Fractures of the Calcaneus

R.J. Claridge MD

Mayo Clinic
Scottsdale Arizona

Fractures of the Calcaneus

Evaluation & Indications

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Disclosures

- No disclosures pertinent to this presentation

Fractures of the Calcaneus

Evaluation

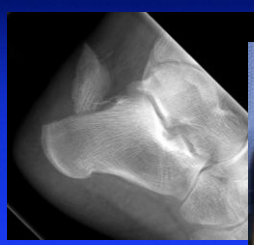
- History and Physical:
  - ✓ Mechanism of injury
  - ✓ Concomitant injuries
  - ✓ Diabetes, neuropathy
  - ✓ Smoking history, vascular disease
  - ✓ Soft tissue damage
  - ✓ Bone quality

Fractures of the Calcaneus

Evaluation

Fractures of the Calcaneus

Evaluation



Fractures of the Calcaneus

Evaluation

- Radiographs:
  - ✓ Foot, 3 views
  - ✓ AP ankle
  - ✓ Harris view
  - ✓ CT scan
  - ✓ 3D reconstruction
  - ✓ MRI
  - ✓ Bone Scan

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Fractures of the Calcaneus

Treatment

- Operative: 3 groups
  - ✓ Always
  - ✓ Never
  - ✓ Maybe

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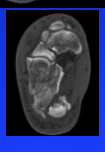

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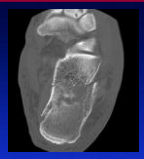

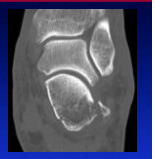

71 yo retired opthalmologist

Fractures of the Calcaneus

Treatment

- Operative: 3 groups
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71 yo retired opthalmologist

4 months post injury

Fractures of the Calcaneus

Treatment

- Operative: 3 groups
  - ✓ Maybe

72 yo male

Fractures of the Calcaneus

Treatment

- Operative: 3 groups
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Fractures of the Calcaneus

Treatment

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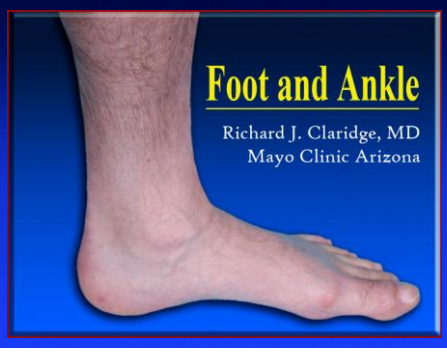
Fractures of the Calcaneus



Open Reduction of Calcaneus Fractures

Prof. V. K. Panchbhavi MD, FACS

Chief Division of Foot & Ankle Surgery

Director Foot & Ankle Fellowship Program

University of Texas Medical Branch

Galveston, Texas, USA

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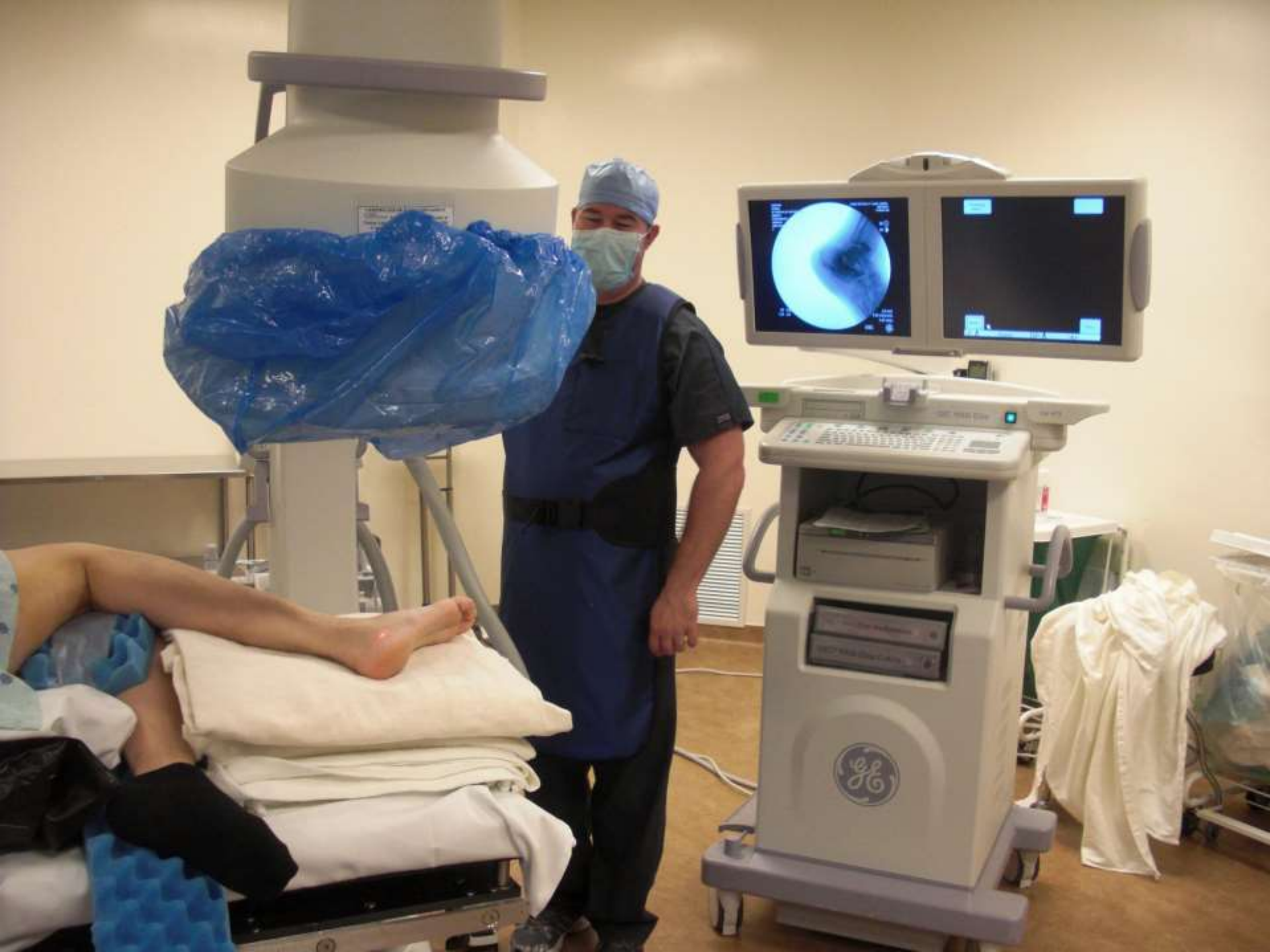
Objectives

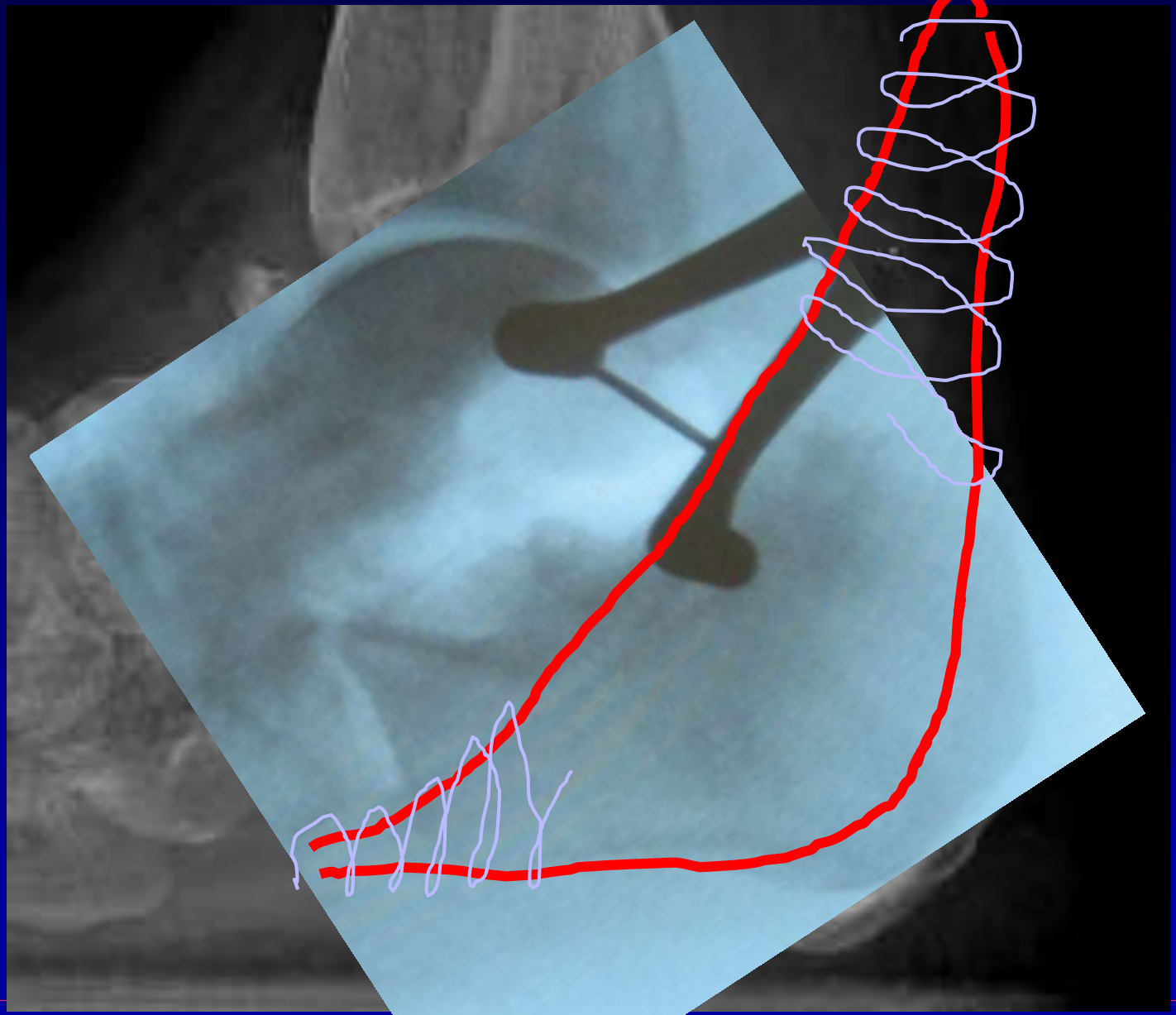
- Patient positioning
- Surgical approaches
- Reduction maneuvers
- Internal fixation methods

