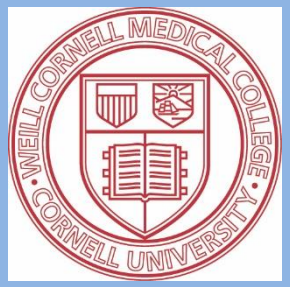
Actuality, Evolution & New Frontiers in Limb Reconstruction (20)

SIFE National Congress
16-17 May 2025
Rome, Italy

S. Robert Rozbruch, MD
Chief, Limb Lengthening & Complex Reconstruction Service
Director, Osseointegration Limb Replacement Center
HOSPITAL FOR SPECIAL SURGERY
Professor of Clinical Orthopedic Surgery



LIMB LENGTHENING.COM

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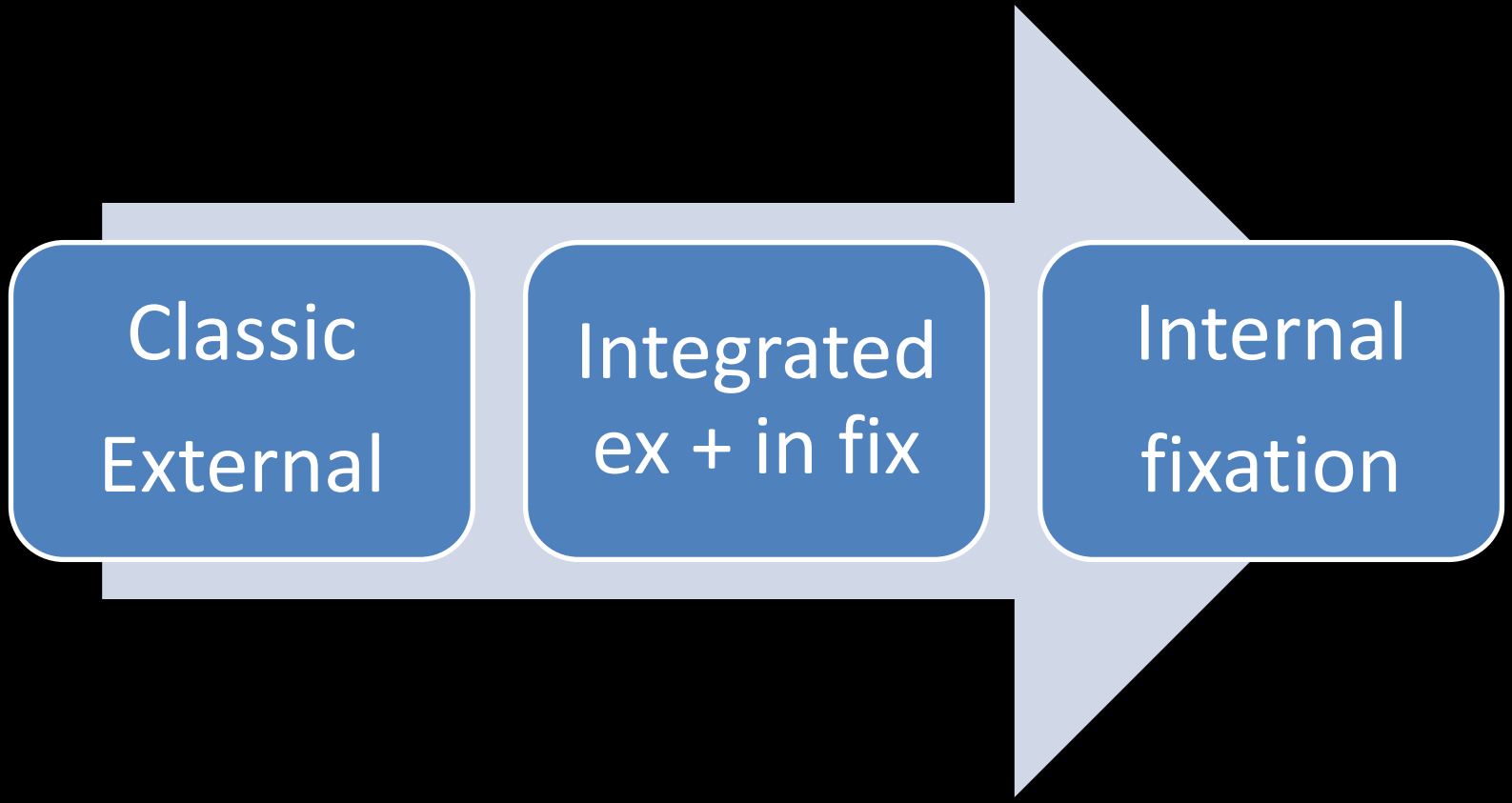
Disclosures

