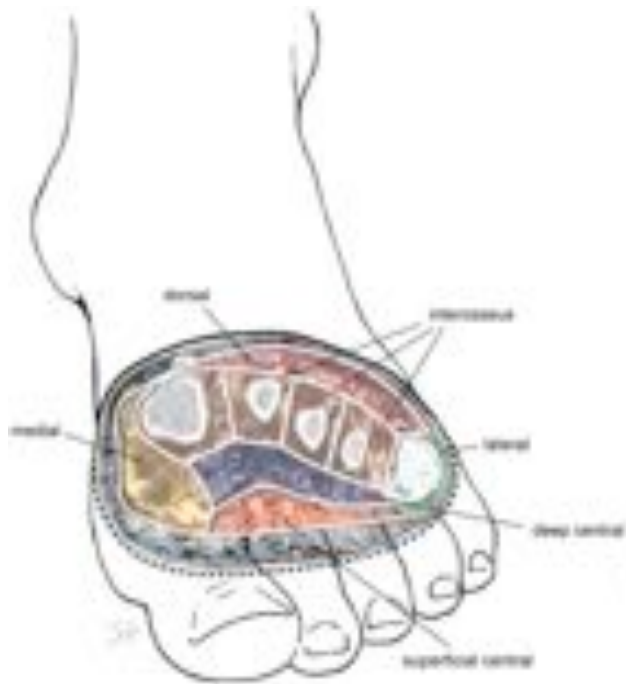


Fig. 5: Adequate release of foot compartments requires both dorsal





- Medial
- Lateral
- Superficial central
- Calcaneal or deep central
- Adductor
- Interosseous x 4





# Acute versus delayed management of foot compartment syndrome



- Controversy exists
- Recommendations are based on Level 4 or 5 evidence
- Aim: to prevent ischaemic contracture deformity of the foot and minimize development of neuropathic pain.
- Early decompression and fasciotomy carry the risk of wound infection and the potential need for soft tissue coverage
- Delayed treatment results in a higher rate of deformity and the sequelae of Volkmann's contracture.



# Key points

- Know the anatomy
- Think dynamic stability
- Classification not useful
- ORIF vs Fusion
- Foot compartment syndrome is controversial



# Simulated CBDs for PAH SpRs Project



**Please submit your CBD  
assessments on ISCP now.**

Hosted on [www.school-of-Andry.com](http://www.school-of-Andry.com)