- Positioning – consideration

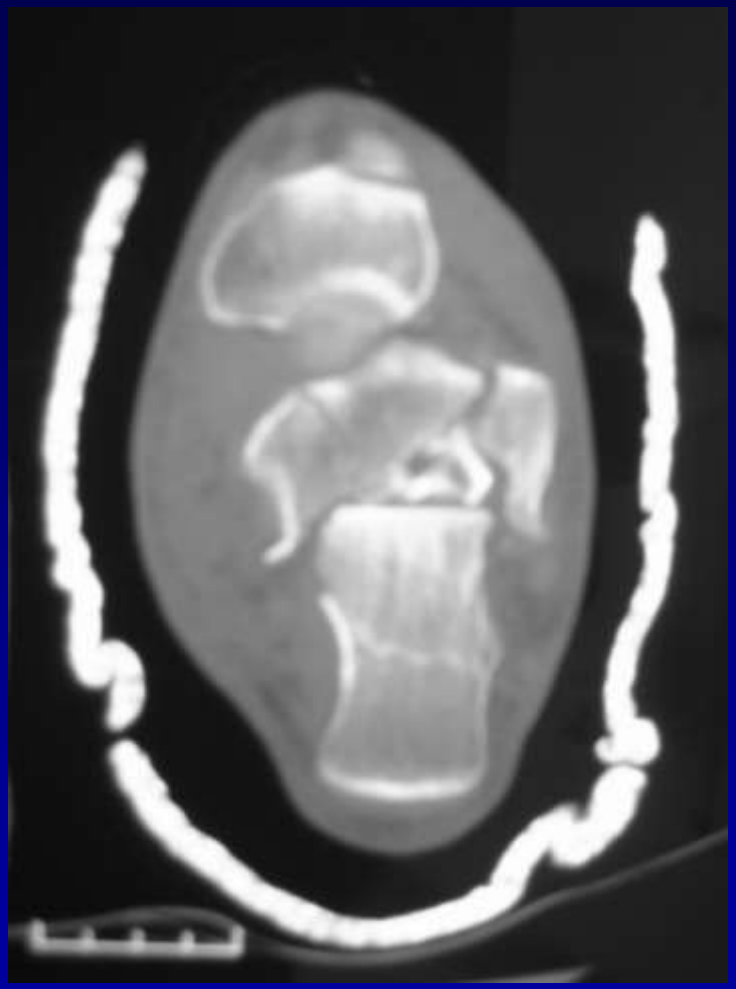


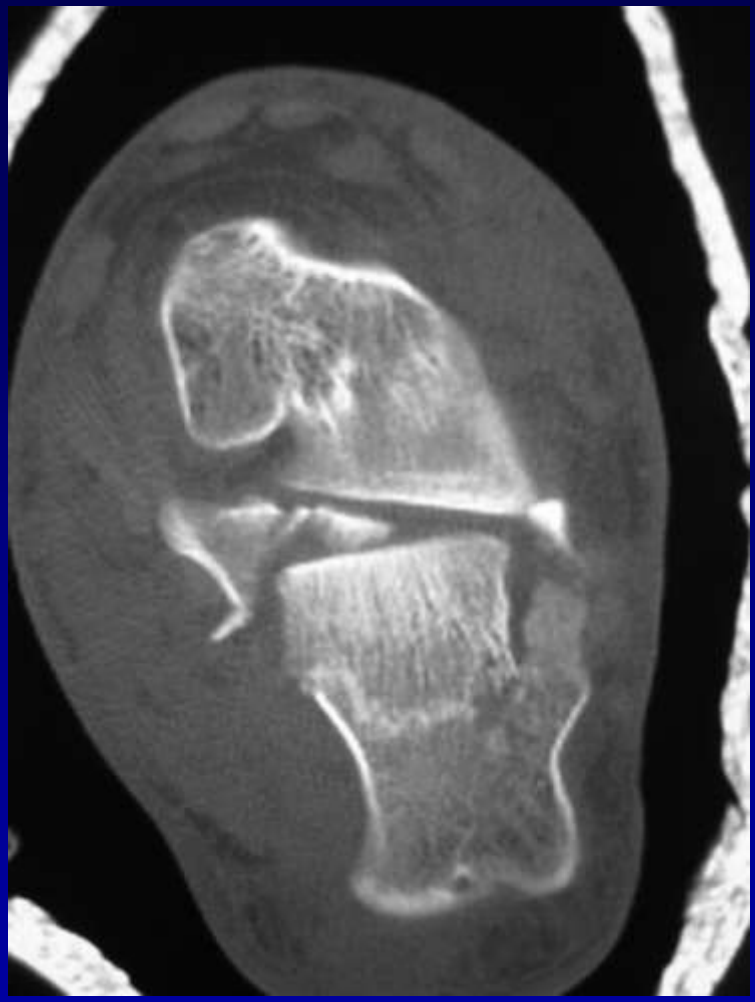
- Surgical approach - considerations

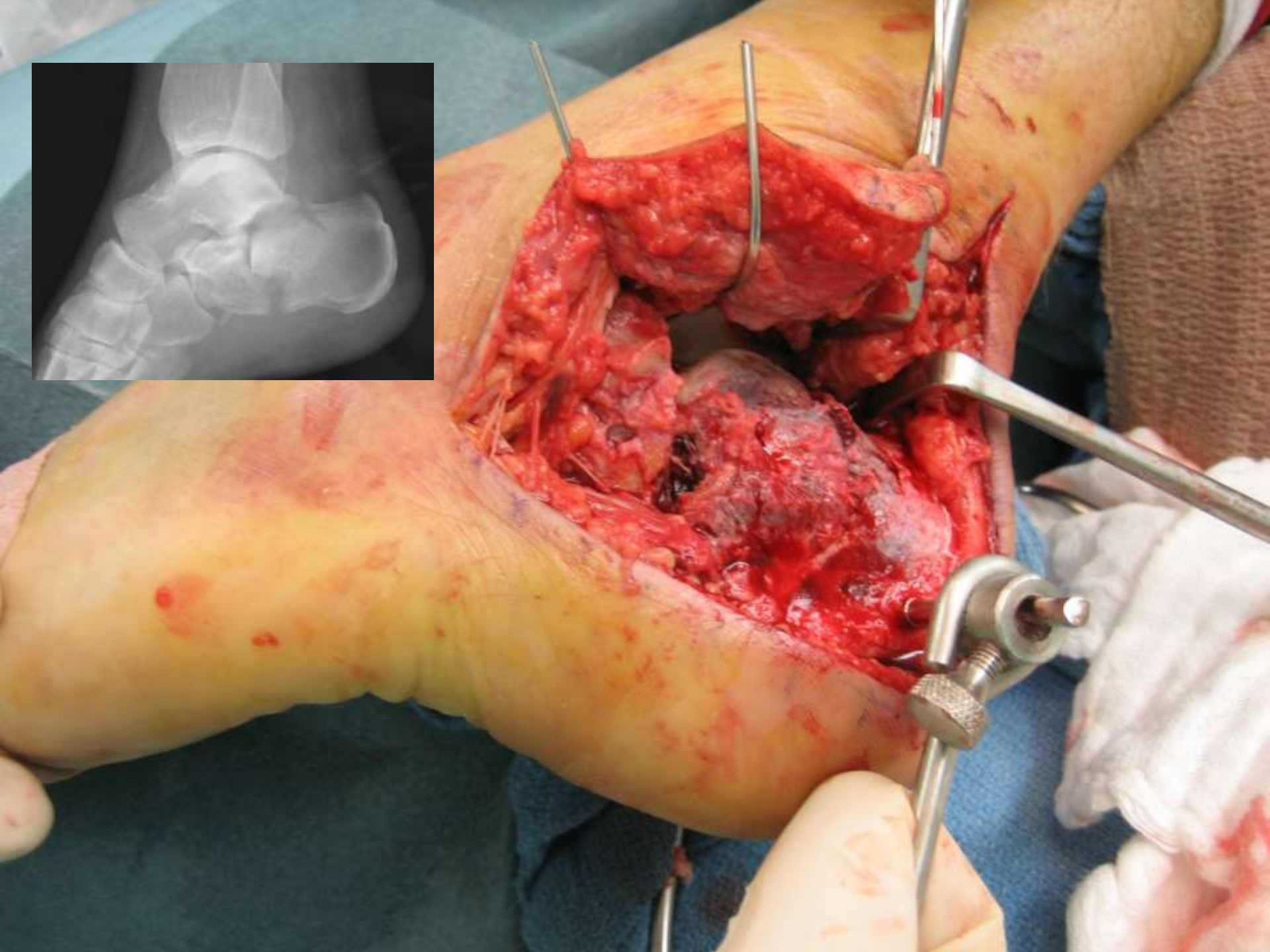
Surgical Approach

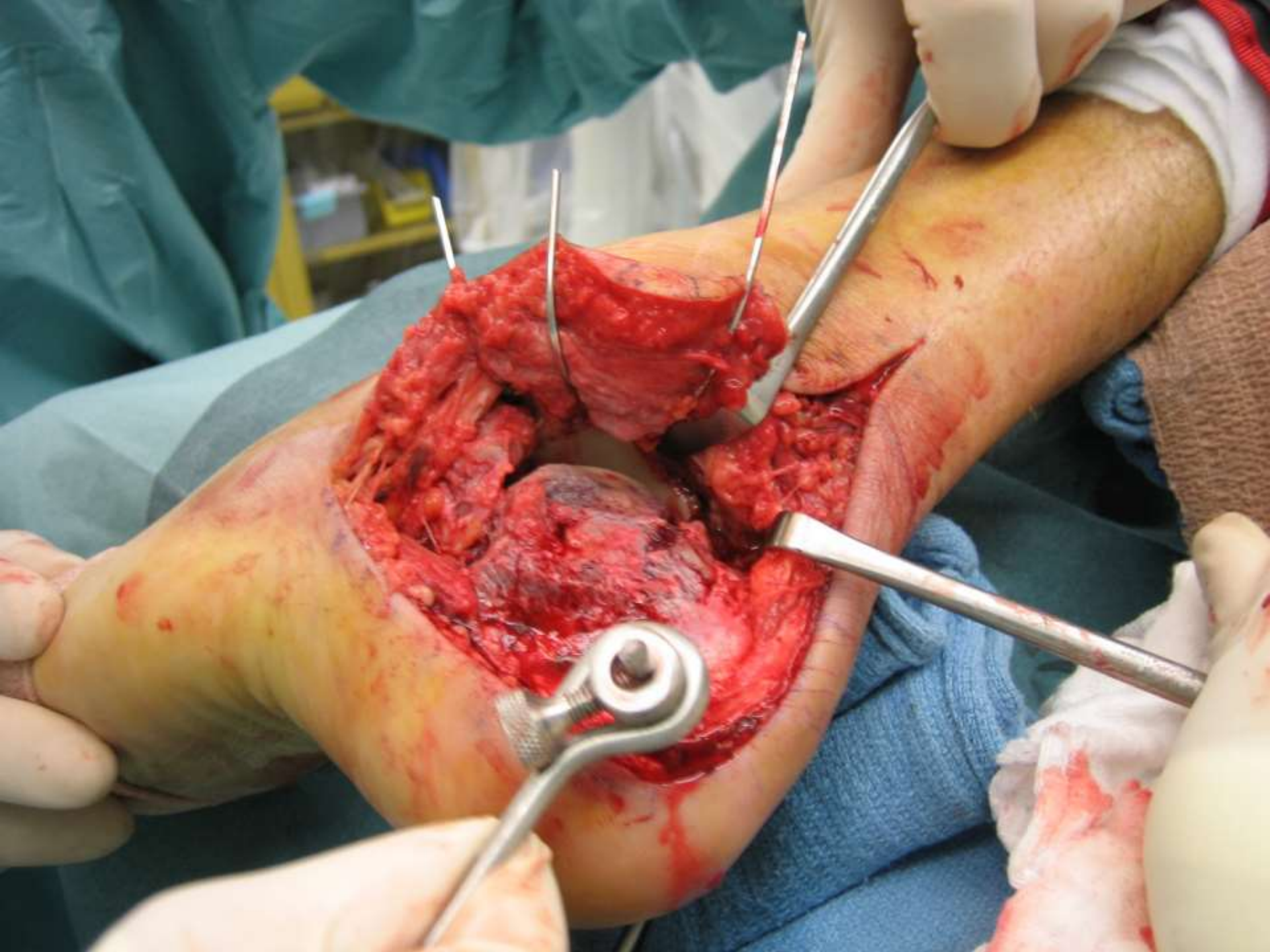