- Nuvasive Technologies
- Johnson & Johnson
- Osteosys
- ALM Ortho

- Patients with face showing have given consent

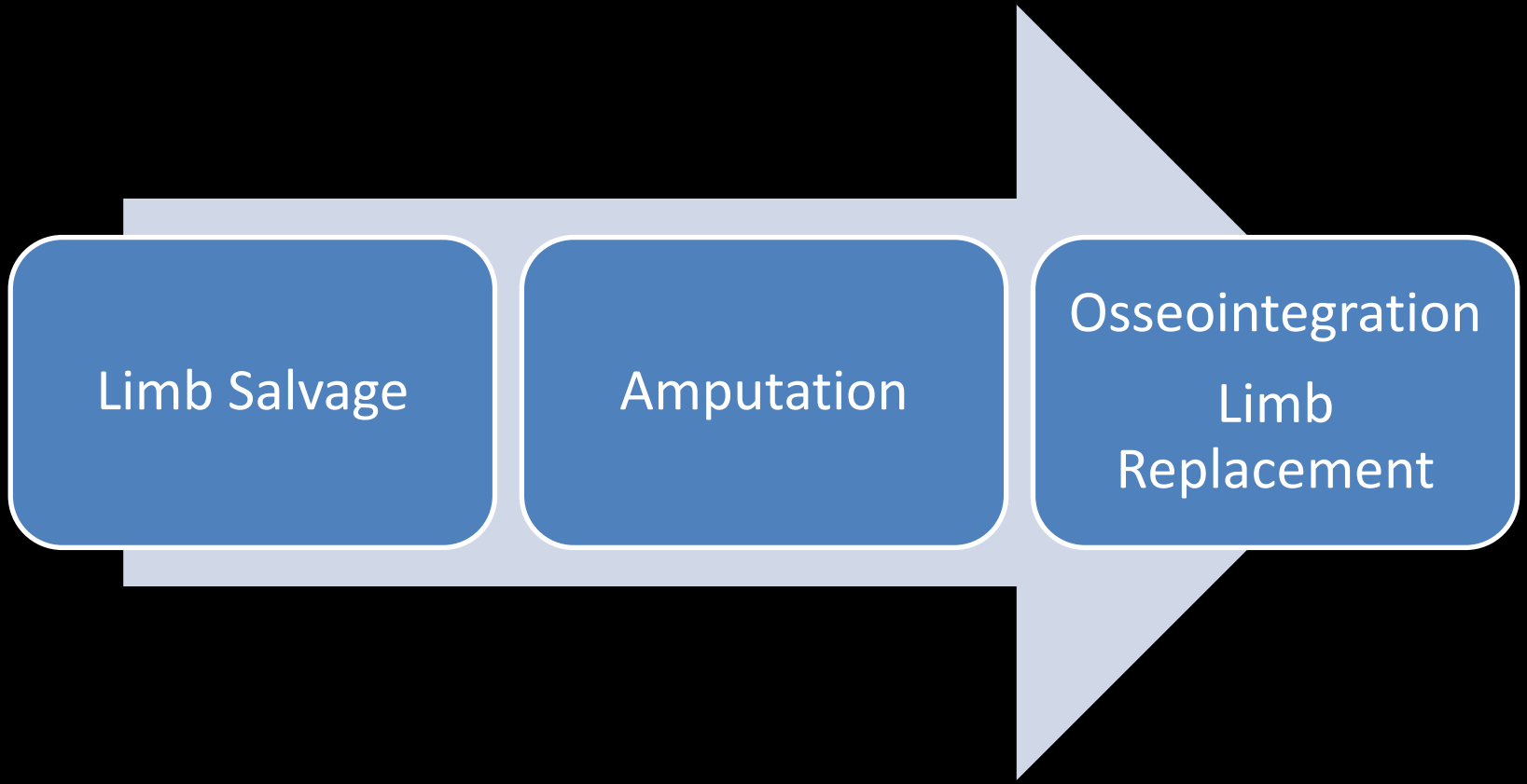
Evolution in technique



Decrease time in external fixation and rate of refracture

Important technical details needed for success

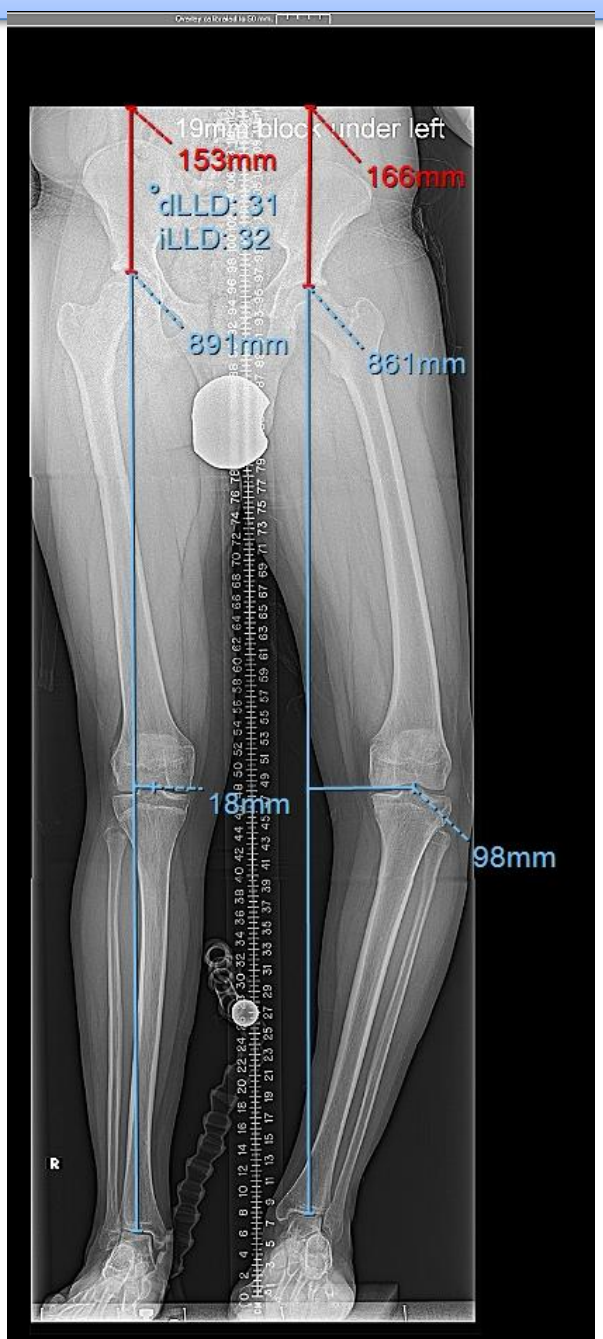
Evolution in approach

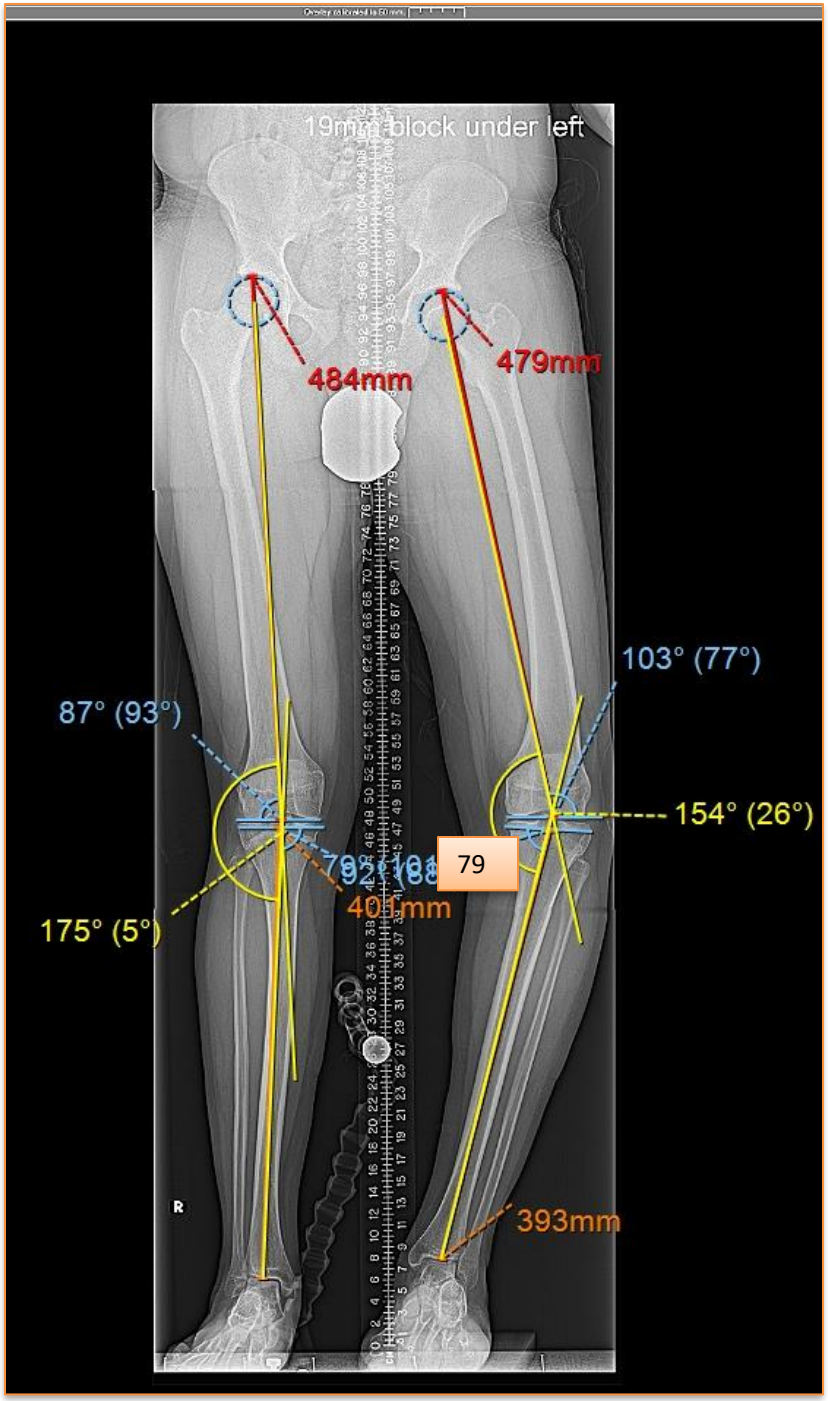


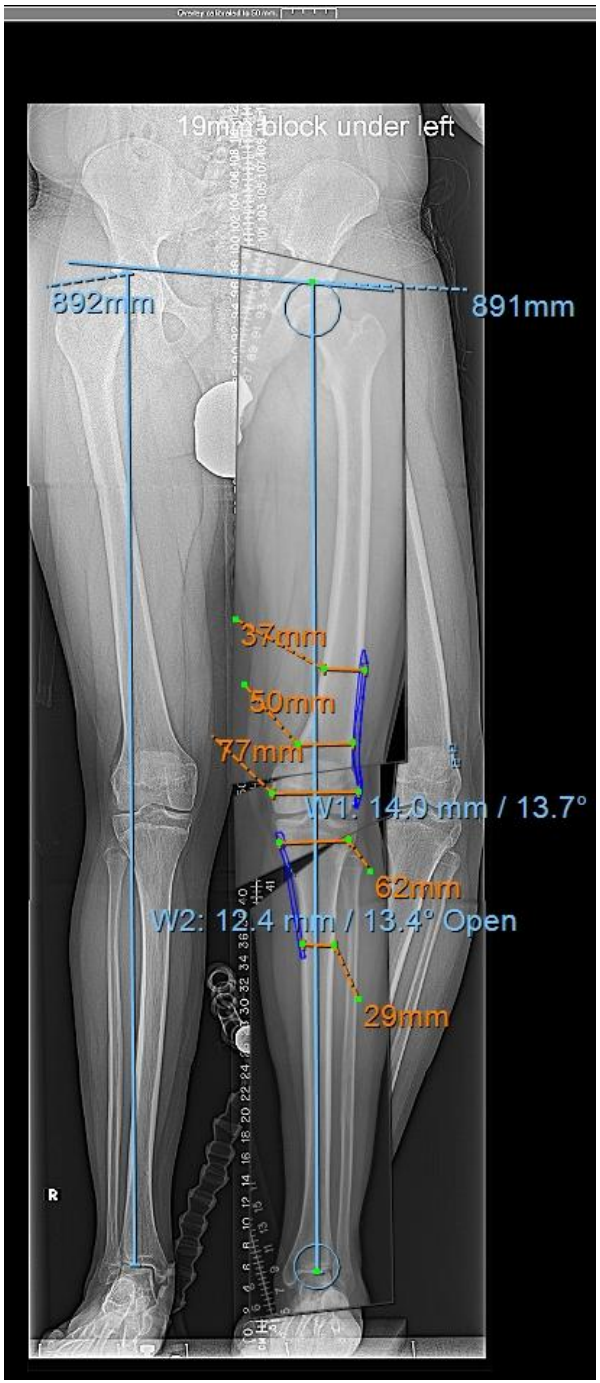
Go for optimal functional result

Patient psychology and relationship with leg important factor

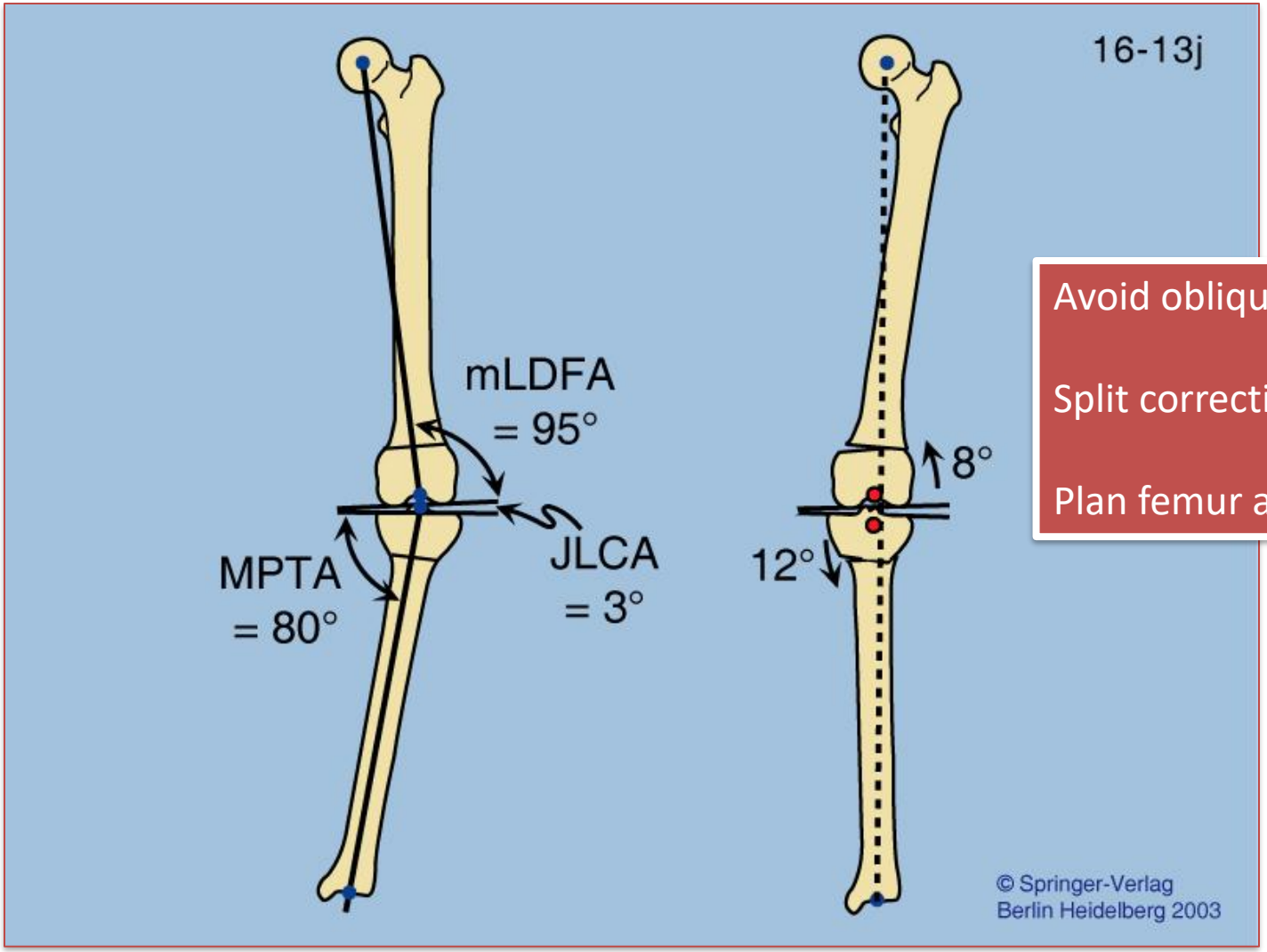
Femur and tibial osteotomy for large deformity




19mm block under left
484mm
479mm
103° (77°)
87° (93°)
154° (26°)
79
401mm
175° (5°)
393mm
R


19mm block under left
892mm
891mm
37mm
50mm
77mm
W1: 14.0 mm / 13.7°
62mm
W2: 12.4 mm / 13.4° Open
29mm
R

Distal femur and proximal tibial osteotomy



Avoid oblique joint line

Split correction of large deformity

Plan femur and tibia independently

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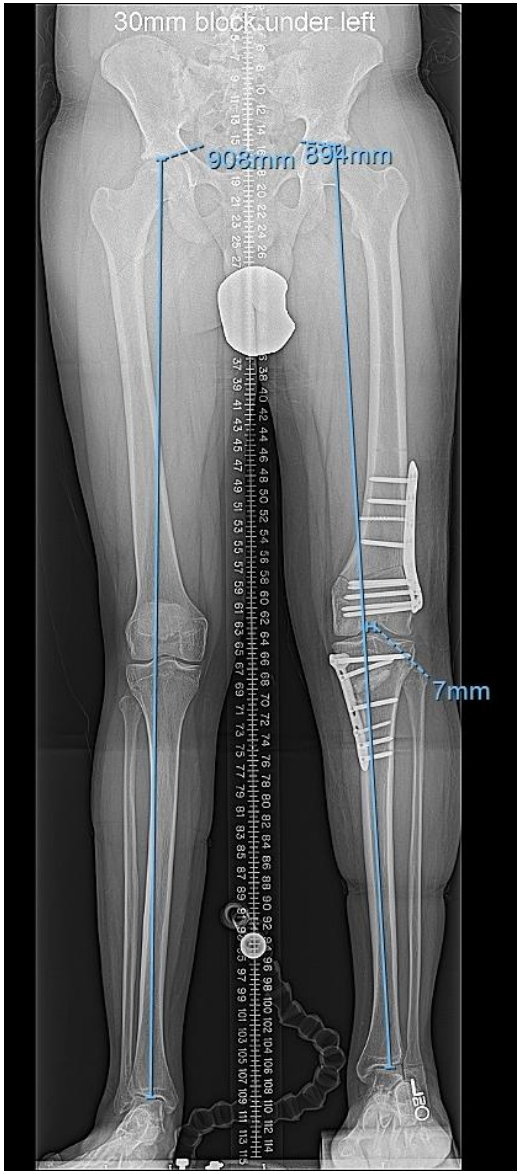