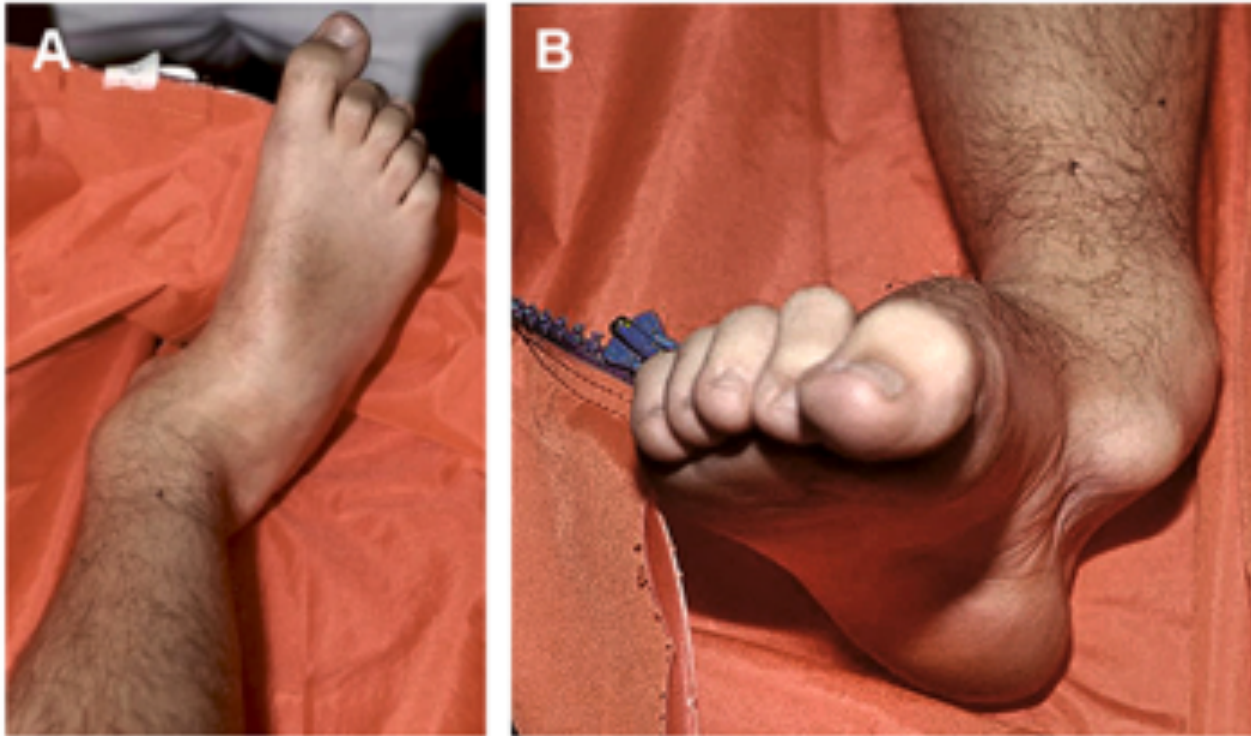


# CASE #3

- A 60-year-old gentleman presented with right ankle pain after falling off a ladder in the afternoon. Please comment on the radiograph.







**Fig. 1.** (A, B) Clinical appearance of a lateral subtalar dislocation with the foot lateral to the lower leg and a medially prominent talar head.

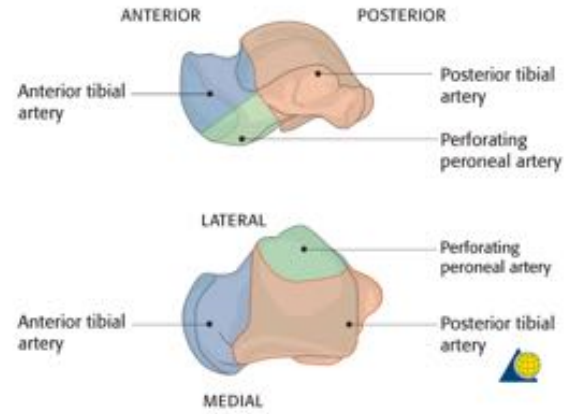
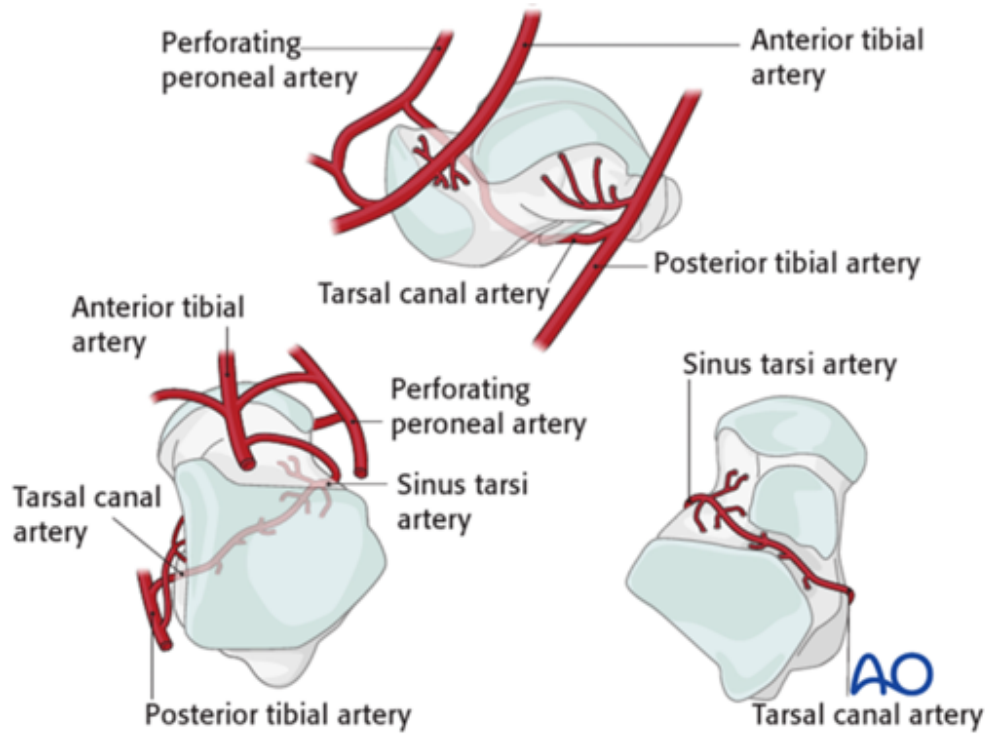


# Blocks to reduction

- Posterior tibialis tendon
- Flexor hallucis longus
- Flexor digitorum longus
- Extensor digitorum brevis
- Peroneal tendons
- Talonavicular joint capsule