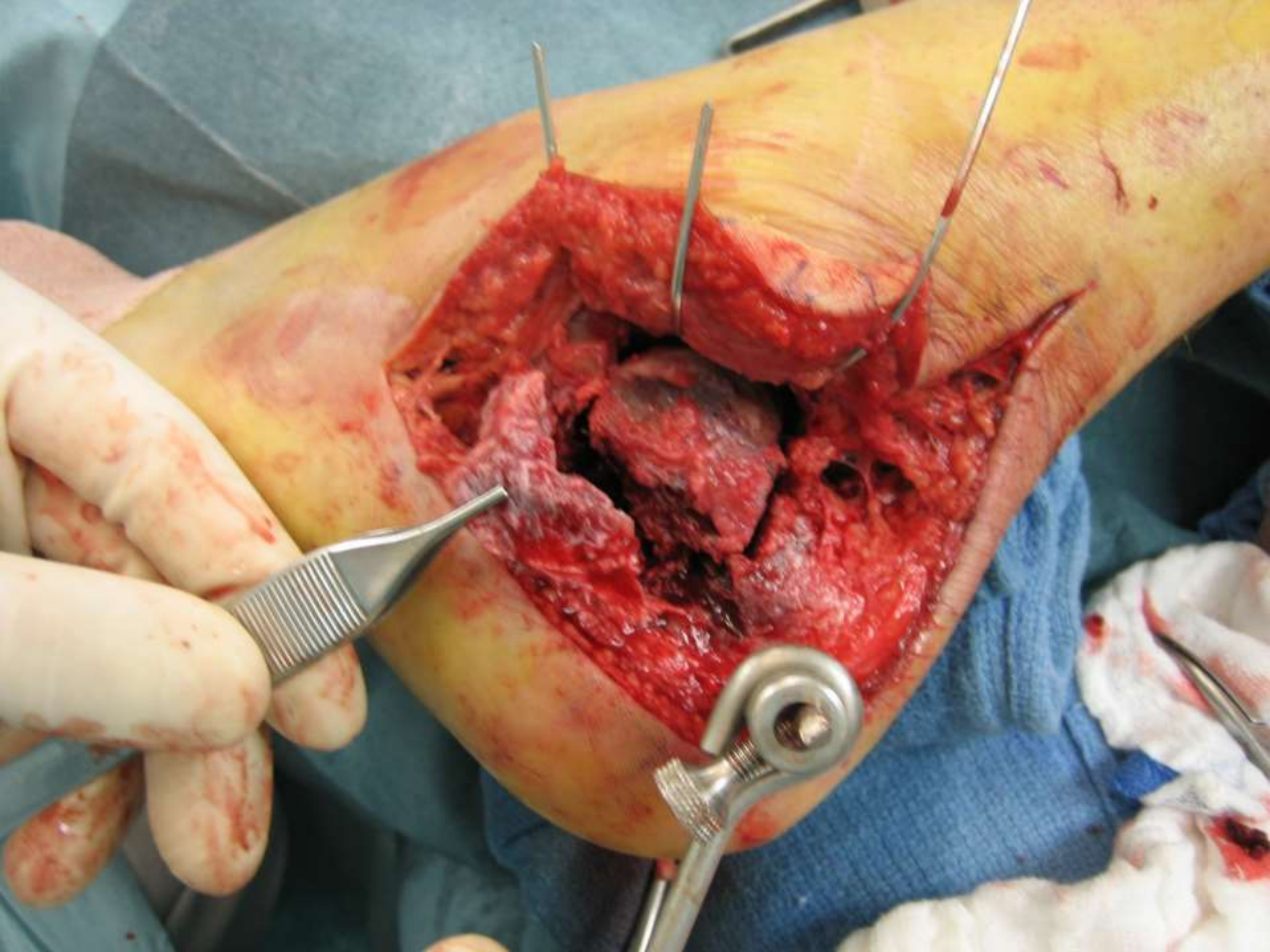
- Reduction maneuvers

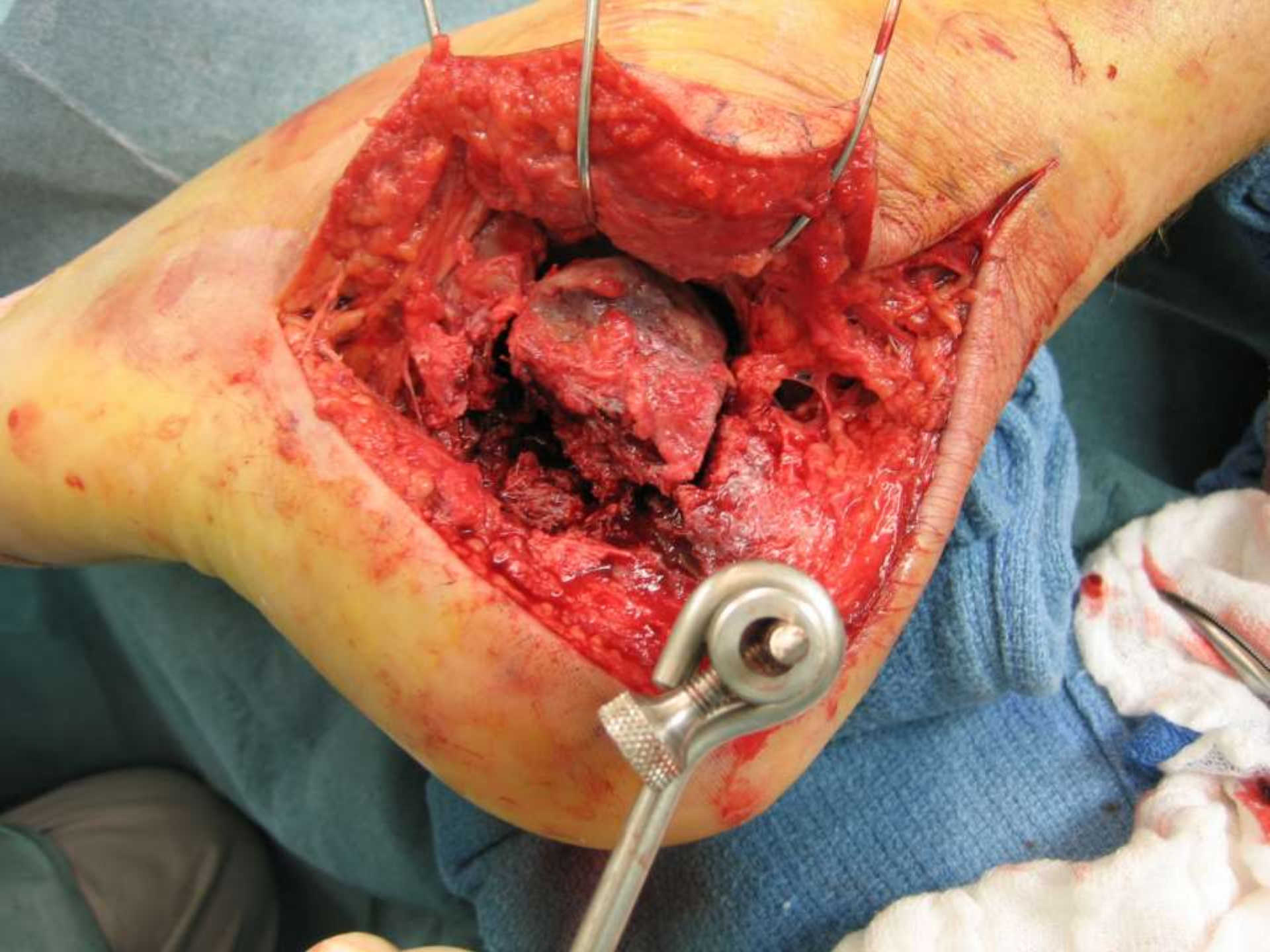


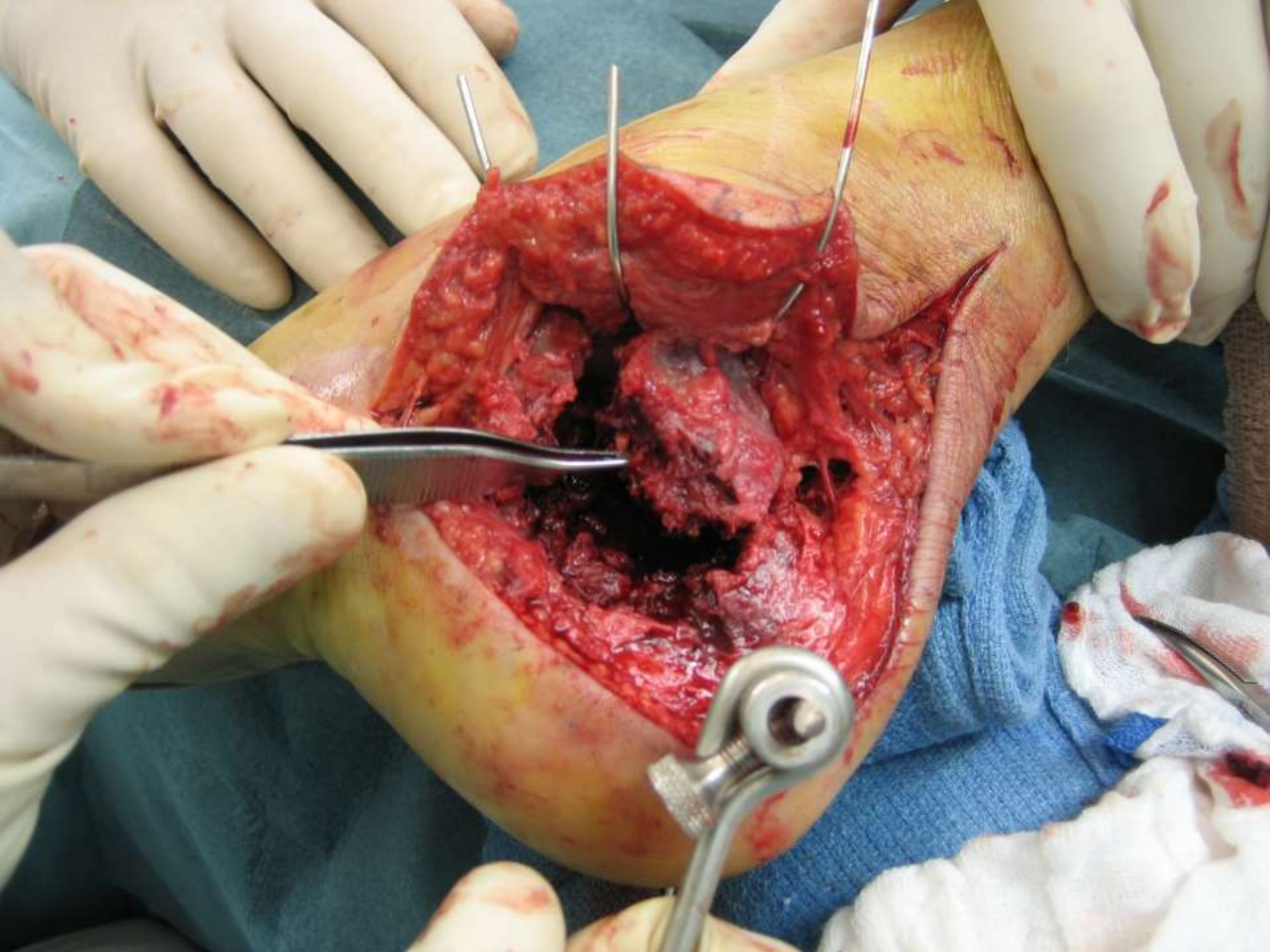


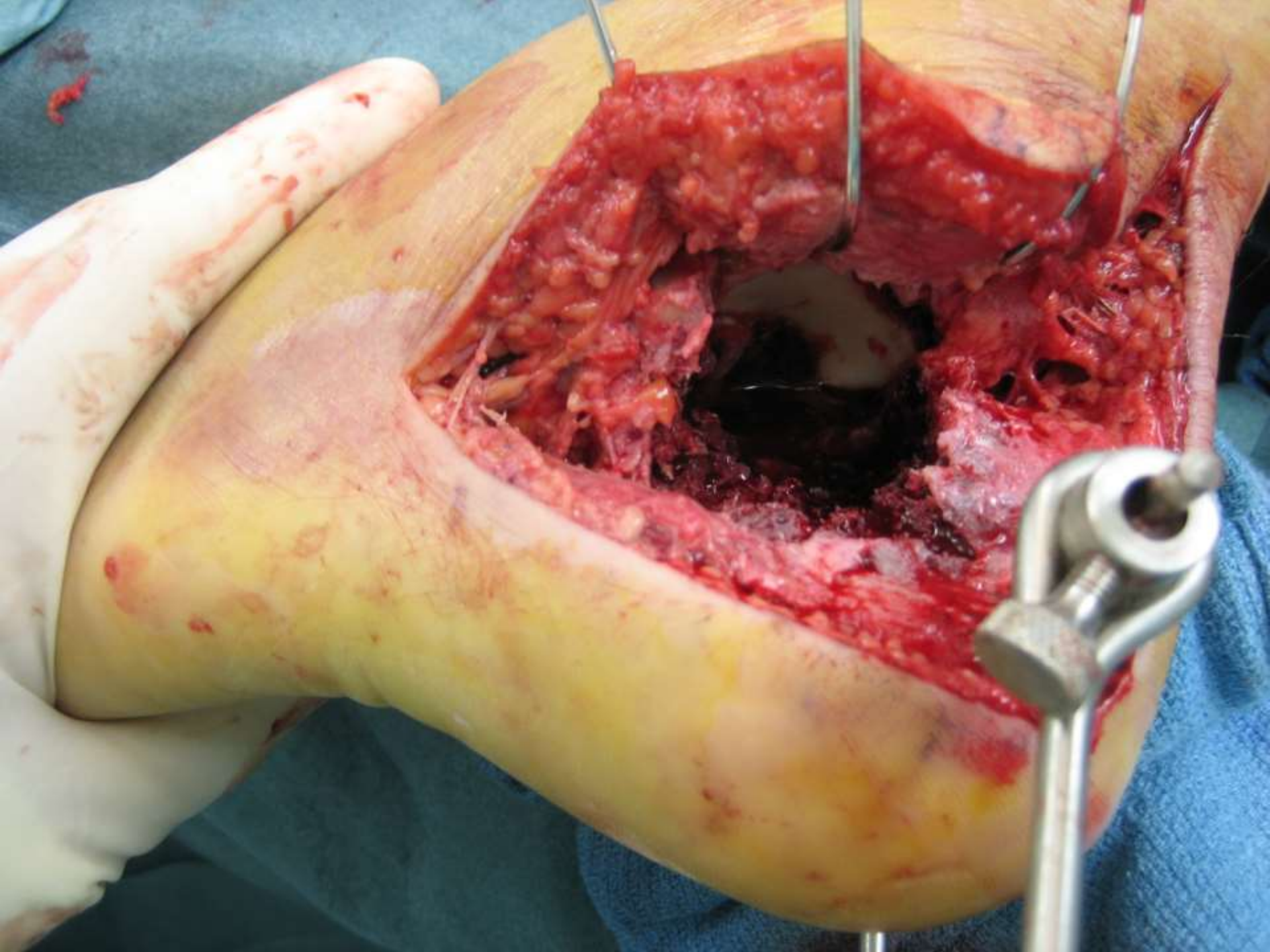












- Reduction of tuberosity to ST
  - Restore height
  - Restore valgus
  - Medial translation