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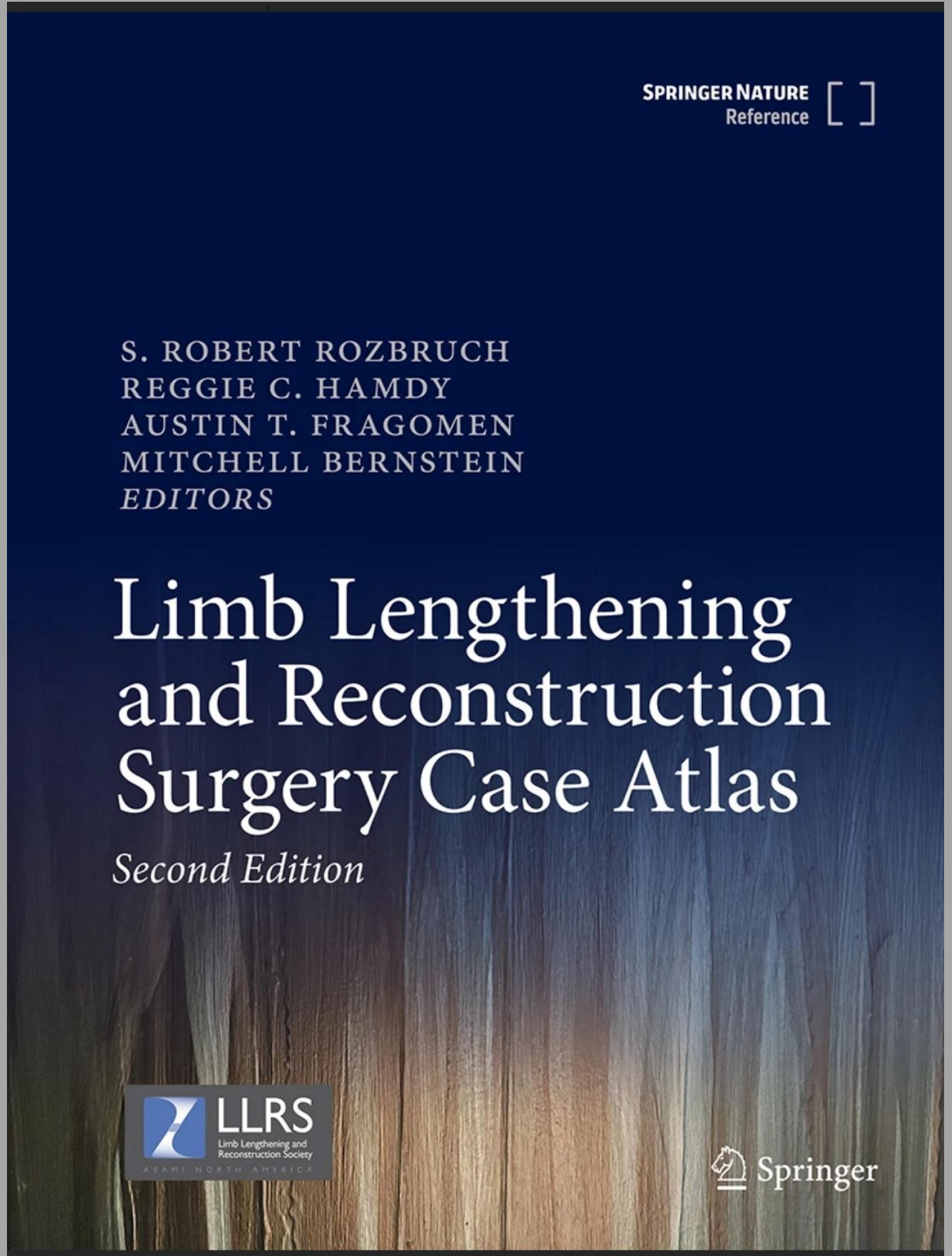
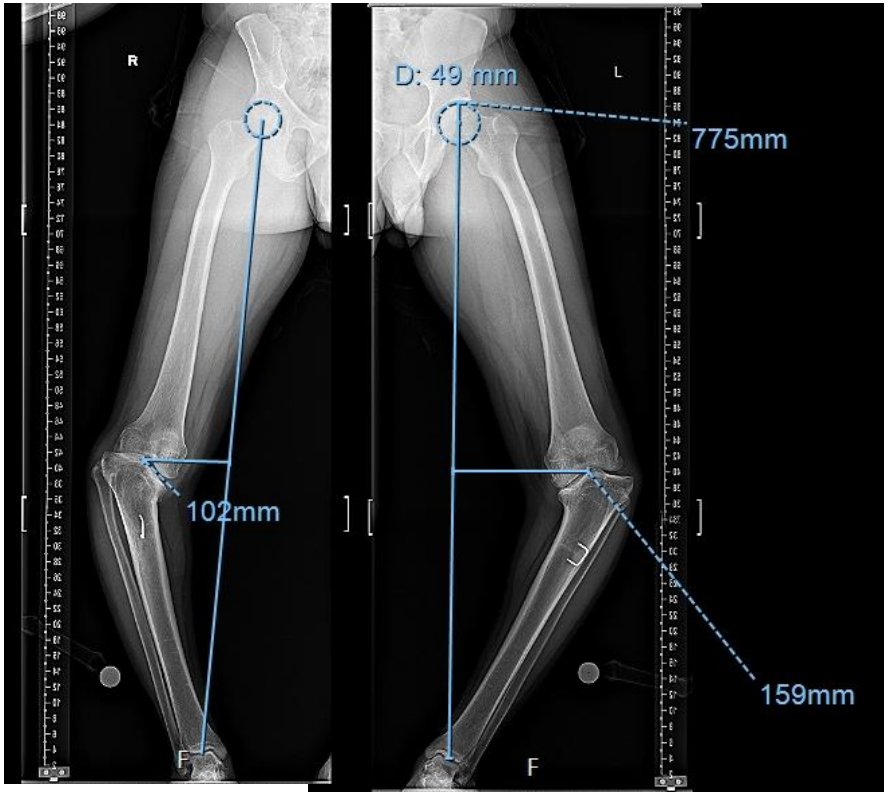
2025

3 Volumes

1. Pediatric Deformity
2. Trauma
   Foot and Ankle
3. Adult Reconstruction
   Tumor
   Upper Extremity



Preop: severe bowleg, knee pain
Hexapod frame & intra-articular osteotomy




R
F


L
F


F
HSS


HOSPITAL FOR SPECIAL SURGE
06/19/2024
9:34:44 AM
PRIOR: 1 of 5
27
32
67 kVp
1.42 mA
162
OEC
6/19/2024, 9:34:44 AM
1.


HOSPITAL FOR SPECIAL SURGE
06/19/2024
9:34:44 AM
C: 32767.0, W: 65535.0
PRIOR: 1 of 5
28
31
67 kVp
1.42 mA
161


HOSPITAL FOR SPECIAL SURGE
Asenso
Michael
XR C-ARM PROCEDURE
2313389
ROZBRUCH, S
MAIN241203765
10/27/1987
M
C: 32767.0, W: 65535.0
PRIOR: 1 of 5
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1.32 mA
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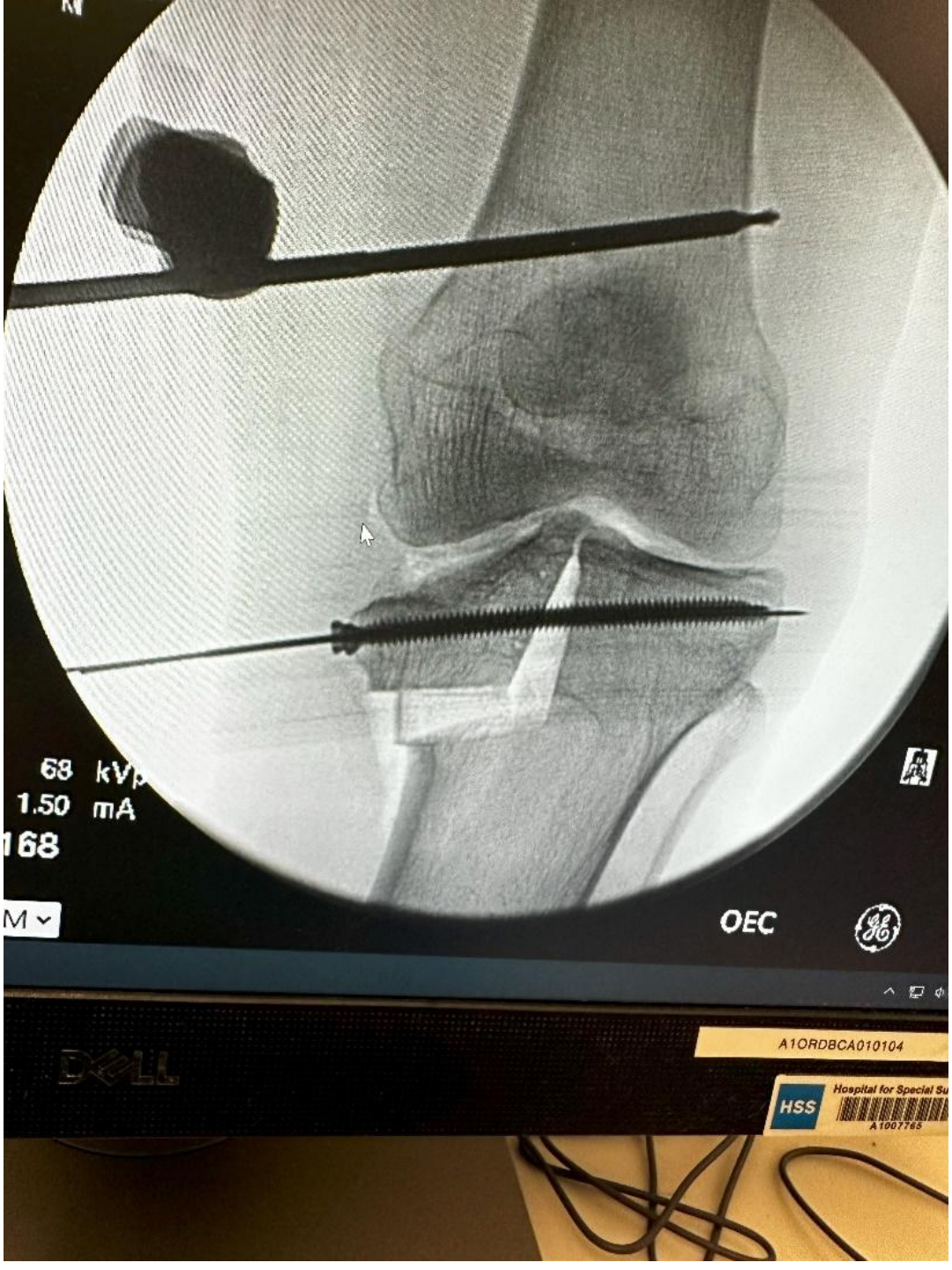
68 kVp
1.50 mA
168
OEC
A1ORDBCA010104
HSS
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A1007765


ARM PROCEDURE
HOSPITAL FOR SPECIAL SURG
BRUCH, S
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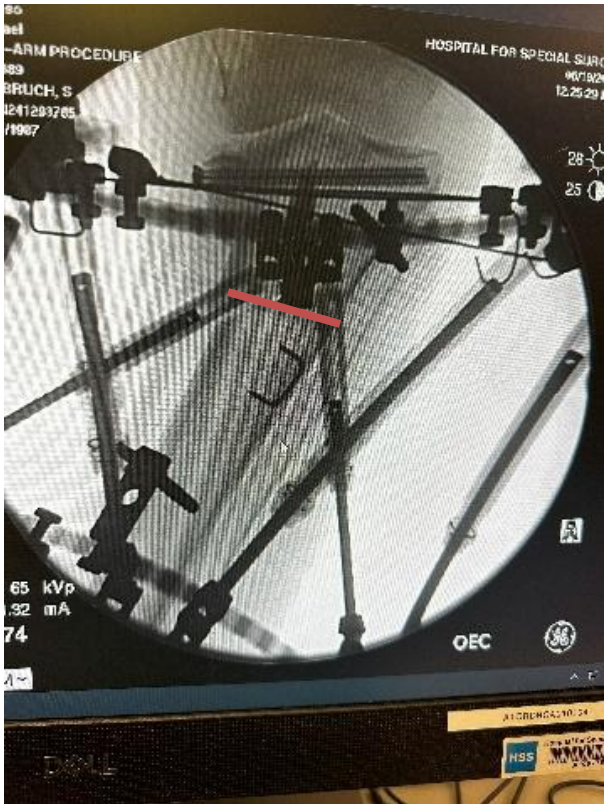
32
68 kVp
.50 mA
69
OEC
HSS


ARM PROCEDURE
HOSPITAL FOR SPECIAL SURG
BRUCH, S
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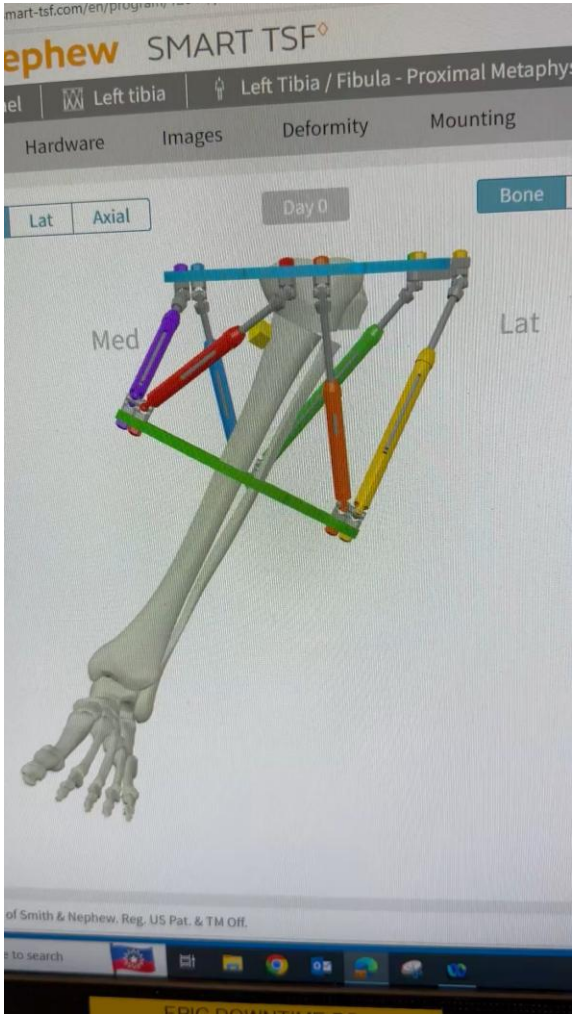
25
65 kVp
.32 mA
74
OEC
HSS


SMART TSF
Left tibia
Left Tibia / Fibula - Proximal Metaphys
Hardware
Images
Deformity
Mounting
Lat
Axial
Day 0
Bone
Med
Lat
of Smith & Nephew. Reg. US Pat. & TM Off.