**In lateral subtalar dislocation, the block to reduction are on the medial side and vice versa.**







# Hawkin's classification of talus neck fracture

- Type I - Nondisplaced talar neck fracture,
- Type II - Talar neck fracture with or without subtalar dislocation
- Type III - Talar neck fracture with subtalar and tibiotalar dislocation
- Type IV - Talar neck fracture with subtalar, tibiotalar, and talonavicular dislocations (Canale & Kelly)



Study	Total AVN cases	Hawkins I	Hawkins II	Hawkins III	Hawkins IV
Hawkins [3]	30	0 (0%)	10 (42%)	20 (91%) <sup>†</sup>	0
Kennwright and Taylor [20]	8	0	0	0	0
Lorentzen et al. [14]	26	2 (8%)	13 (24%)	11 (69%)	0
Canale and Kelly [6]	33	2 (13%)	15 (50%)	15 (44%) <sup>‡</sup>	1 (50%) <sup>†</sup>
Penny and Davis [10]	13	0 (0%)	2 (20%)	11 (100%)	0
Schulze et al. [9]	8	0 (0%)	2 (13%)	5 (29%)	1 (100%)
Lindvall et al. [16]	7	0 (0%)	4 (40%)	2 (40%)	1 (100%)
Sanders et al. [7]	8	NR	NR	NR	NR
Vallier et al. [15]	12	NR	NR	NR	NR
Vallier et al. [12]	16	0 (0%)	4 (13%) <sup>‡</sup>	11 (41%)	1 (33%)
Total	161	4	40	76	4

AVN: avascular necrosis.

NR: not reported.

<sup>†</sup> Excludes 5 patients who had primary talarctomy.

<sup>‡</sup> Not used.

<sup>§</sup> Excludes two ankles in which Blair fusion was performed and two patients who had either talarctomy as a primary procedure or prior to the time when talar body could be evaluated for avascular necrosis.

<sup>††</sup> Excludes one patient with primary talarctomy.

<sup>‡‡</sup> Separated over groups IIIA and IIIB depending on rate of dislocation. All 4 (25%) cases were in the IIIB group.

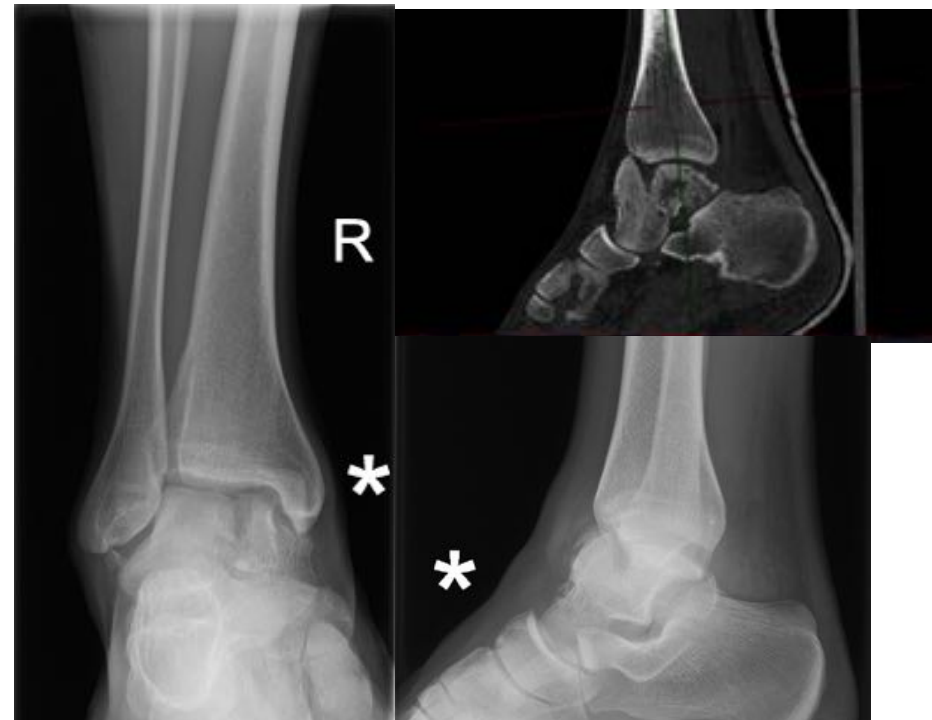






# Key points

- CT scan post reduction for subtalar dislocation
- Blood supply to talus
- Hawkins classification & relevance to AVN rates
- Dual approach for talar fixation



# Simulated CBDs for PAH SpRs Project



**Please submit your CBD  
assessments on ISCP now.**

Hosted on [www.school-of-Andry.com](http://www.school-of-Andry.com)