Technique Tip: Reduction of the Medial Wall in Calcaneal Fractures

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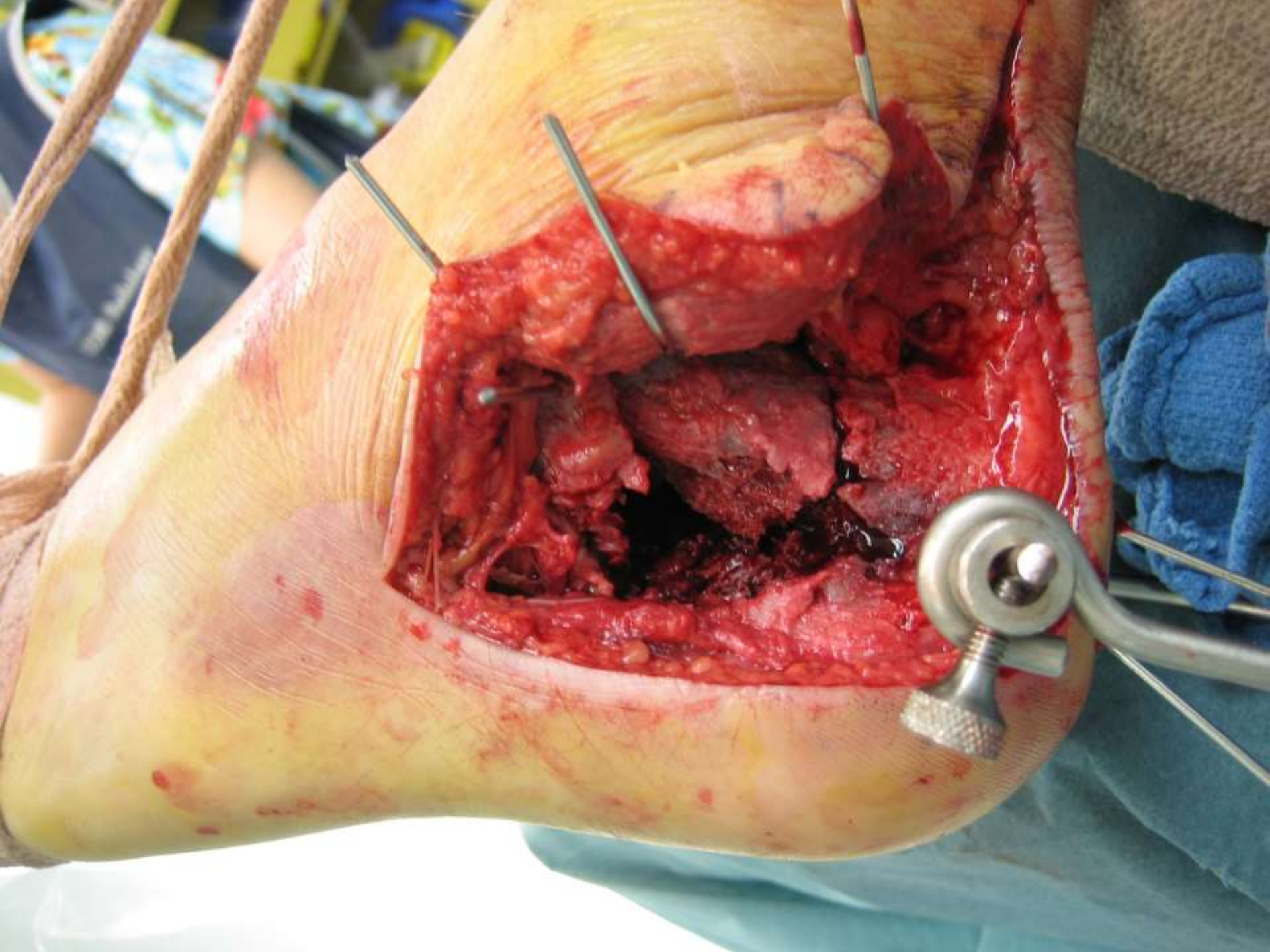
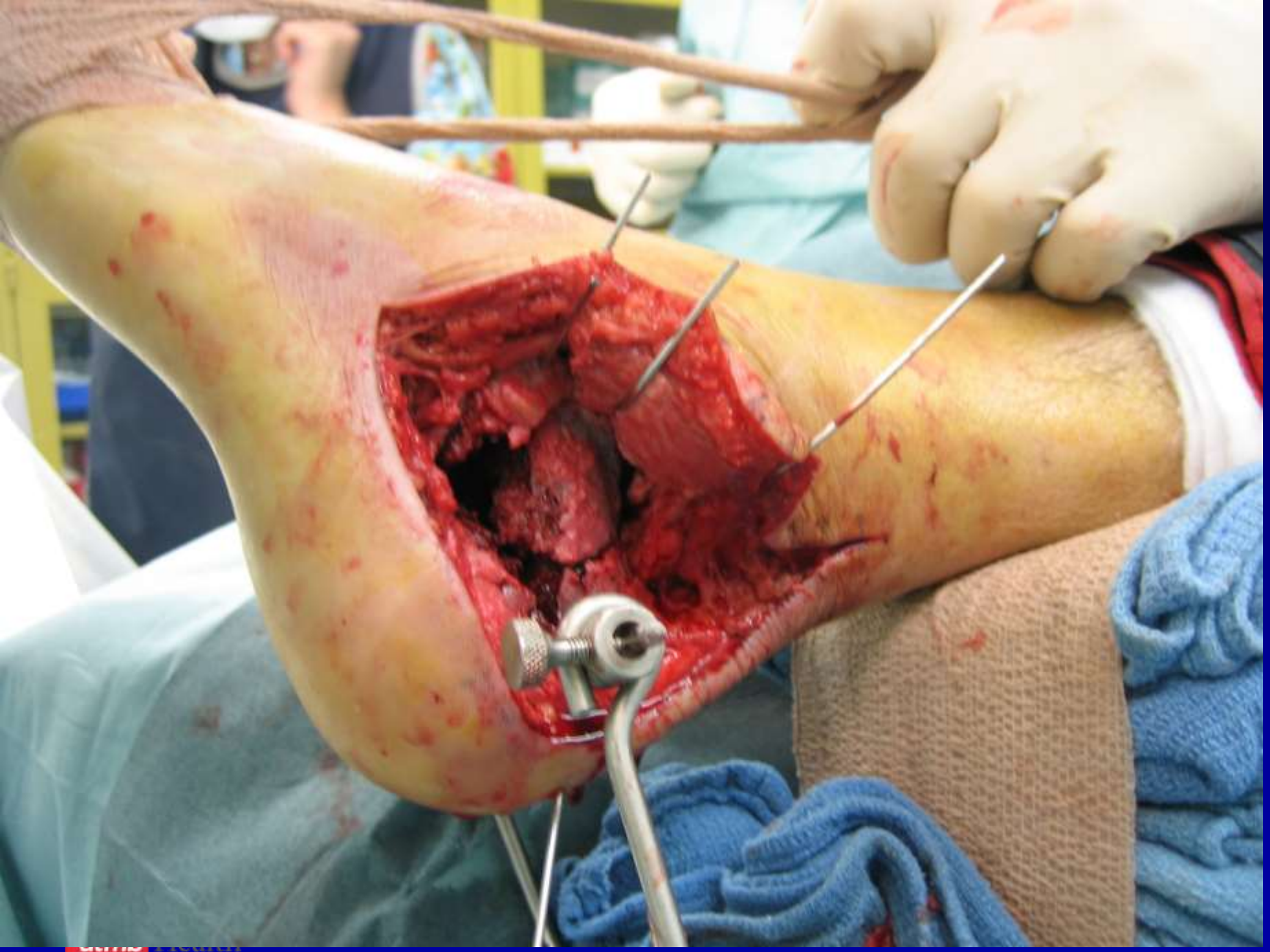
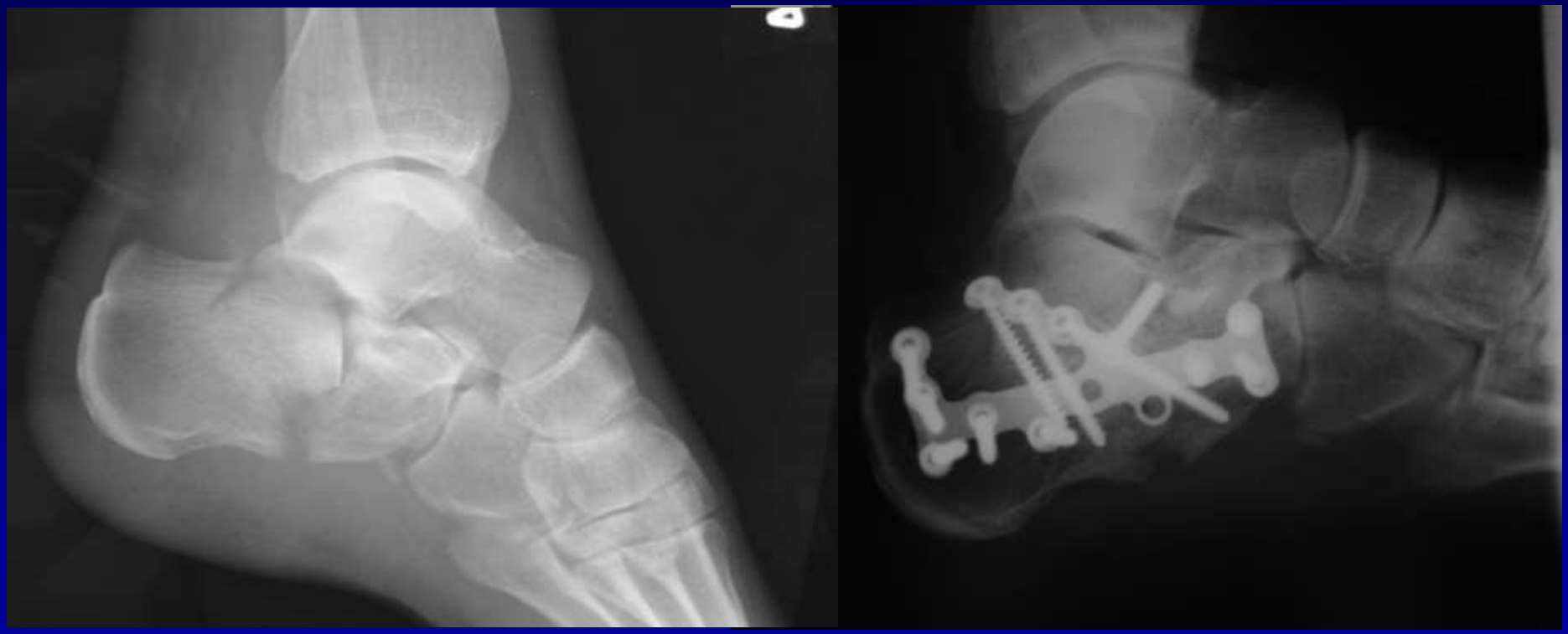
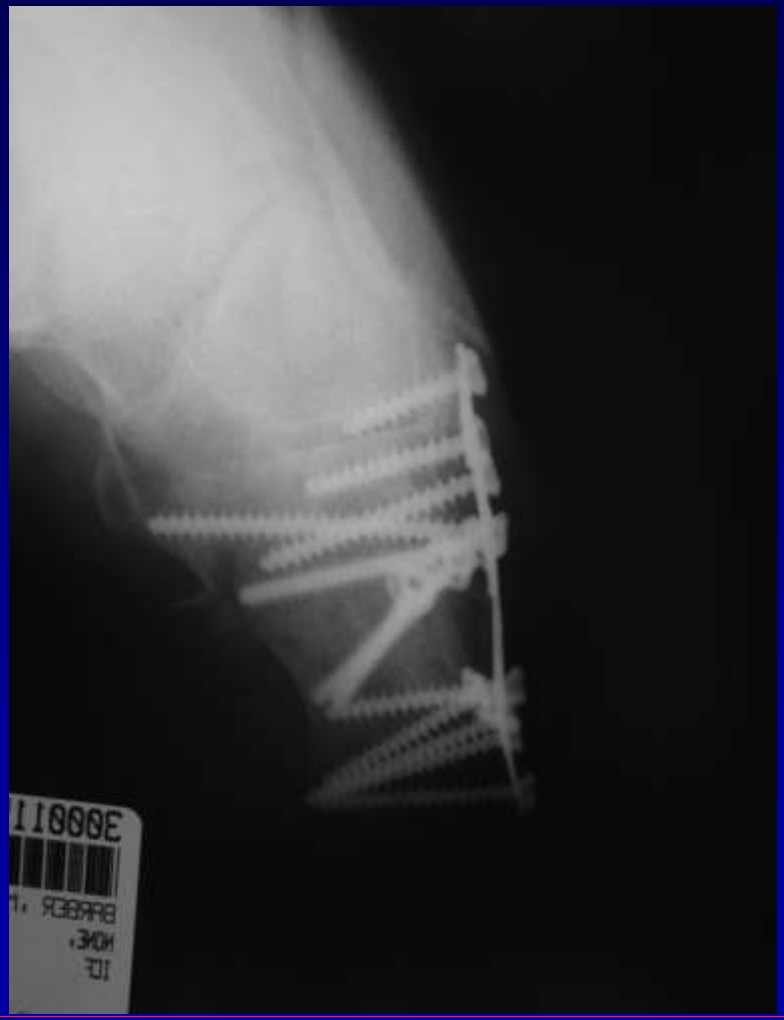
Vinod K. Panchbhavi, M.D., F.R.C.S.
Galveston, TX









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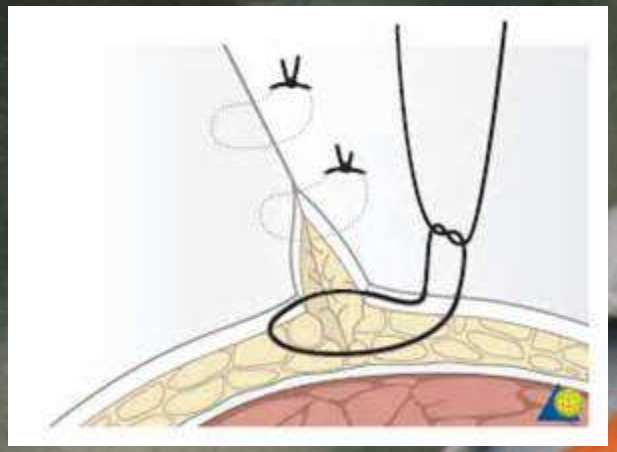

Donati-Allgower Stitch


Marcaine


RIOTRADIO.COM


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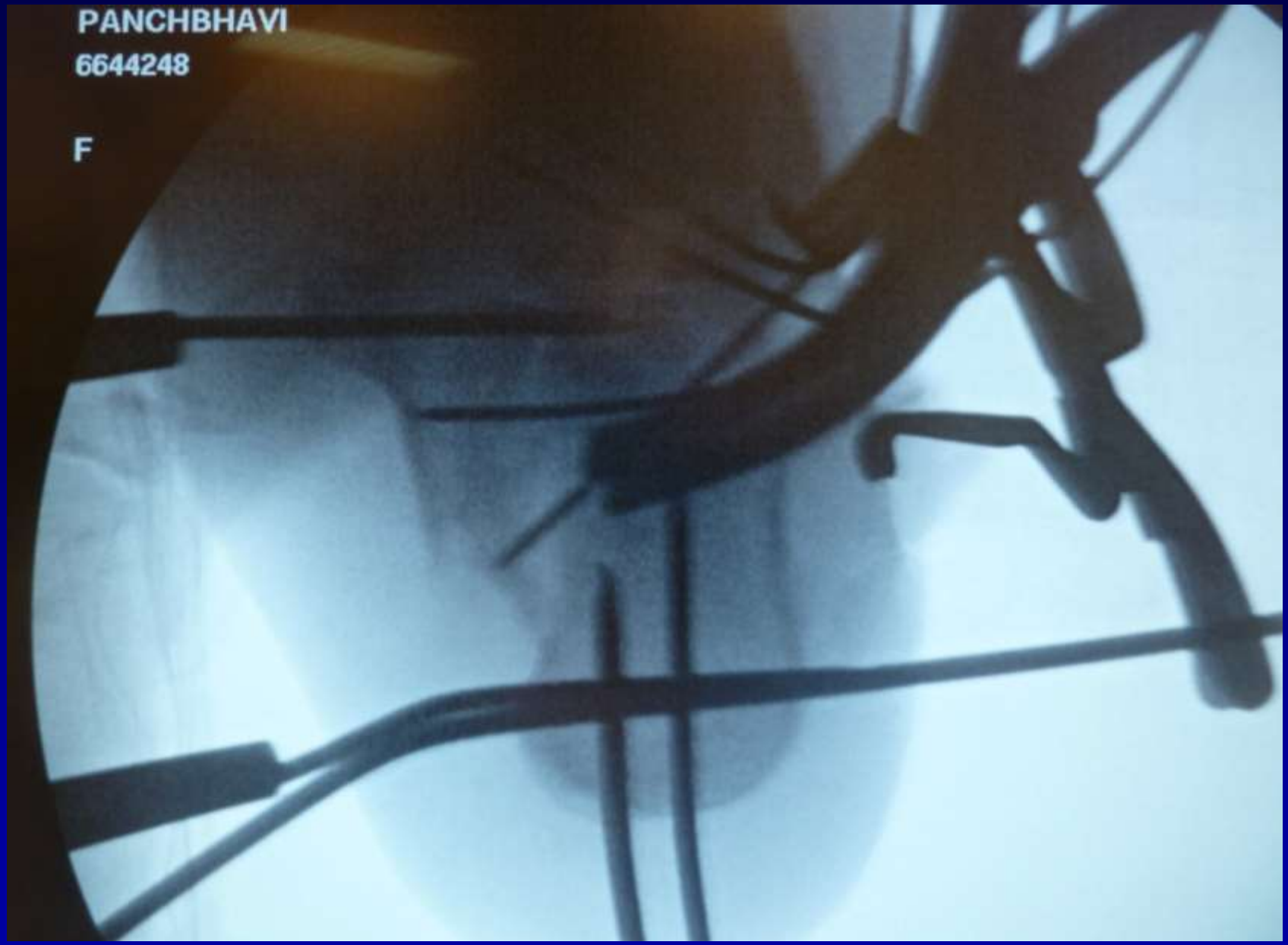
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71 kVp
0.72 mA
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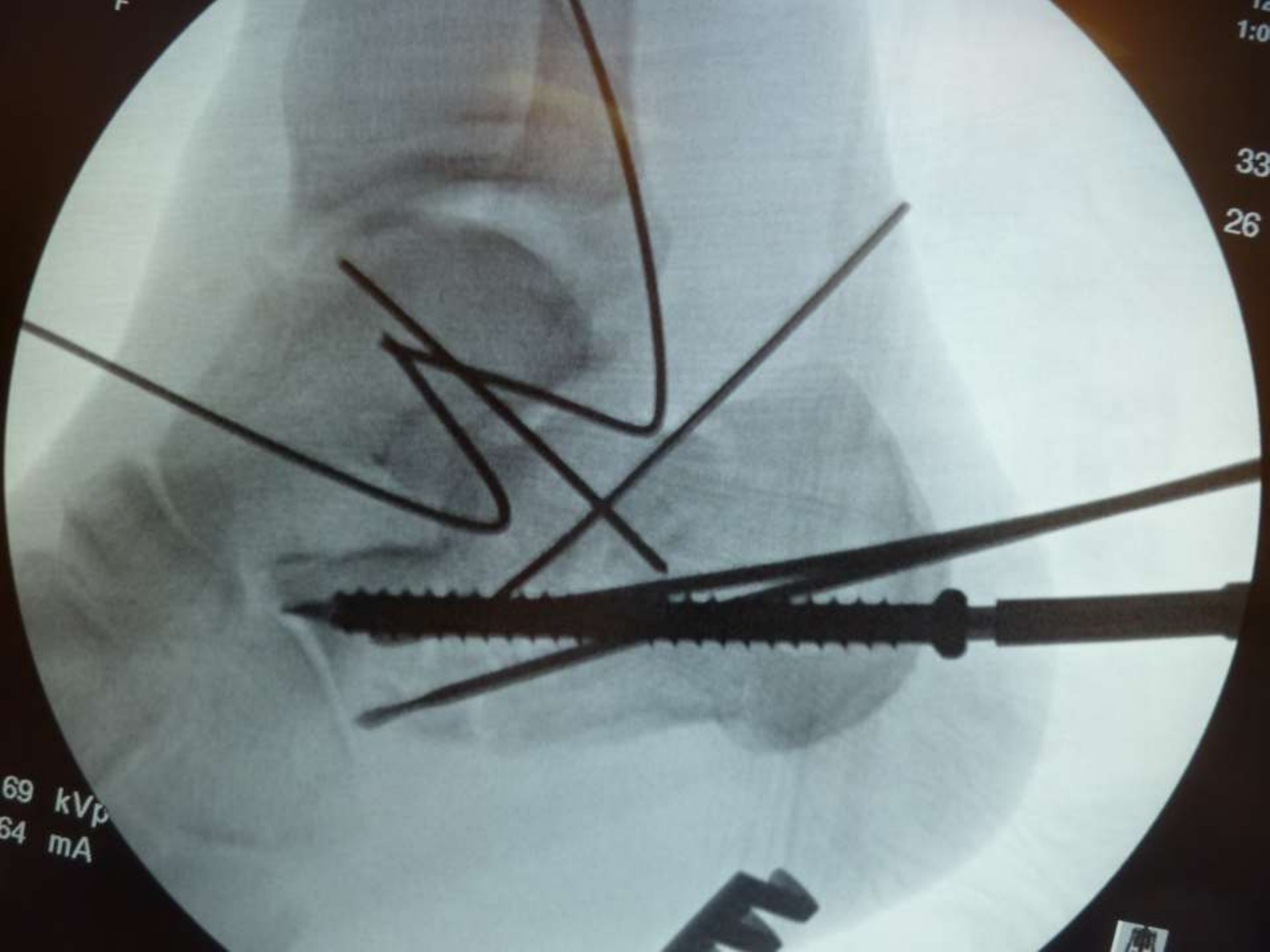
69 kVp
64 mA