1.
HOSPITAL FOR SPECIAL SURG
07/31/2024
1:24:52 PM
C: 32767.0, W: 65535.0
PRIOR: 3 of 6
29
30
70 kVp
1.59 mA
72
OEC
7/31/2024, 1:24:52 PM


1.
HOSPITAL FOR SPECIAL SURG
07/31/2024
1:42:44 PM
C: 32767.0, W: 65535.0
PRIOR: 3 of 6
28
33
69 kVp
1.53 mA
73
OEC
7/31/2024, 1:42:44 PM


1.
HOSPITAL FOR SPECIAL SURG
07/31/2024
4:05:35 PM
C: 32767.0, W
PRIOR:
29
24
69 kVp
1.51 mA
168
OEC
7/31/2024, 4:05:35 PM


HOSPITAL FOR SPECIAL SURG
07/31/2024
1:46:45 PM
C: 32767.0, W: 65535.0
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1.57 mA
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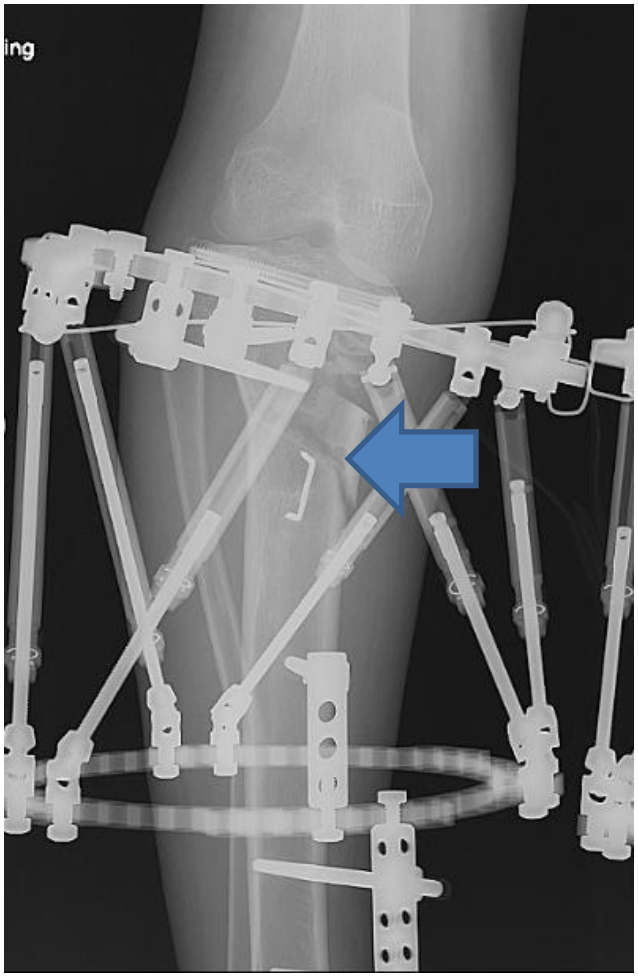
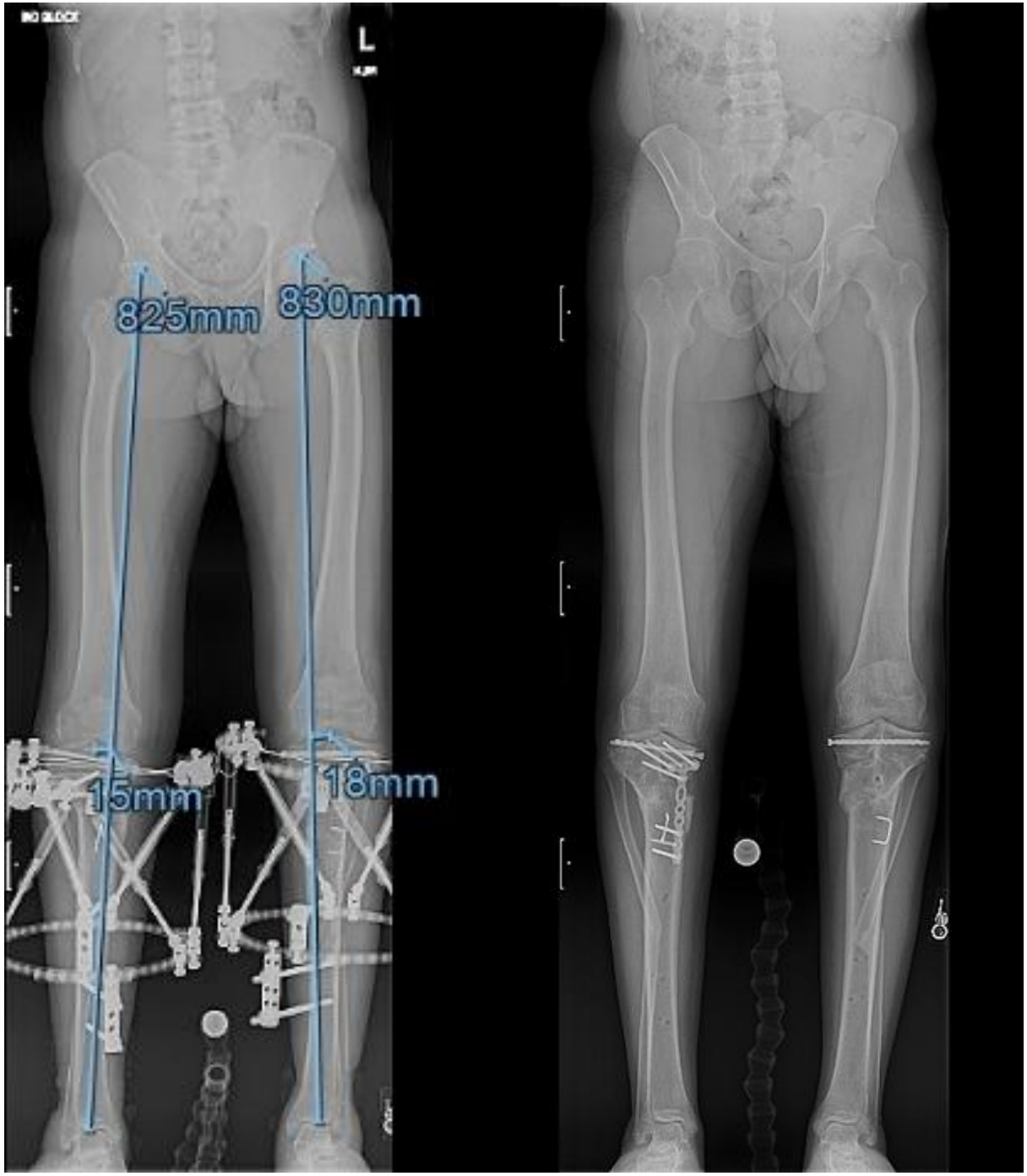
OEC
7/31/2024, 1:46:45 PM




L
825mm
830mm
15mm
18mm


7 cm

2025

3 Volumes

1. Pediatric Deformity
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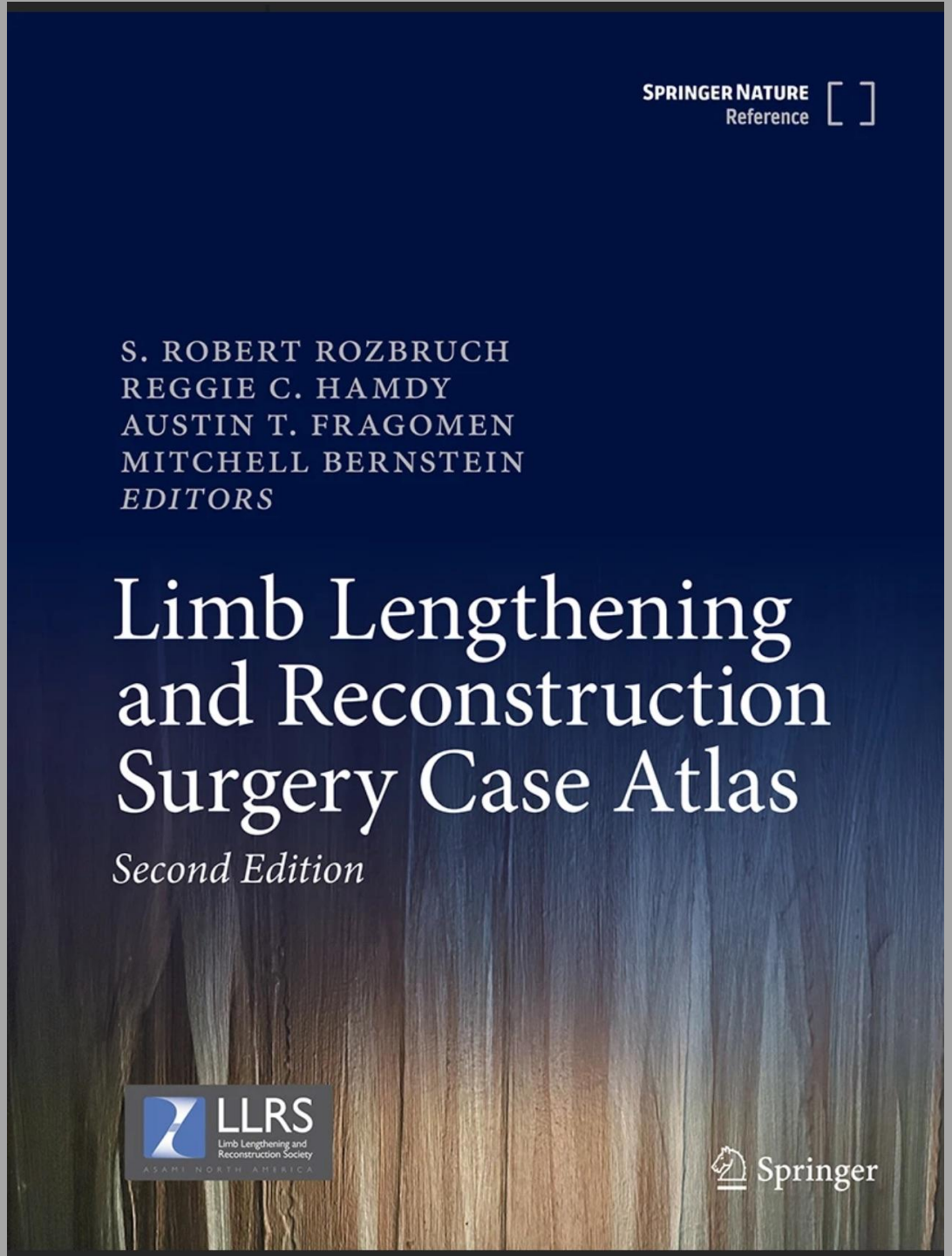
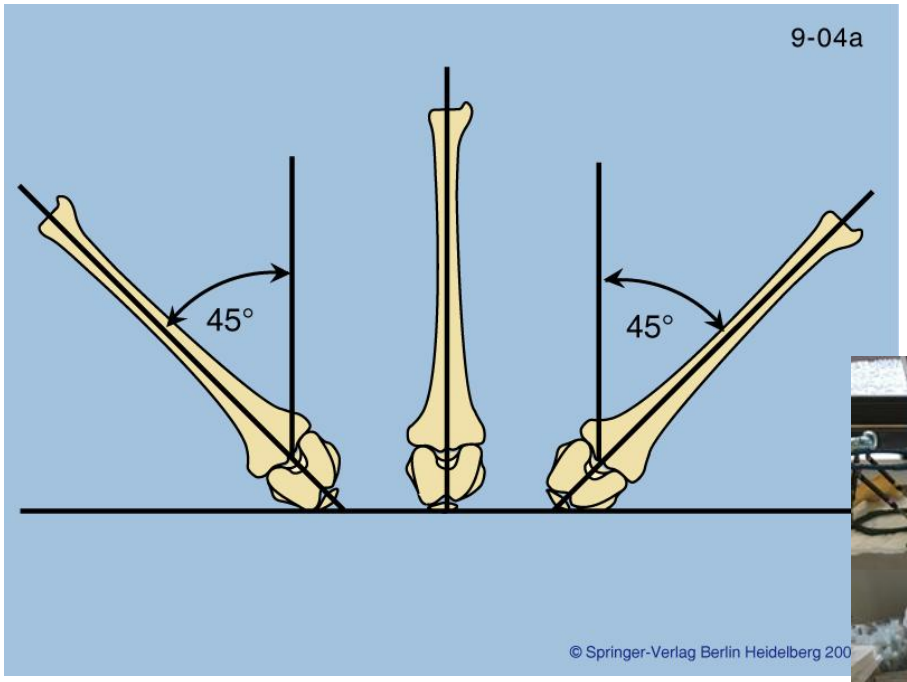
   Foot and Ankle
3. Adult Reconstruction
   Tumor
   Upper Extremity