26

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125


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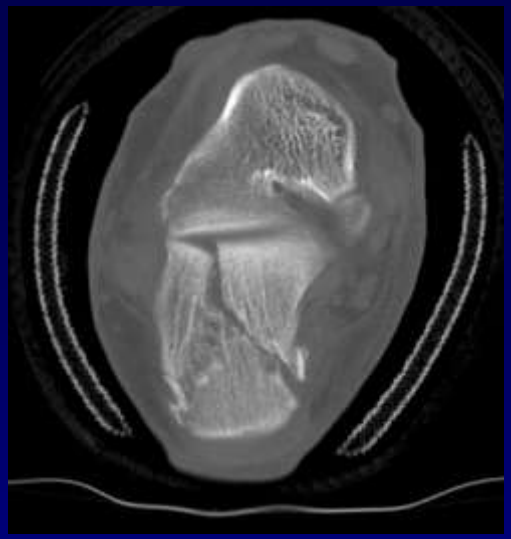

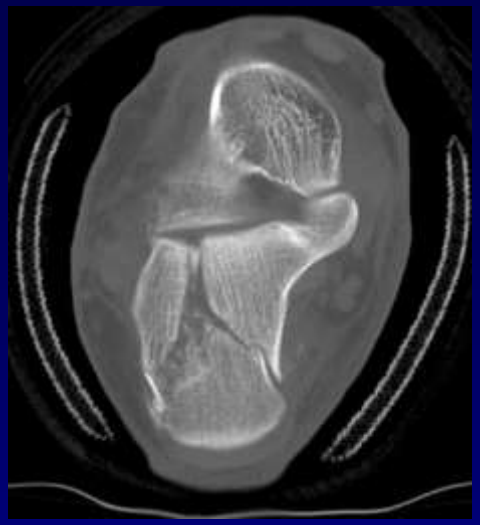


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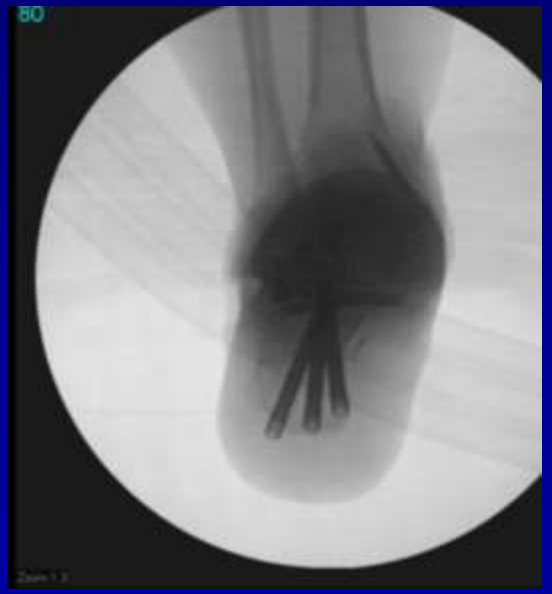
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Take Home Messages

- Understand 3 D anatomy
- Study the fracture planes and displacement
- Plan the approach
- Reduce the articular surface
- Restore the height
- Restore the tuberosity

Thank You

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Calcaneal Fractures

- Dr. Alastair Younger
- Associate Professor,
- University of British Columbia

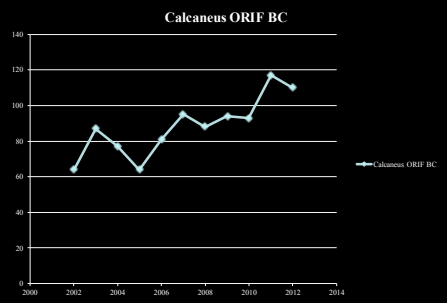
Disclaimers

- Institutional support from Linvatec, Smith and Nephew, Cartiva, Wright Medical, Integra foundation, BMTI, Acumed, Bioset, Synthes.
- Consultant Biomimetics (Wright), Acumed and Cartiva

Background

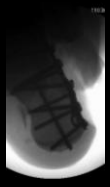
- Buckley paper
- Early reports
  - No difference with OR
- Final paper
  - Beneficial in select groups

Rates of ORIF British Columbia



Aims of ORIF

- Surgeon must:
  - Restore the tuberosity fragment
  - Restore the subtalar joint
  - Reconstruct the medial wall
  - Reduce the peroneal tendons
  - Restore height
  - Avoid wound complications
  - Release tendons and nerves from the fracture



Why less invasive

- Wrinkle test
- Elevate
- Cryocuff
- After fracture blisters resolve

Technical factors

- Dissection and approach

Technical factors

- Assessment of reduction
- Fixation

Reduction

Case – tuberosity

- Running from Hooker
- Skin issues urgent
- Reduction using large fragment clamp
- Held with ex fix
- Medial and lateral bar

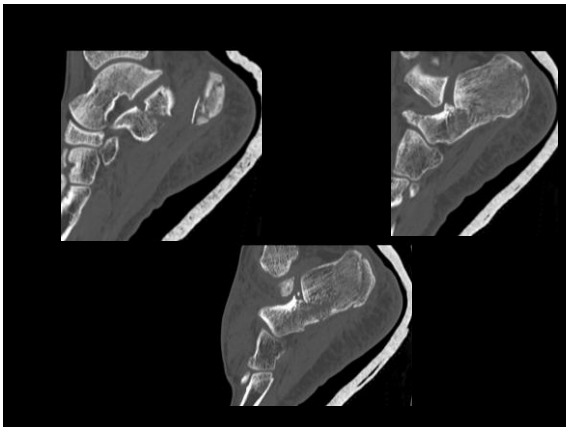
Less invasive – still need to reduce the peroneal tendons

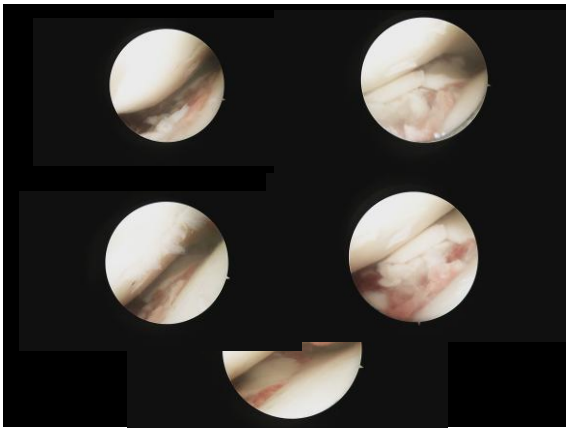
- Reduction of peroneal tendons

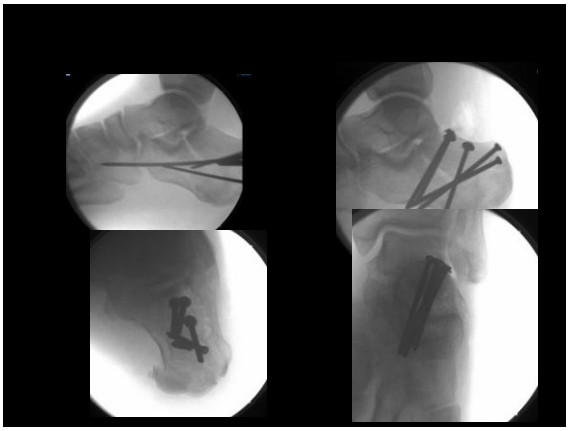
Calc fracture – arthroscopic reduction

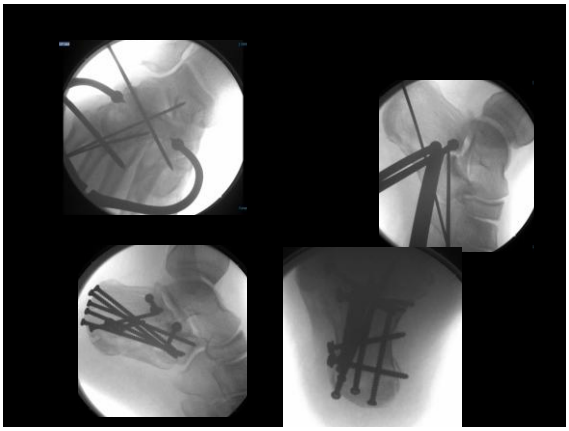

R
X-Table
R
L


R
L
R



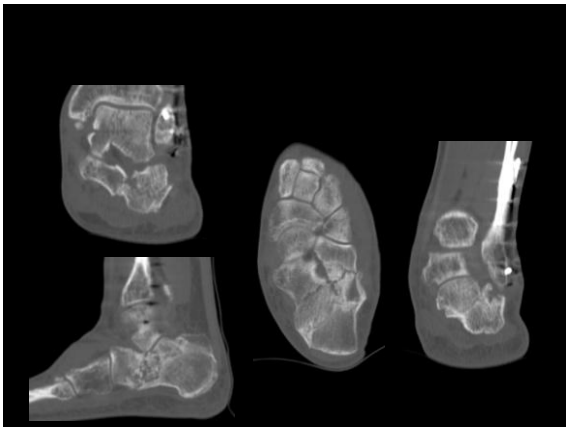


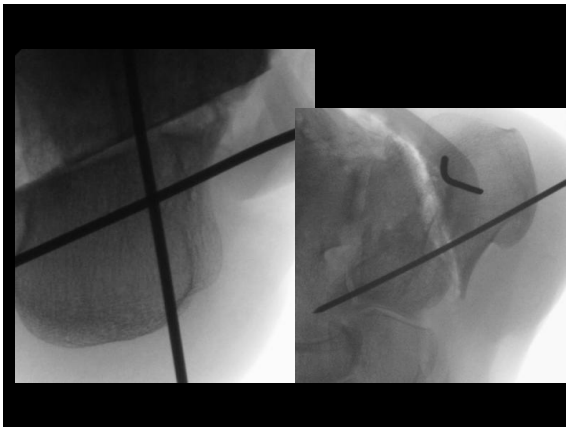


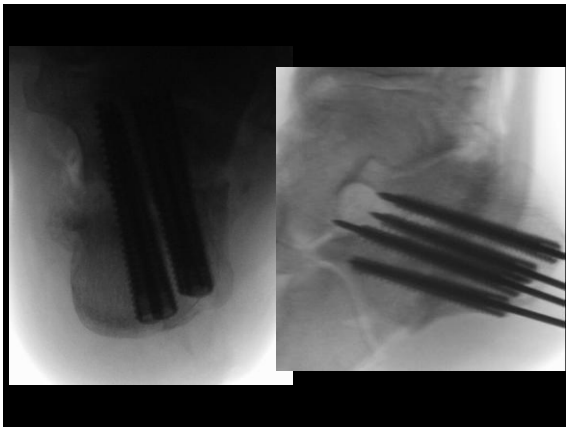


Missed calcaneal fracture

- 4 months out

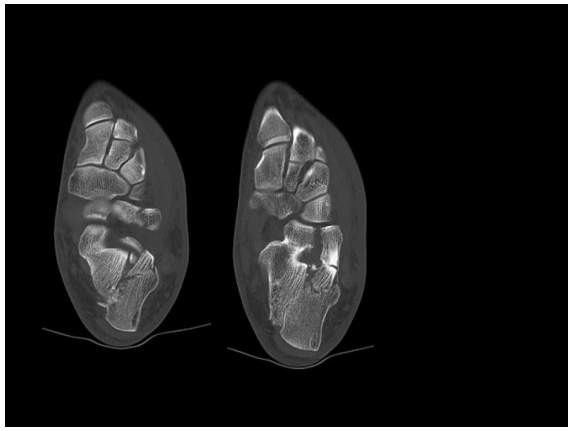


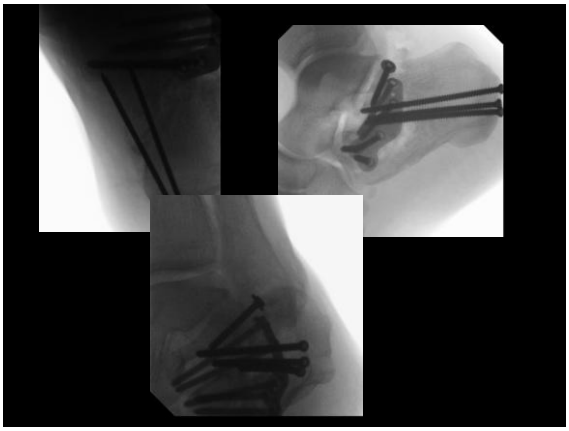




Calcaneal fracture – 3 weeks out

- 60 year old
- Fell from boxes in a storage locker
- Healthly – enjoys golf



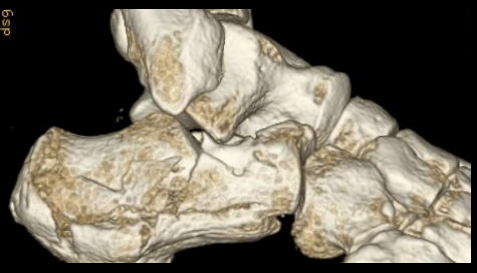


Minimally invasive calcaneus

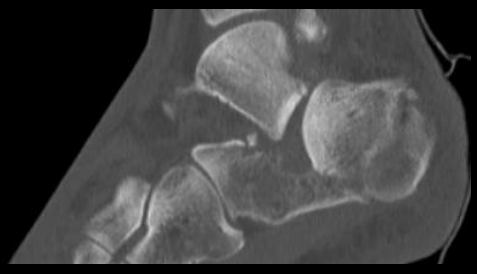
45 year old

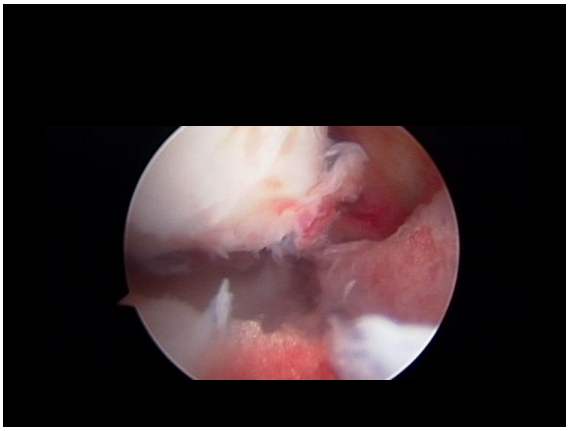
- Movie set constructor
- Fell off the top of a 14 foot cowboy set building

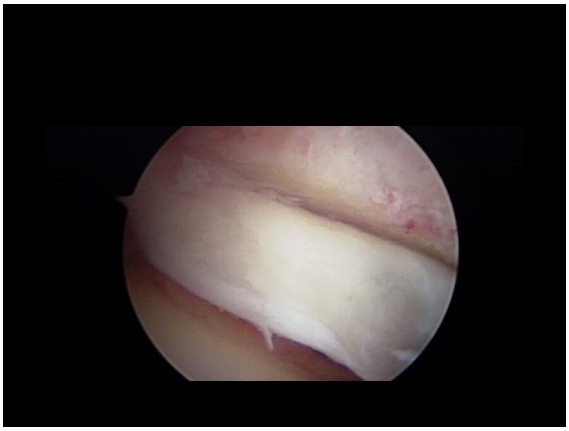
Bilateral calcaneal fractures

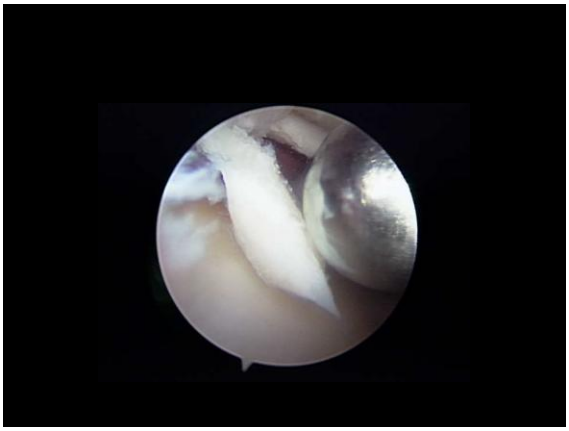


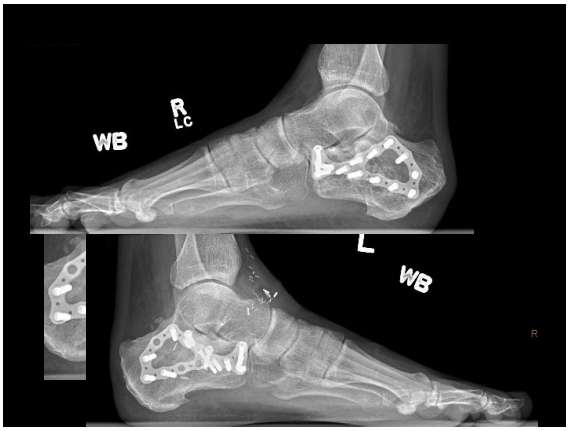
Left side









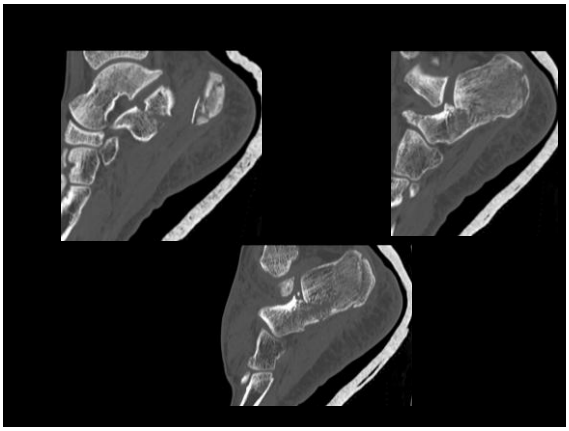


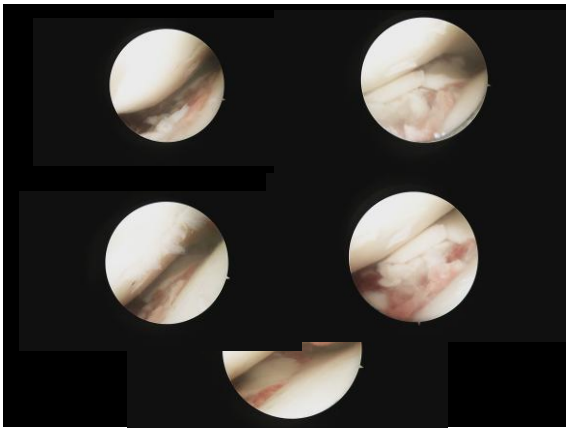
Calc fracture – arthroscopic reduction

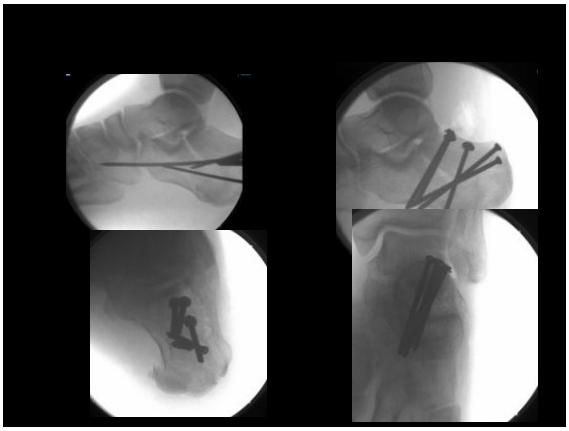
Bilateral calcaneal fracture case

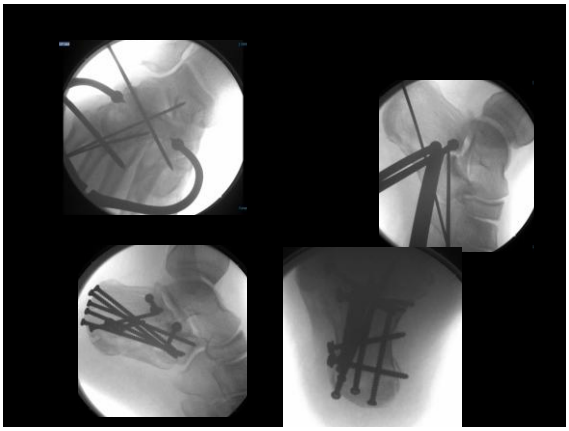

R
X-Table
R
L


R
R
L



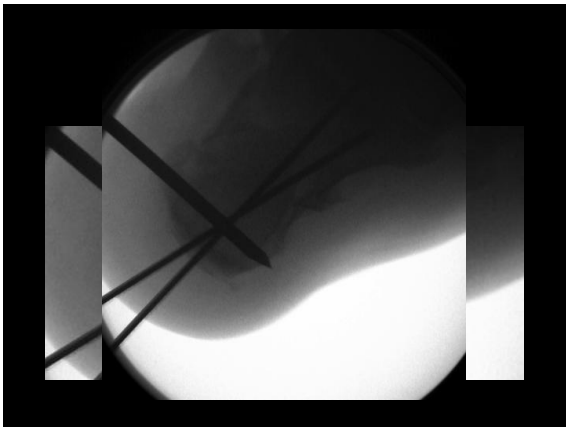


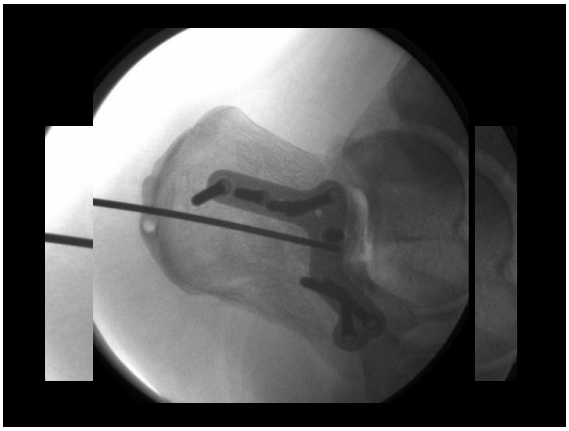


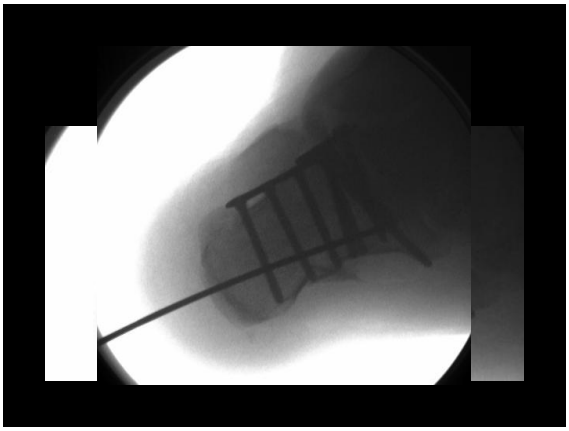


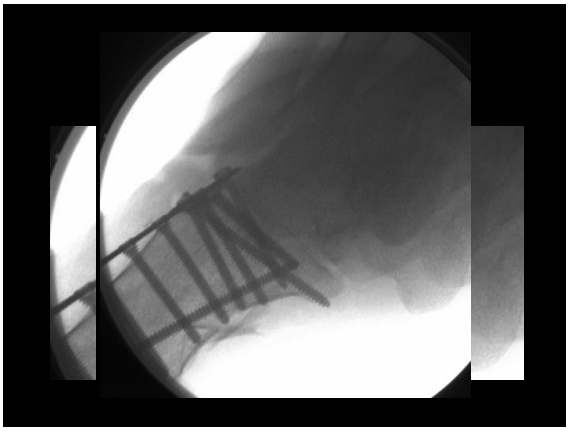
28 year old male

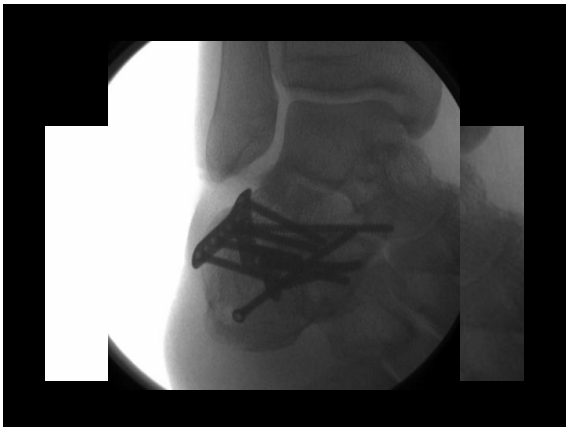
- Fell off bus stop
- Plays hockey
- Works as a doorman downtown hotel