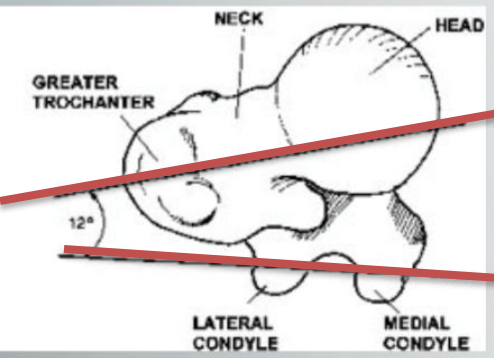
Rotational deformity-femur

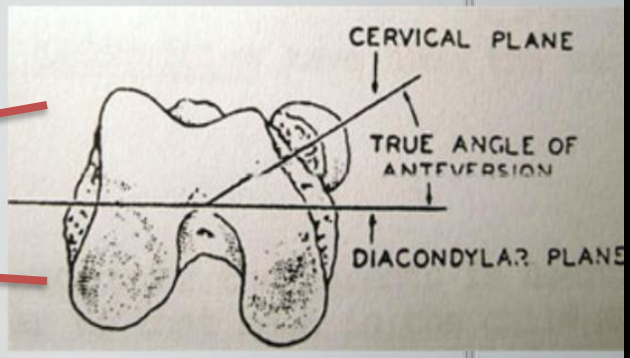


Prone Physical exam

CT scan

Femoral angles



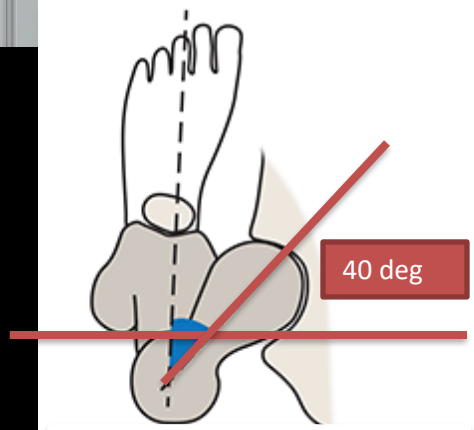


Proximal femur
Superior view

Distal femur
Inferior view

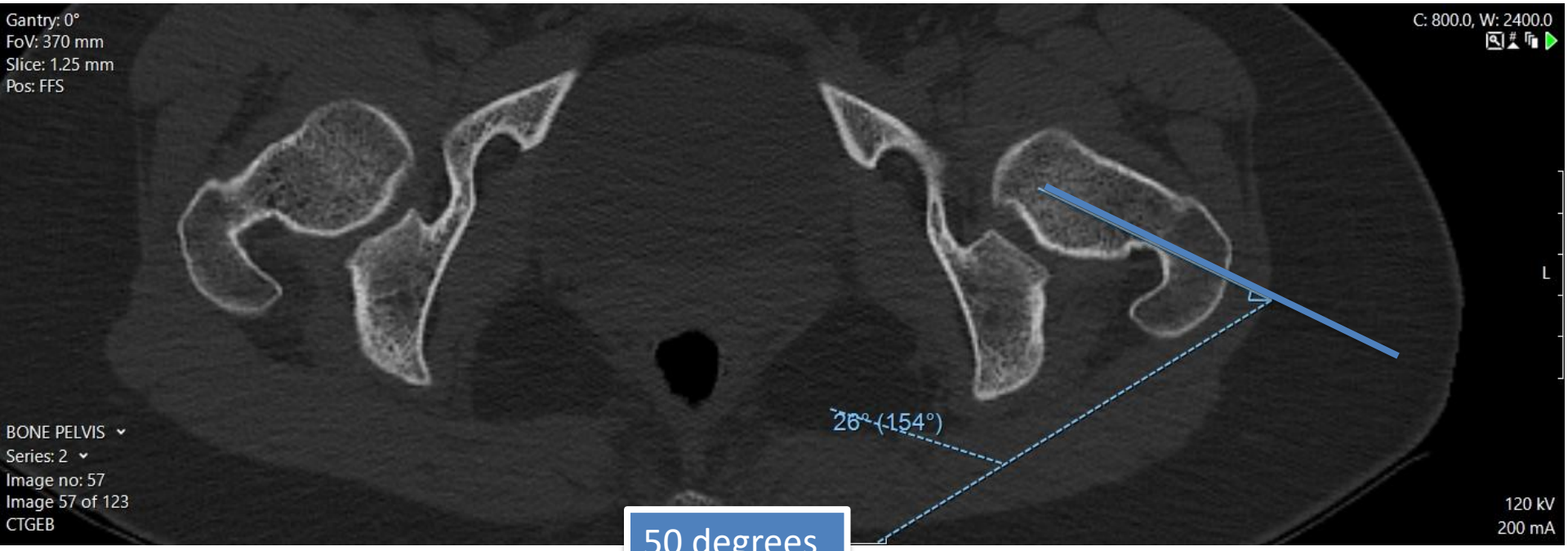
Normal
Femoral anteversion
15 degrees (10-20 deg)

Excessive Femoral Anteversion

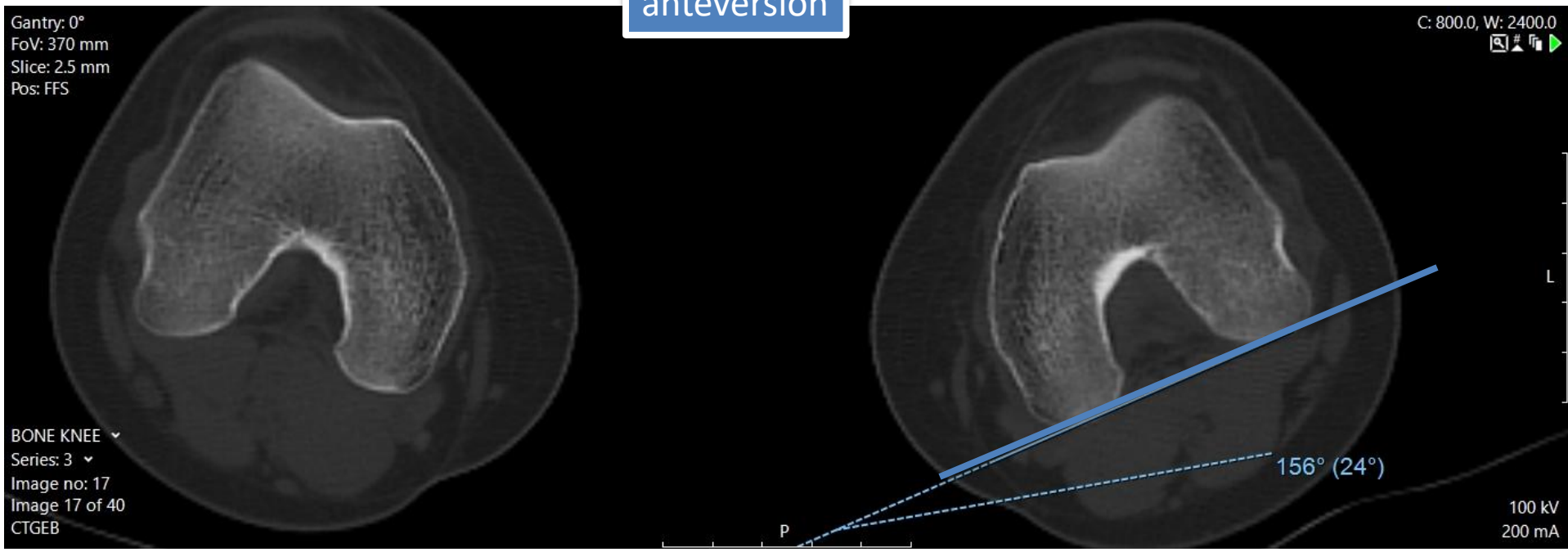


NOT COMFORTABLE

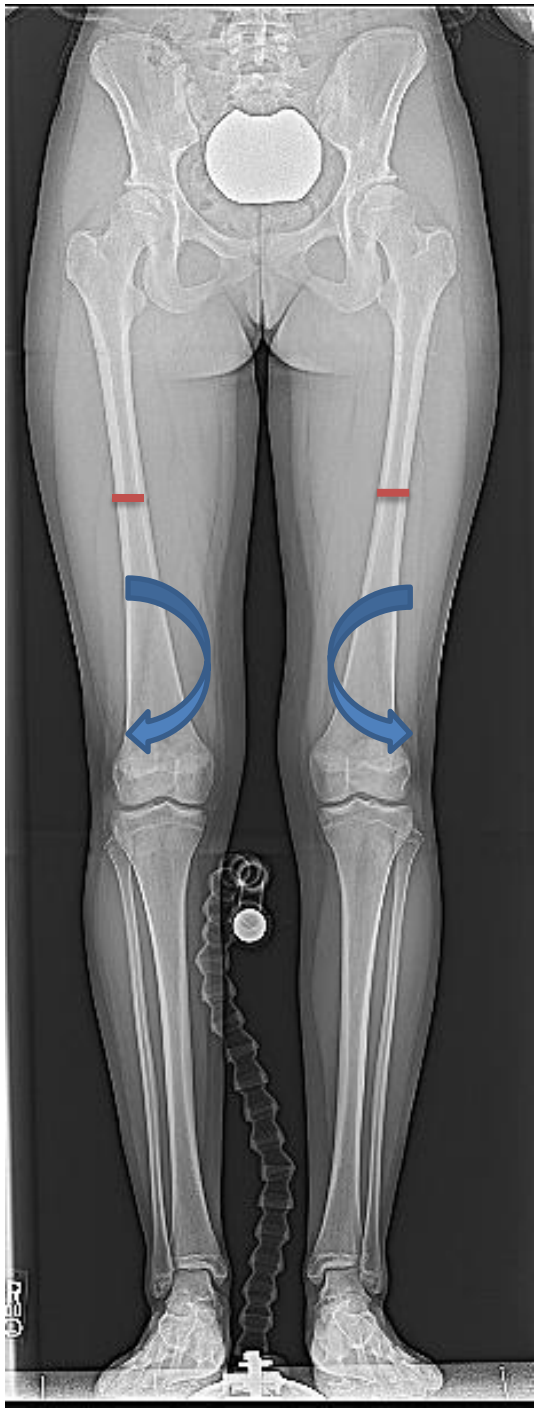
Position of the femoral head with the foot straight.