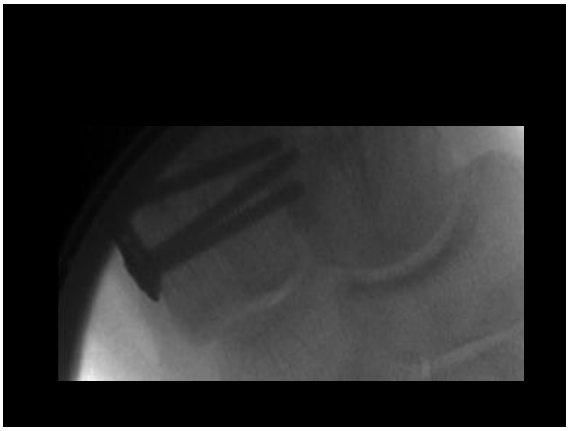






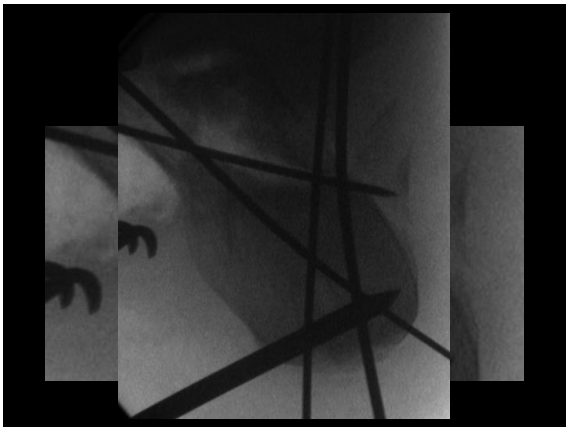


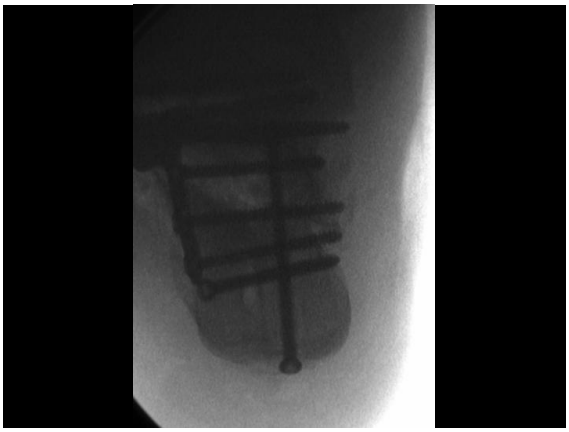




Compound calcaneus

- Fell from height
- Large medial compound wound
- Drug abuse, smoker, not employed



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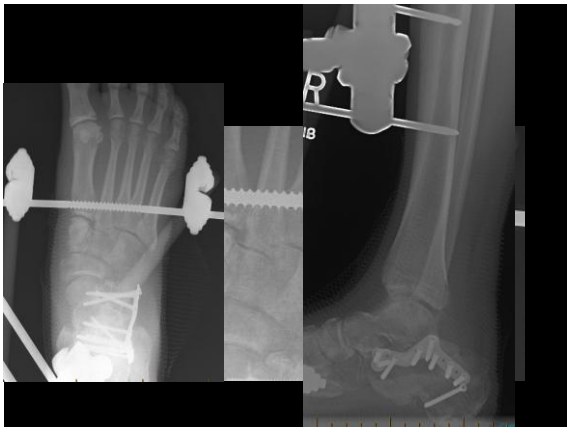
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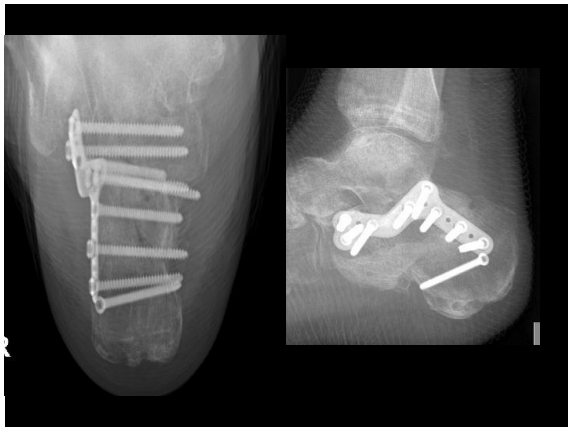
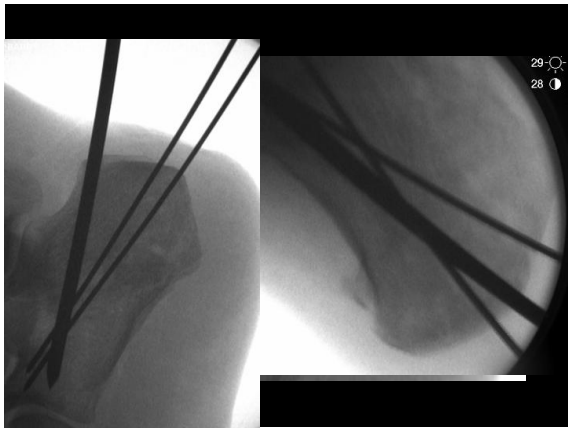


Bilateral calcaneal fractures

- Fell from tree
- 45 year old male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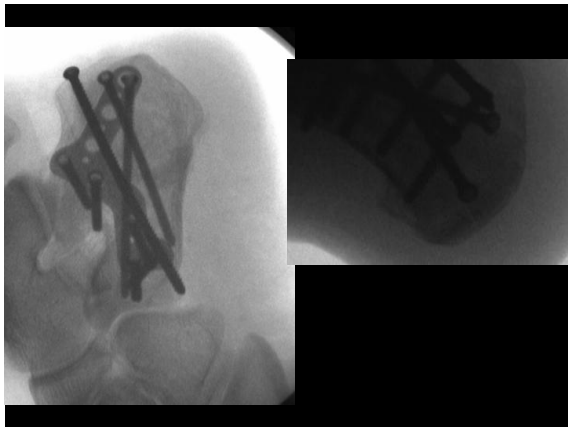
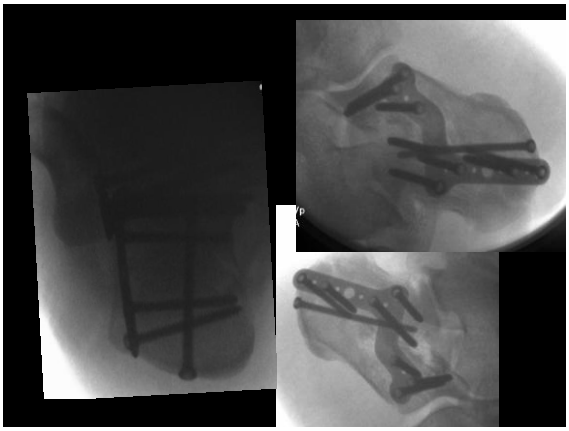




Summary

- ORIF beneficial in most cases
- Techniques are changing to reduce morbidity and expanding indications
- Late reconstruction is difficult and may not restore function
- Make sure you restore normal anatomy
  - Early and late
  - Open or percutaneous

Thank You

Calcaneal Fracture Management The Evolution From Extensile Lateral to "Percutaneus" Techniques

Steven Steinlauf, MD
The Orthopaedic Foot and Ankle Institute of South Florida
Clinical Assistant Professor University of Miami
Memphis, TN October 2013

Disclosure

- I am a consultant and designer for Smith and Nephew (VLP Foot System)
- I Instruct for the AO

Complications of Extensile Lateral Approach

- Poor wound healing
- Risk of infection
- Significant scar tissue
- Decreased ROM

A Better Solution?
Minimal Incision Techniques

- The concept = Less damage to the soft tissues
- Biologic fixation principles
- Medial – Bordeaux, no direct reduction of post facet or ant calcaneus
- Medial and limited lateral
- Percutaneus Fixation
  - Tongue and Tuberosity fractures
- **Sinus tarsi approach**
  - **Screws only**
  - **Screws and mini-plates**
  - **Custom plates**

Which is better?

- Kline AJ, et. Al. FAI 2013, June, Sinus Tarsi Vs. extensile lateral
- Retrospective
  - 79 - extensile lateral approach
  - 33 - minimally invasive
- Wound complication –
  - 29% extensile vs. 6% minimally invasive
- 20% extensile - secondary surgery, 2% minimally invasive
- FFI - 31 extensile group vs. 22 minimally invasive
- VAS pain - 36 extensile, 31 minimally invasive
- 84% extensile satisfied, 94% minimally invasive
- no differences - Bohler's angle and angle of Gissane.

The sinus tarsi approach in displaced intra-articular calcaneal fractures: a systematic review.

- Schepers T Int Orthop, 2011
- 8 case series reporting on 256 patients with 271 calcaneal fractures
- good to excellent – ¾
- **minor wound complications of 4.1% was reported and major wound complications in 0.7%.**
- **The results, i.e. functional outcome and complication rates, of the sinus tarsi approach compare similarly or favourably to the extended lateral approach.**

Mini-incision Treatment for calcaneal fractures

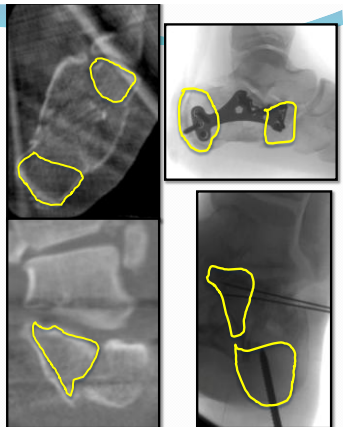
- Workup - same
- Radiographs and CT – same
- Timing – different
  - Extensile lateral incision – Once swelling goes down (usually within 3 weeks)
  - **Mini-incision techniques - 1 – 14 days (The earlier the better, soft tissues permitting)**
- Preop –
  - RICE
  - Jones dressing

Indications

- Very Narrow at first
  - A learning curve exists
  - Easier if you have performed many through an extensile lateral exposure
  - Understand the anatomy and the fracture

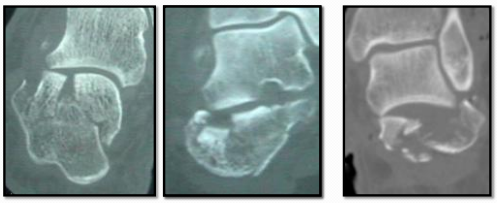
Indications

- You must have good bone in 3 locations:
  - Anterior, Posterior tuberosity, Constant fragment
  - These are the areas for needed screw fixation
  - Specific percutaneus plate – fracture lines extending to these regions – locking screws help

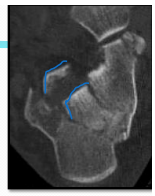


Indications

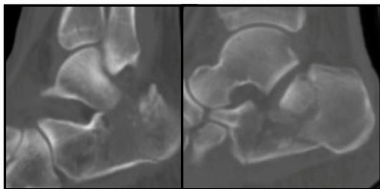
- Specific Fracture Patterns:
  - Sander's 2 part (Easiest)
  - Sander's 3 Part with an anterior central part (Difficult)
  - Sander's 4 part (Fairly Straight forward)
    - Need to reestablish articular anatomy grossly and then fuse
  - Excellent for open injuries in the correct setting



Contraindications



- Sander's 3 part fractures with posterior fragments
  - You cannot get to them from the sinus tarsi incision
- Fractures where you do not think that you can achieve an anatomic reduction of the joint
- ***Remember – Small Incisions with a poor reduction achieve nothing!!!***



Positioning

Supine for unilateral or bilateral

Lateral decubitus

Percutaneus Plate Sanders 2 Part

Step 1 -Medial Ex-Fix Placement

Placement of medial ex- fix:

- Enables you to "pull" the posterior tuberosity out of the way.
- This allows for:
  - Easier reconstruction of the posterior facet
  - Easier correction of height and varus
  - No need for a medial screw
  - Greatest advance in technique

Steps 2 - Incision / Disimpaction

- ❑ Sinus tarsi incision – Dorsal to the peroneals
- ❑Keep the peroneals in their sheath
- ❑Compress Lateral wall "blow-out"
- ❑Make path for the plate – *stay on the outside of the posterior tuberosity*
- ❑Disimpact medial wall – Curved elevator
- ❑Correct varus and height

Steps 2 - Incision / Disimpaction

Steps 2 - Incision / Disimpaction

Step 3 -Reduction and stabilization of posterior facet

Pulling the posterior tuberosity out of the way makes the posterior facet reduction possible

Lag the posterior facet with 2.0 to 3.0mm screws as needed (canulated vs. solid)

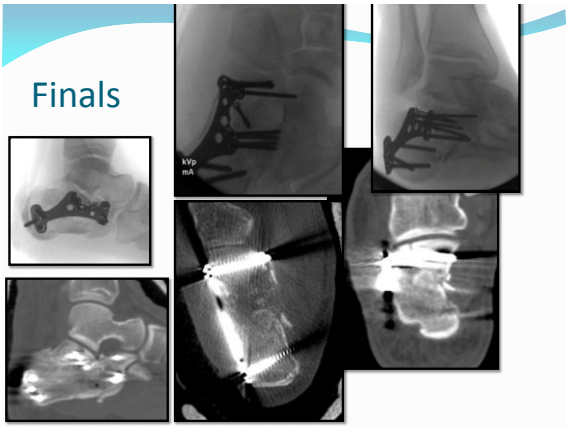
- Aim towards sustentaculum as much as possible
- Confirm reduction with scope and fluro

Step 4 - Plate Placement

Step 4 - Plate Placement

Step 4 - Plate Placement

Finals



Post-op Protocol

- Start Early Motion – 7 days +/- (when the wound is ready)
- Better final ROM?

Complications

Delayed Wound Healing

- Rough with tissues
  - Incision too small
- Fix after 2 weeks
- Move too soon (less than 1 week)
- Stop movement until wound is healed

Infection

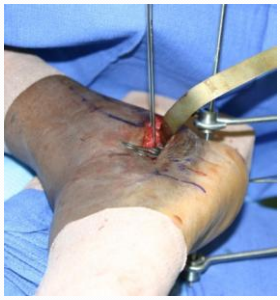
- Mini incision
- ORIF and primary fusion for an open Sander's 4 fracture
- Vac
- Abx
- No need for a flap
- Hopefully risk will be less

Sural Nerve Injury

- Take care to place screws dorsal or plantar to the nerve

Peroneal Tendonitis

- Protect the tendons throughout the case
  - Keep them in their sheath
- Possibly more pain and need for ROH?



Our Study:

- Total patients undergoing percutaneus plating (minimum f/u 3 mos.): 49 pts.
- Total Fxs.: 51
  - 2 patients with Bilateral fxs had both sides tx with ORIF
- Males – 33 (34fxs), Females – 16 (17 fxs)

Patients

- Not at high risk for infection - 26 pts. (26 fxs.)
  - 1 infection at operative site
  - 1 infection at site of posterior skin necrosis near tongue fx.
- High Risk Patients" –
  - Smokers: 14 pts. (16fxs.)(No infecs)
  - Diabetic: 3 pts. (No infecs)
  - Smokers (plus diabetes / HIV): 2 pts. (No infecs)
  - Open Fractures: 4 pts. (1 infection)
- High Risk Group 1 infection in 25 cases.
- No infections since 2008.
- 9 pts - extension for stabilization of pers – 0 infecs.

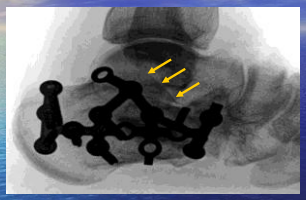
Our Study:

- Delayed wound Healing – 5 pts.
  - None required additional surgery or special treatment
- Painful hardware requiring removal – 4 pts.

Conclusions

- **The sinus tarsi approach offers the following benefits:**
  - Fewer serious wound complications
  - Lower risk of infection
    - Especially in high risk groups
  - Anatomic reduction of Sanders type II and some type III fractures (confirmed with an arthroscope)
  - Able to use for Type IV fractures (primary subtalar fusion)
  - Functional outcome is likely similar to extensile lateral approach (We need to complete phase 2)

SURGICAL MANAGEMENT OF THE CALCANEAL MALUNION



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VUMEDI CALCANEUS WEBINAR 2014

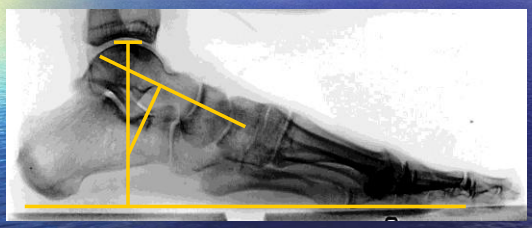
CALCANEAL LENGTH

- MAINTAINS LATERAL COLUMN LENGTH
  - PROTECTS POSTEROMEDIAL ARCH

- REFLECTED BY CALCANEAL PITCH ANGLE

CALCANEAL HEIGHT

- DETERMINES ORIENTATION OF TALUS: INDIRECTLY AFFECTS ANKLE DF

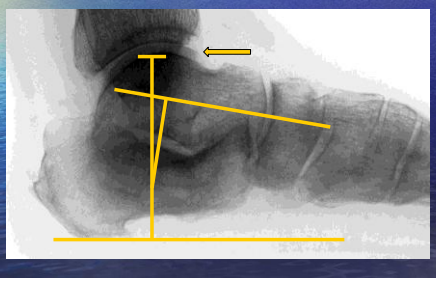


RESIDUAL ARTICULAR INCONGRUITY

- POST-TRAUMATIC ARTHRITIS
- SUBTALAR JNT
- CALCANEOCUBOID JNT

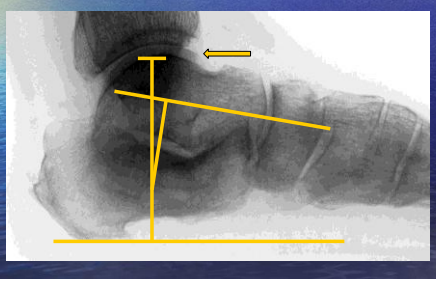
LOSS OF CALCANEAL HEIGHT

- RELATIVE HORIZONTALIZATION OF TALUS
- ANTERIOR ANKLE IMPINGEMENT
- INDIRECT LOSS OF ANKLE DORSIFLEXION



LOSS OF CALCANEAL HEIGHT

- DECREASED GASTROC-SOLEUS LEVER ARM
- LIMB-LENGTH INEQUALITY



TUBEROSITY MALALIGNMENT

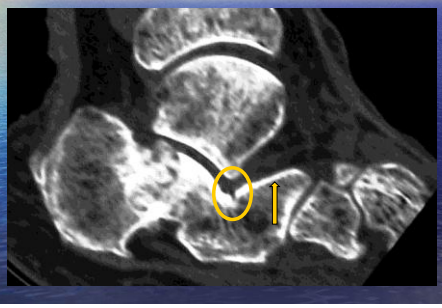
- ALTERED SHOE WEAR / GAIT PATTERN

LATERAL WALL EXPANSION

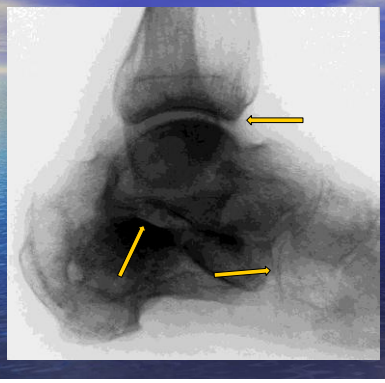
- LATERAL SUBFIBULAR IMPINGEMENT
- PERONEAL TENDON
  - STENOSIS
  - TENDINITIS
  - DISLOCATION

ANTERIOR PROCESS DISPLX

- BONY BLOCK TO SUBTALAR MOTION
- IMPINGEMENT PAIN IN SINUS TARSI



CHRONIC 3-JOINT INJURY



CLINICAL EVALUATION

- STANDING EXAMINATION
  - VARUS / VALGUS MALALIGNMENT
- ASSESS LATERAL HINDFOOT SKIN
  - PREVIOUS INCISION(S)
  - OVERALL MOBILITY
  - NICOTINE USE

RADIOLOGIC EVALUATION

- WEIGHTBEARING FILMS ESSENTIAL !
  - STANDARD WB 3-VIEWS ANKLE & FOOT
  - HARRIS AXIAL VIEW
- CT SCAN
  - AXIAL / SAGITTAL / CORONAL VIEWS

DETERMINE ORIGINAL FX PATTERN

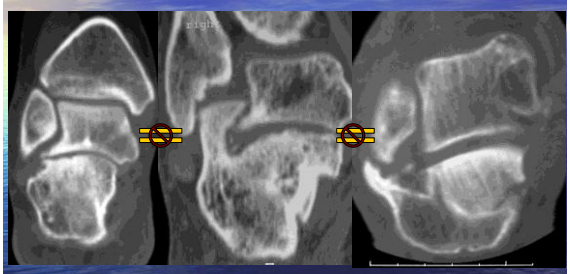
- SANDERS CLASSIFICATION
  - SANDERS, ET AL. CORR 290, 1993
- RELEVANT ACUTE PATHOANATOMY

DETERMINE MALUNION PATTERN

- STEPHENS-SANDERS CLASSIFICATION
  - STEPHENS & SANDERS, FAI 17, 1996

- RELEVANT CHRONIC PATHOANATOMY
- UNDERSTANDING MALUNION "PERSONALITY"
  - TECHNICAL STEPS OF DEFORMITY CORRECTION

MALUNION "PERSONALITY"



EXTENSILE LATERAL APPROACH

- LATERAL DECUBITUS POSITION

- FULL-THICKNESS FLAP

LATERAL WALL EXOSTECTOMY

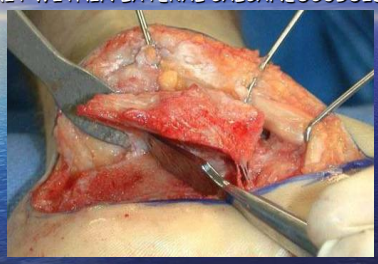
- COTTON, ANN SURG 74, 1921
- A/O OSTEOTOMY SAW

- SLIGHTLY ANGLED IN SAGITTAL PLANE
- PRESERVE MORE BONE PLANTARLY

- PROTECT TALOFIBULAR JNT

LATERAL WALL EXOSTECTOMY

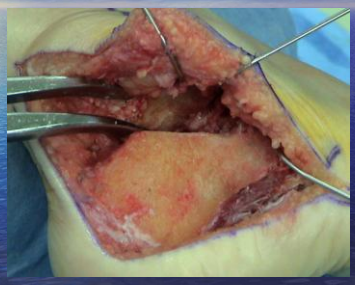
- COMPLETE WITH OSTEOTOME
  - EXIT WITHIN LATERAL CALCANEOCUBOID JOINT



- PRESERVE AS SINGLE FRAGMENT

SUBTALAR JOINT MOBILIZATION

- OSTEOTOME IN PLANE OF POSTERIOR FACET
- COMPLETE WITH LAMINAR SPREADER



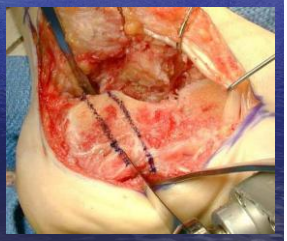
SUBTALAR JOINT PREPARATION

- PRESERVE SUBCHONDRAL PLATE
- SHARP PERIOSTEAL ELEVATOR

- SUBCHONDRAL PERFORATIONS
- 2.5MM DRILL BIT

CALCANEAL OSTEOTOMY (TYPE III)

- VARUS: DWYER OSTEOTOMY
- VALGUS: MEDIAL SLIDE
- ~ PARALLEL TO POSTERIOR FACET

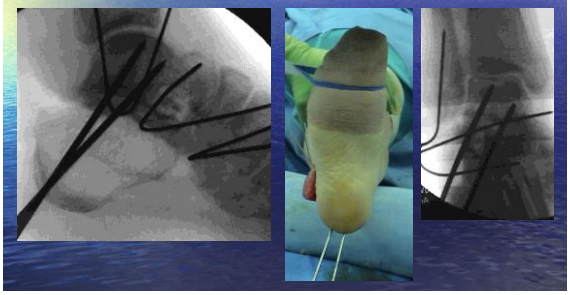


BONE BLOCK INSERTION

- KALAMCHI & EVANS, JBJS-BR 59, 1977
- LAMINAR SPREADER POSTEROMEDIALLY
- SHAPE GRAFT WIDTH-WISE
- BROADEST PORTION POST-MED
- SUPPLEMENTAL VOID FILLER / GF

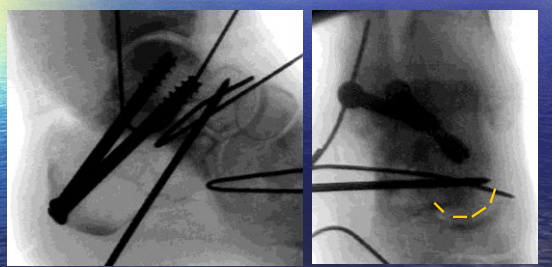
DEFINITIVE STABILIZATION

- 6.5 - 8.0 MM CANNULATED SCREWS
- DIVERGENT PATTERN

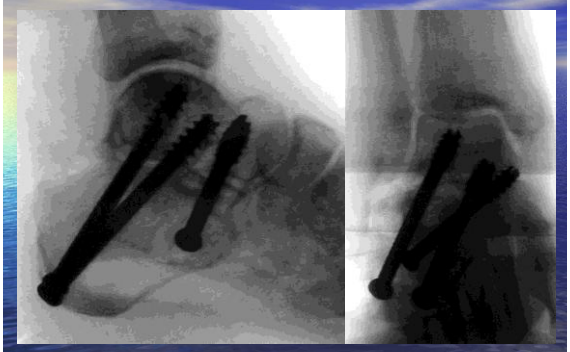


DEFINITIVE STABILIZATION

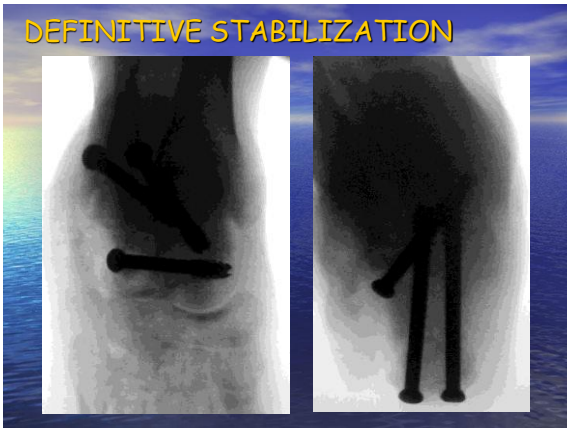
- ANTERIOR PROCESS:TALAR HEAD



DEFINITIVE STABILIZATION



DEFINITIVE STABILIZATION



PERONEAL TENOLYSIS

- FREER ELEVATOR ALONG UNDERSURFACE OF FLAP
- MOBILIZE PERONEAL TENDONS
- PERONEAL GROOVE TO CUBOID TUNNEL

WOUND CLOSURE

- DEEP DRAIN / ABSORBABLE SUTURE

- ENDS TOWARD APEX (ADVANCING FLAP)

WOUND CLOSURE

- MODIFIED ALLGÖWER-DONATI
  - 3-0 MONOFILAMENT

POST-OPERATIVE PROTOCOL

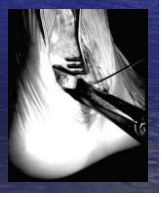
- SPLINT / CAST IMMOBILIZATION
- NON-WEIGHTBEARING X 10-12 WEEKS
- BOOT / ADVANCE WEIGHTBEARING
- BOOT TO SHOE / PROGRESS ACTIVITY

FX-DISLX VARIANT MALUNION

- ROMASH OSTEOTOMY
  - ROMASH, CORR 290, 1993
- OSTEOTOMY THRU PRIMARY FX LINE
- RESTORE HEIGHT
- SUBTALAR ARTHRODESIS

POOR LATERAL SKIN / OLD INCISION

- LATERAL WALL EXOSTECTOMY / BONE BLOCK ARTHRODESIS
- ~ GALLIE INCISION / VERTICAL LIMB OF E-L
- CARR, ET AL. FOOT & ANKLE 9, 1988



STILL A SALVAGE PROCEDURE

- CLARE, ET AL. JBJS-AM 87, 2005
- RADNAY, ET AL. JBJS-AM 91, 2009
- VERY DIFFICULT TO COMPLETELY RESTORE HINDFOOT ANATOMY IN CALCANEAL MALUNION
- MALUNION SURGERY CANNOT RESTORE HINDFOOT MORPHOLOGY LIKE ACUTE FRACTURE REDUCTION (ORIF) CAN

ACUTE ORIF BENEFICIAL

- CLARE, ET AL. JBJS-AM 87, 2005
- RADNAY, ET AL. JBJS-AM 91, 2009

- RESTORATION OF CALCANEAL HEIGHT / LENGTH / OVERALL MORPHOLOGY

- EVEN IN THE EVENT OF LATE PTOA: IN-SITU SUBTALAR ARTHRODESIS

SUMMARY

- 3-JOINT INJURY: 3-JOINT MALUNION

- DETERMINE ACUTE PATHOANATOMY: CHRONIC PATHOANATOMY

- INDIVIDUALIZE TREATMENT

- RESTORING CALCANEAL HEIGHT / WIDTH
- ELIMINATING LATERAL WALL EXPANSION
- MOBILIZING PERONEAL TENDONS