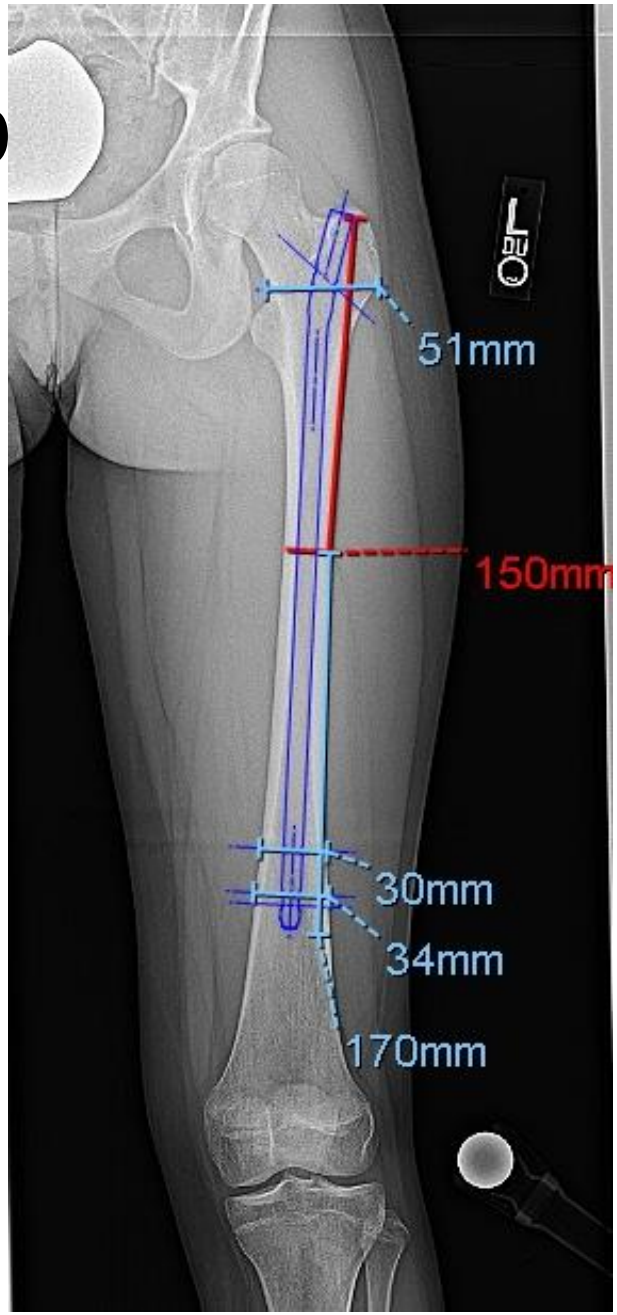


50 degrees anteversion

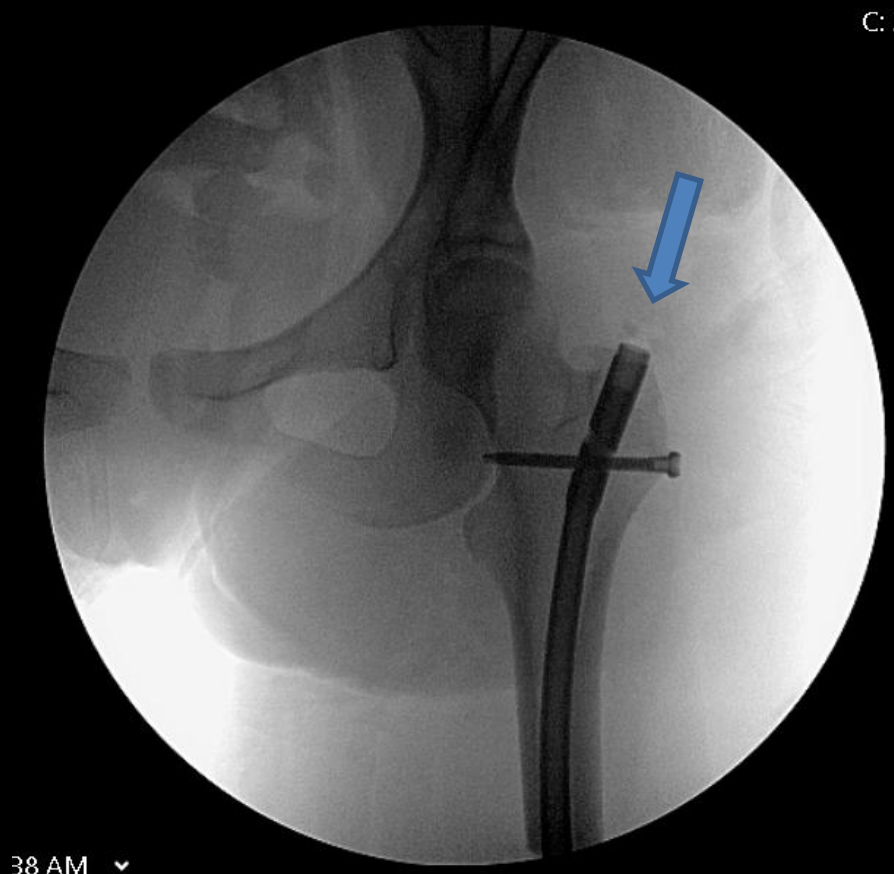


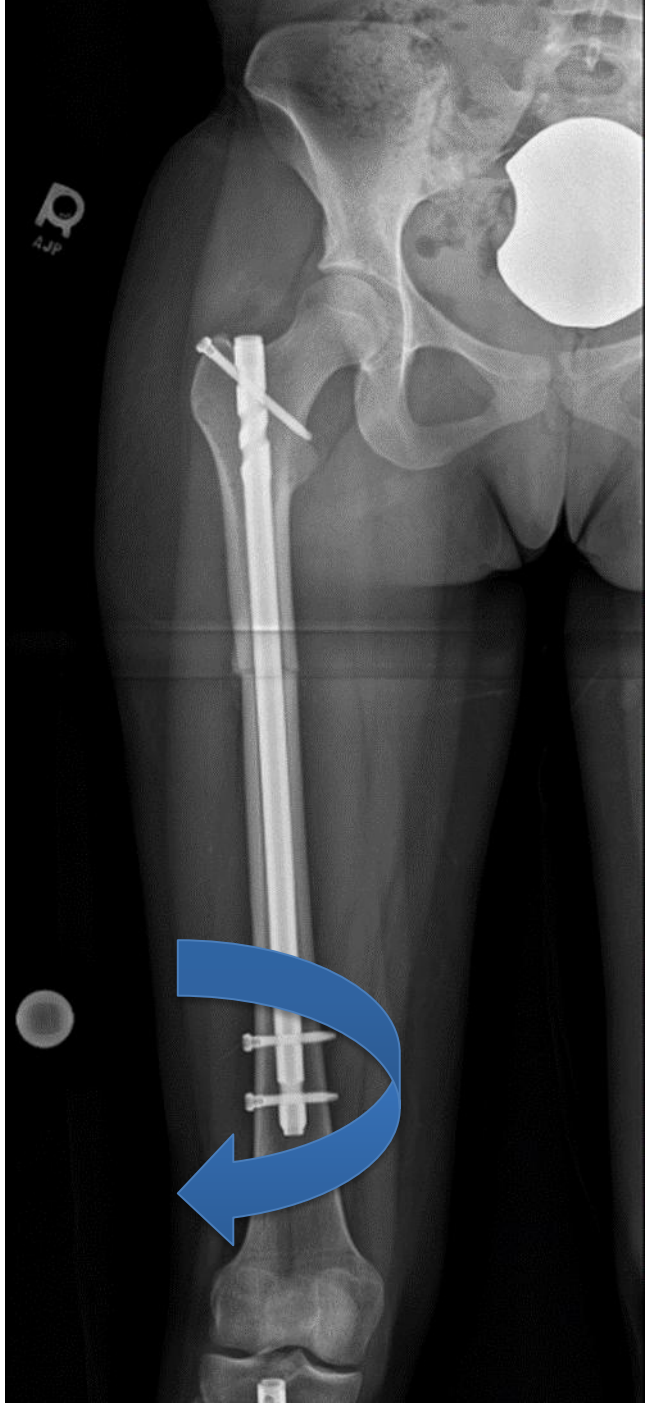
preop



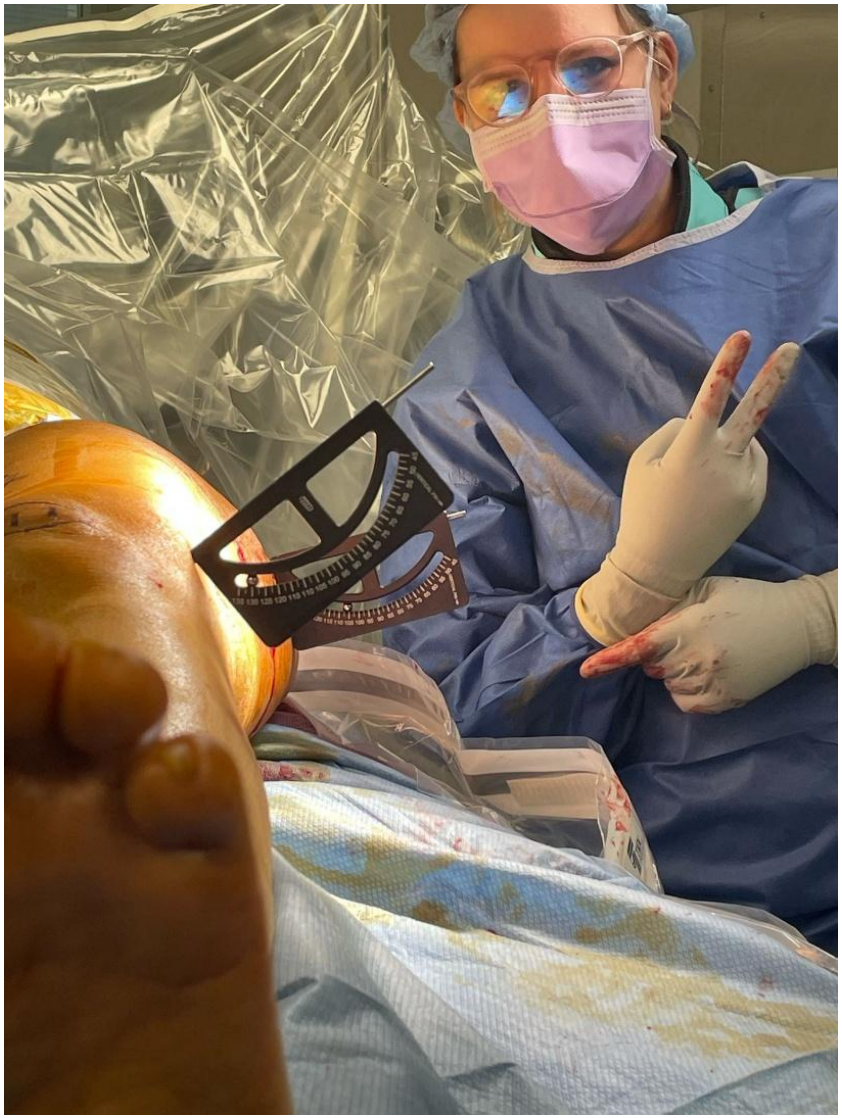


During surgery





Procedures:
Derotation osteotomies
-rotate knee external



2025

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2. Trauma
   Foot and Ankle
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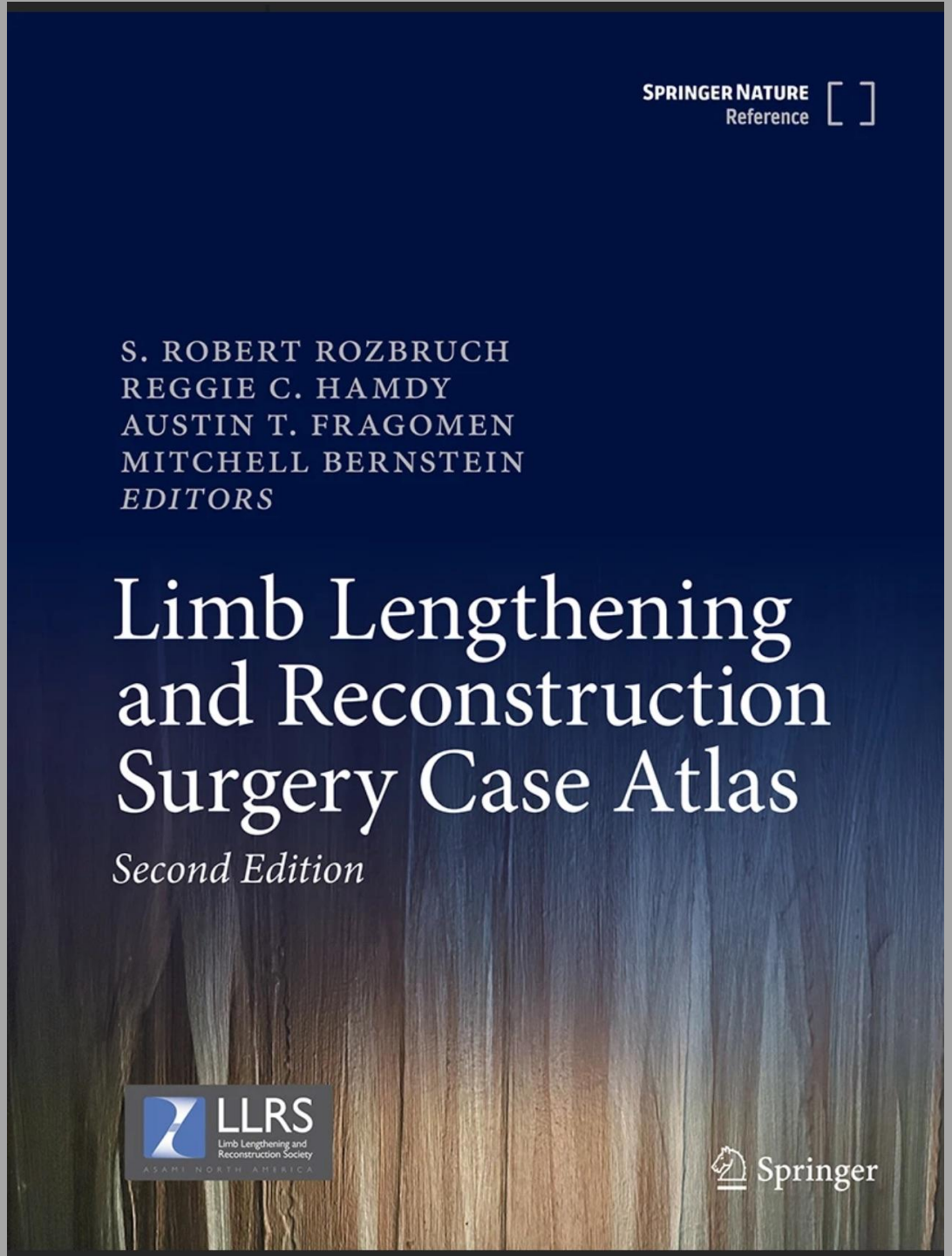
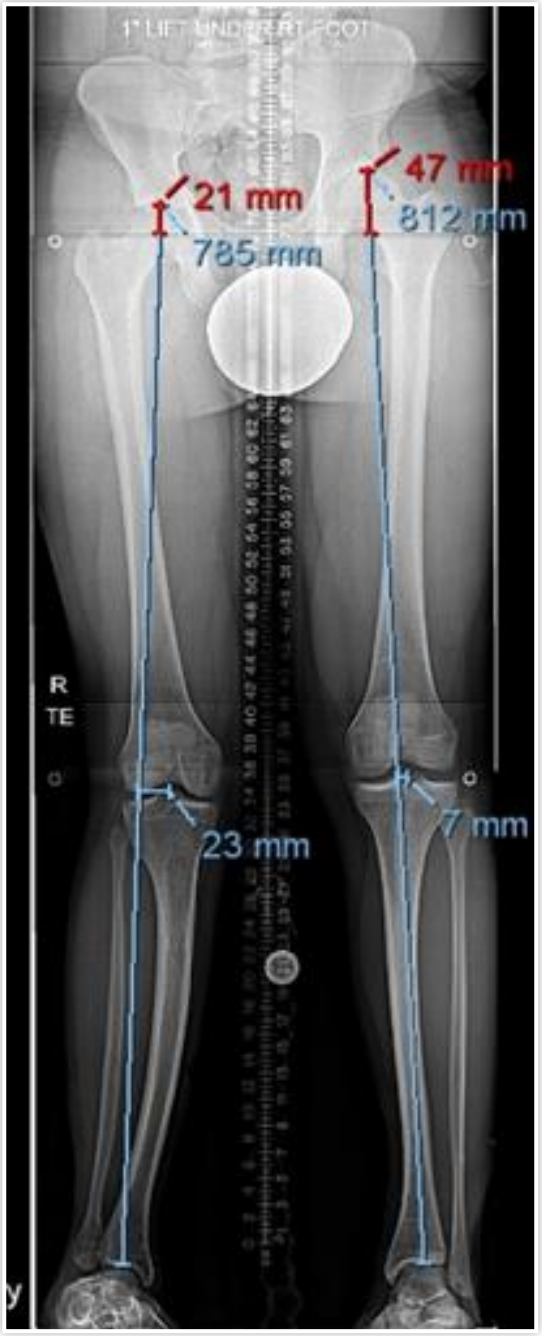
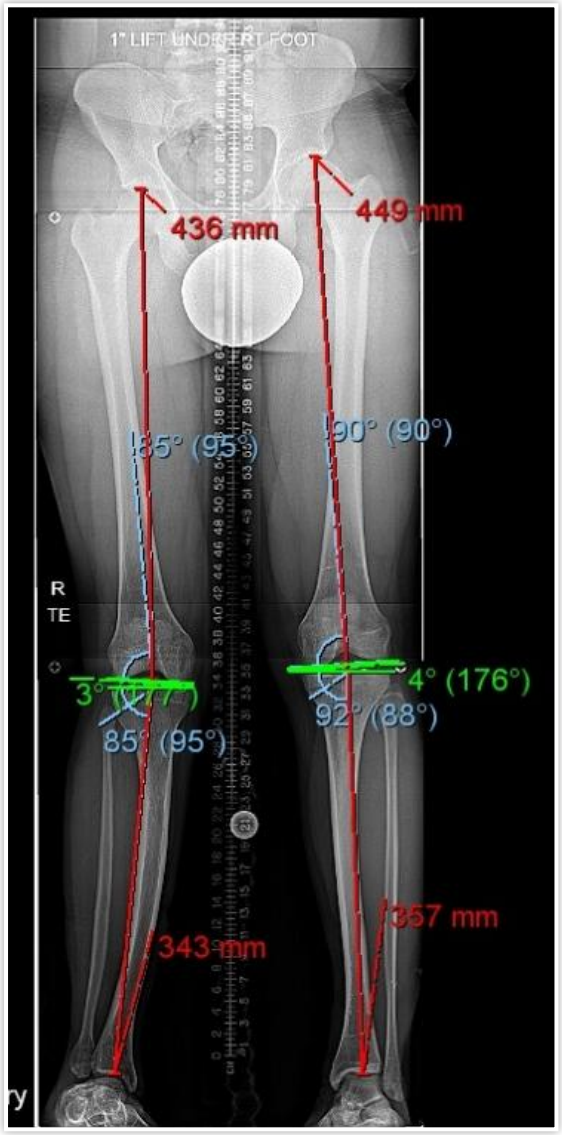
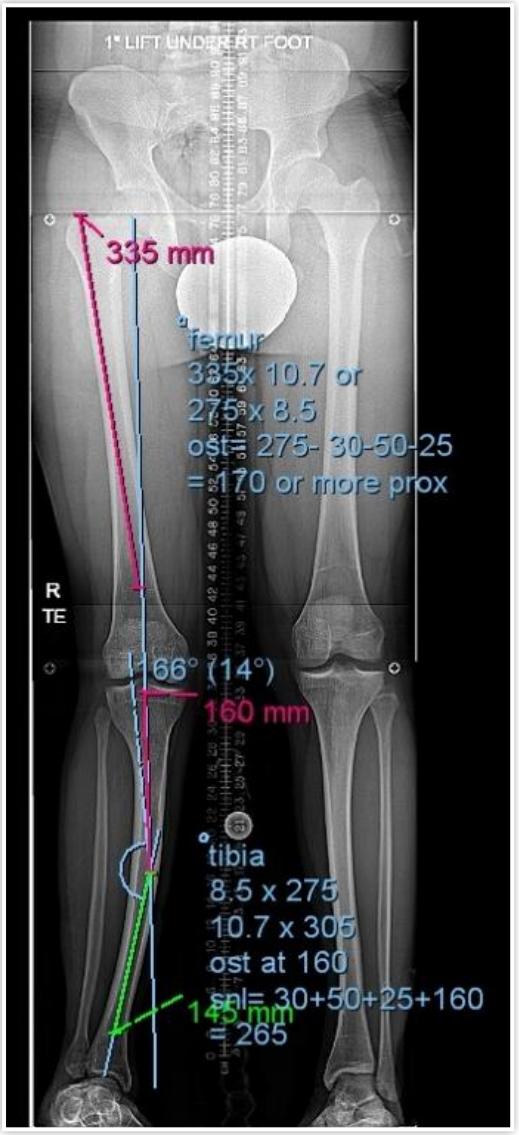
   Tumor
   Upper Extremity



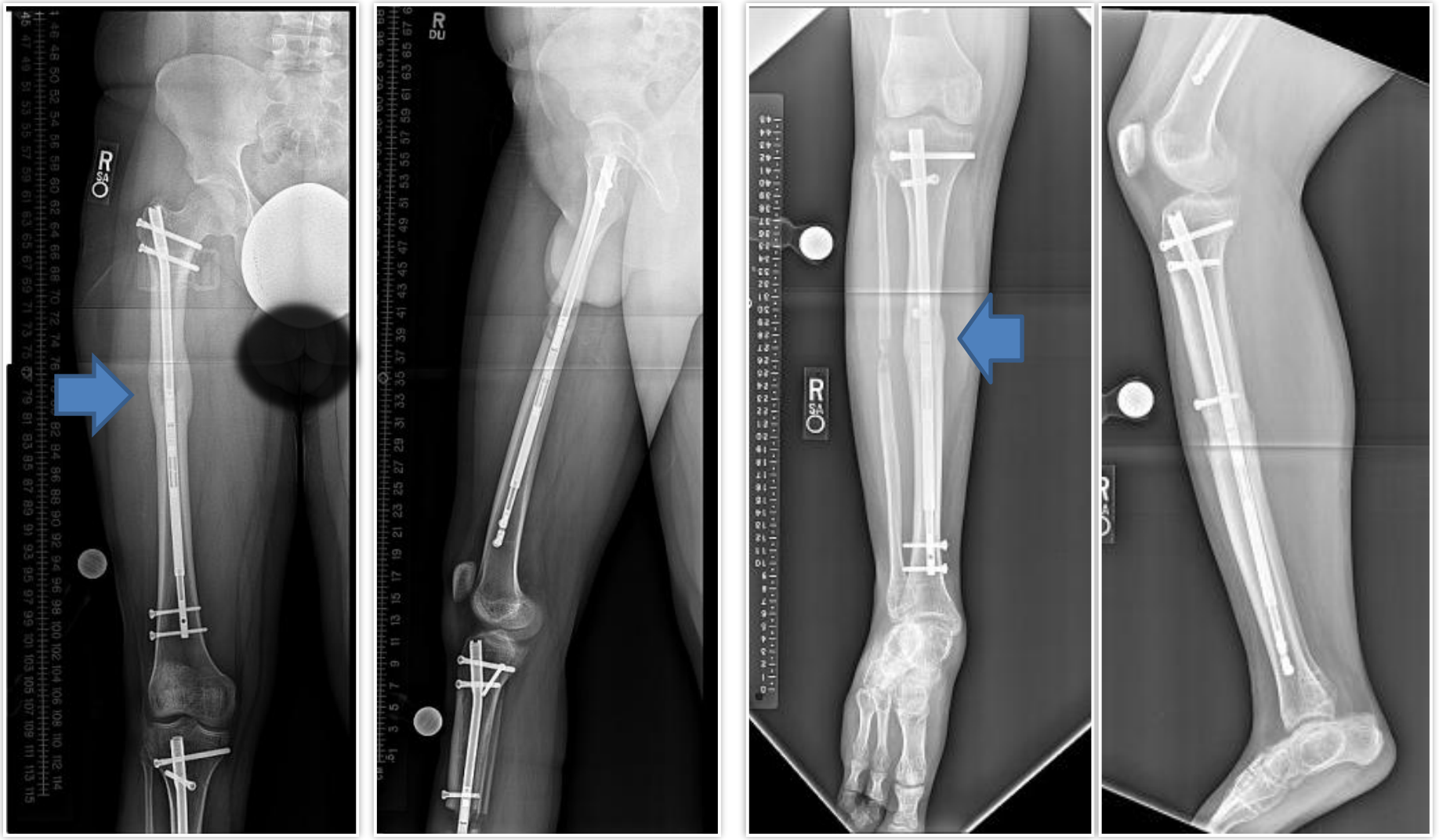


20 y/o male with untreated congenital short femur and fibular hemimelia
DLLD= 27mm
ILLD= 25+26= 51mm
including foot





LLD split between femur and tibia
Correct valgus in tibia



Journal of AAOS 22023

OPEN Research Article

Treatment of Angular Deformity and Limb Length Discrepancy With a Retrograde Femur Magnetic Intramedullary Nail: A Fixator-assisted, Blocking Screw Technique

Erik J. Geiger, MD
Adam D. Geffner, BS
S. Robert Rozbruch, MD
Austin T. Fragomen, MD

ABSTRACT

Background: Fixator-assisted nailing techniques that incorporate magnetic internal lengthening nails (MILNs) permit acute deformity correction and then gradual limb lengthening without needing postoperative external fixators.

Purposes: We sought to investigate the safety and accuracy of a fixator-assisted, blocking screw technique using retrograde MILNs for the correction of LLD and limb malalignment.

Methods: Forty-one patients (13 patients with genu varum and 28 patients with genu valgum) with LLD treated with fixator-assisted, blocking screw retrograde MILN reconstruction were included. Preoperative LLD, mechanical axis deviation, and joint orientation angles were compared with values at the end of treatment, and bone healing indices were calculated. Perioperative complications were tracked.

Results: Preoperatively, the mean mechanical lateral distal femoral angle of the varus cohort was 98 ± 12°, whereas the mean lateral distal femoral angle of the valgus cohort was 82±4°. Both cohorts had an average 3-cm LLD. 99% of the planned limb lengthening was achieved. Final LDFAs were 91 ± 6° and 89 ± 4° in the varus and valgus cohorts, respectively, and the limb mechanical axis angles were normalized. 10 patients underwent a total of 21 returns to the operating room. Most commonly, this involved percutaneous injection of bone marrow aspirate concentrate to bone regenerate exhibiting delayed union (6 patients).

Conclusions: The use of a retrograde MILN with a fixator-assisted, blocking screw technique is an effective means of acute deformity correction and gradual limb lengthening through minimal incisions. The accuracy of deformity correction relies on intraoperative execution of the appropriate nail start site, osteotomy location, and placement of blocking screws.

From the Department of Orthopedic Surgery, The Rothman Institute, Thomas Jefferson University, Philadelphia, PA (Dr. Geiger) and the Department of Limb Lengthening and Complex Reconstruction, Hospital for Special Surgery, New York, NY (Mr. Geffner, Dr. Rozbruch, Dr. Fragomen).

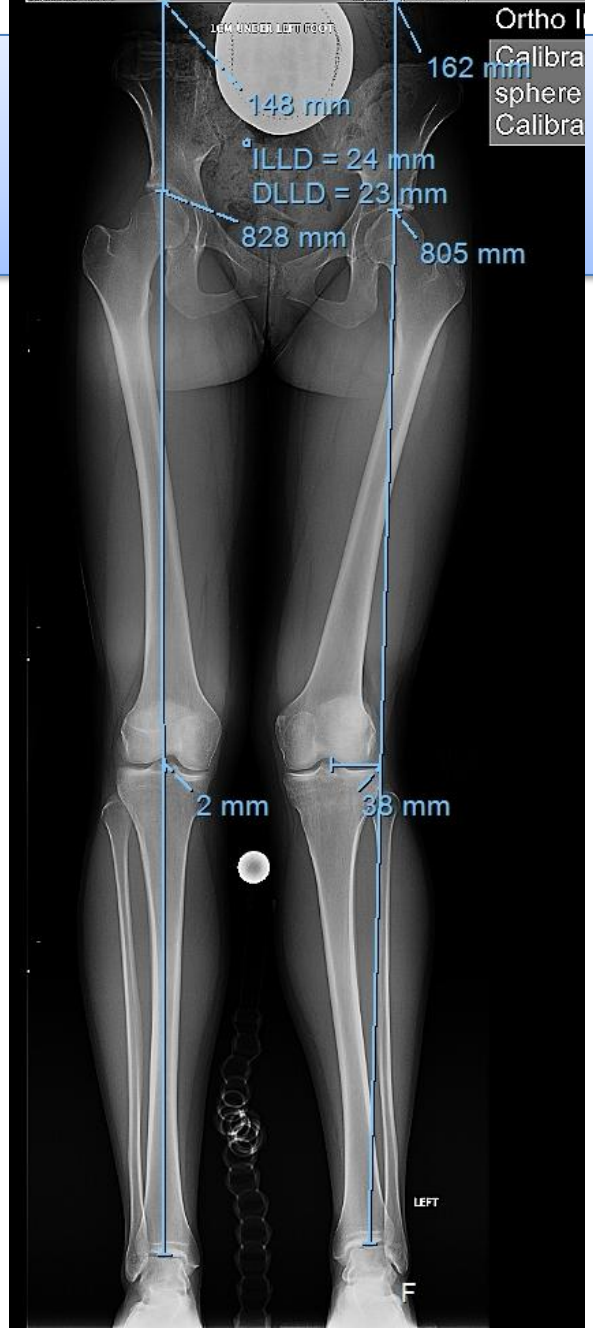
Correspondence to Dr. Geiger: erik.geiger@rothmanortho.com

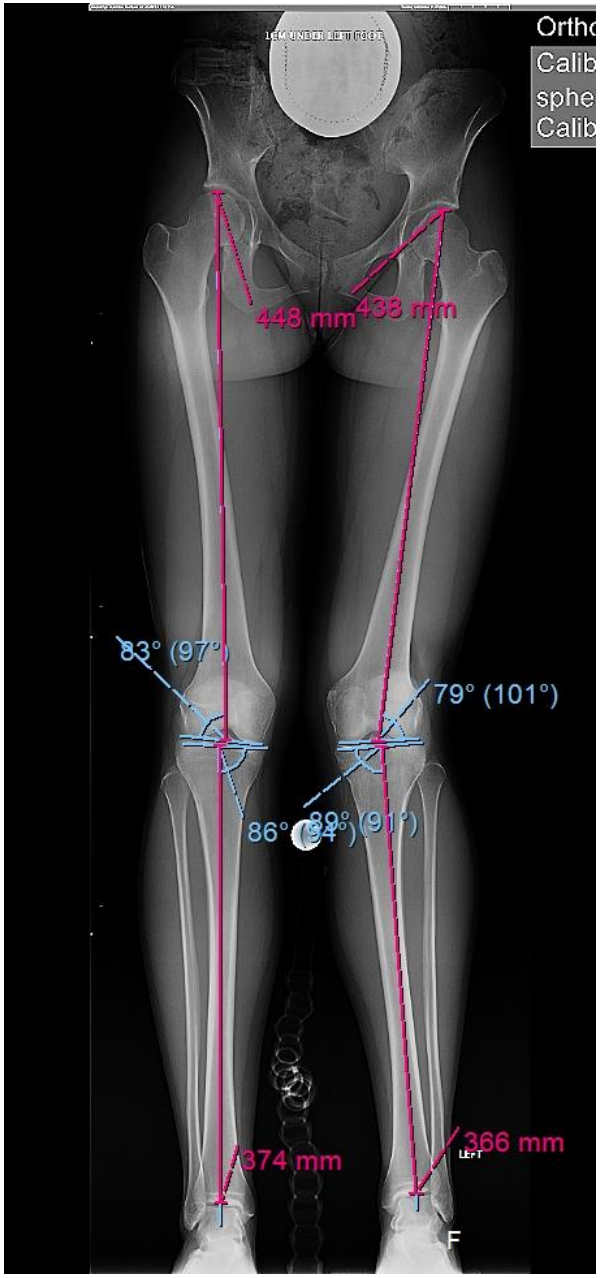
Dr. Rozbruch or an immediate family member serves as a paid consultant to NuVasive, Smith&Nephew, and J&J (Synthes); is a member of a speakers' bureau; or has made paid presentations on behalf of J&J (Synthes).

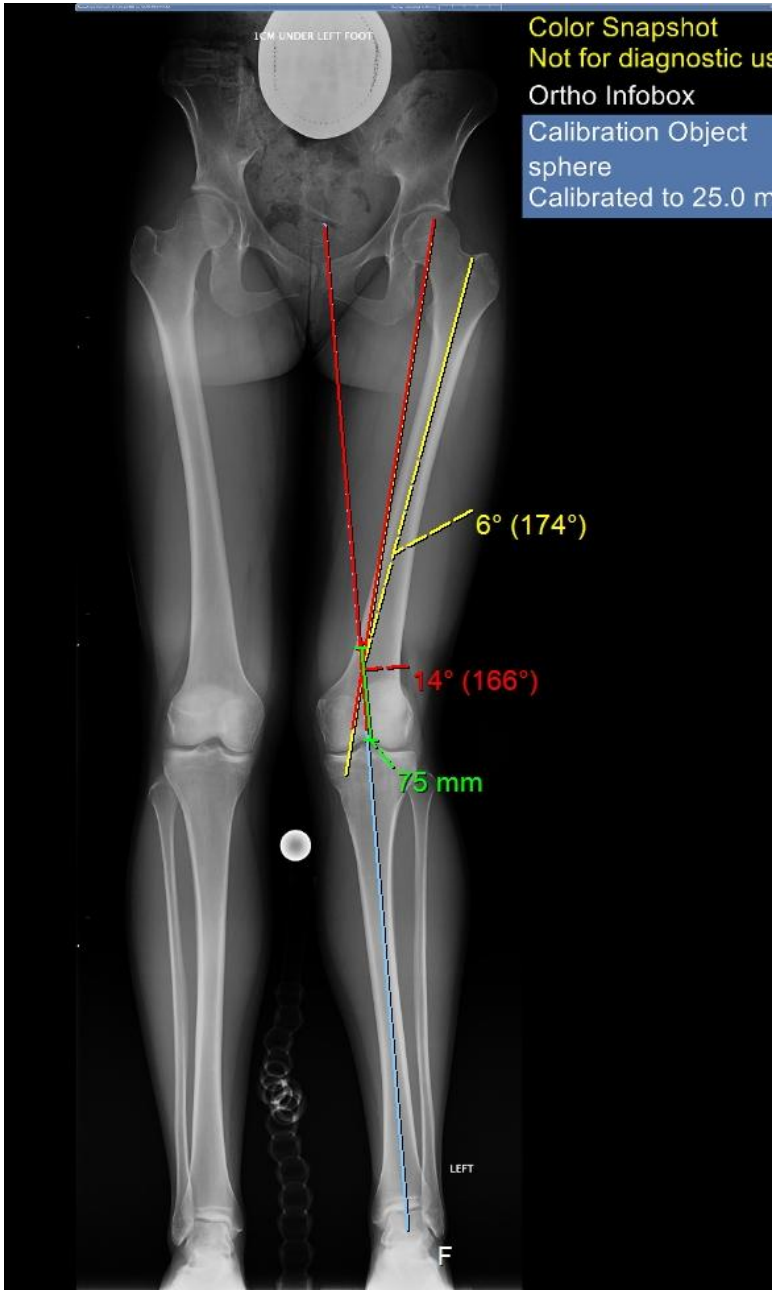
JAAOS Glob Res Rev 2023;7: e23.00053

DOI: 10.5435/JAAOSGlobal-D-23-00053

LLD 24 mm
Valgus deformity



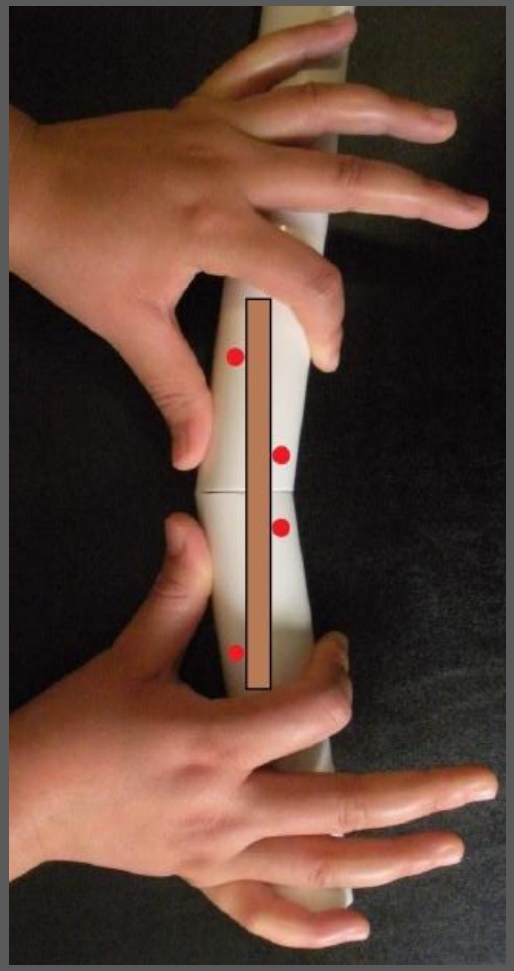

Ortho
Calib
sphe
Calib
448 mm
438 mm
83° (97°)
79° (101°)
86° (94°)
89° (91°)
374 mm
366 mm
LEFT
F

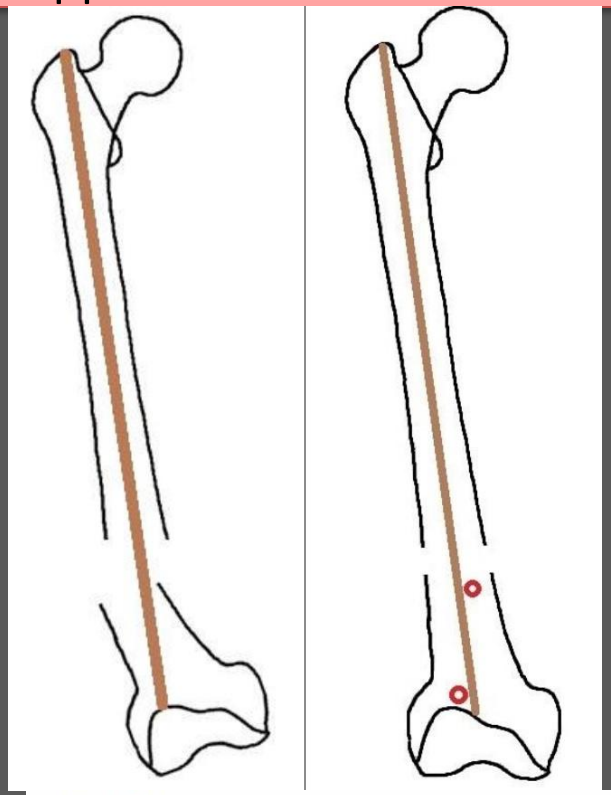

Color Snapshot
Not for diagnostic us
Ortho Infobox
Calibration Object
sphere
Calibrated to 25.0 m
6° (174°)
14° (166°)
75 mm
LEFT
F

Reverse Rule of Thumbs

Thumbs= olive wire location

Blocking screw is opposite location





Strat Traum Limb Recon
DOI 10.1007/s11751-016-0265-3

CrossMark

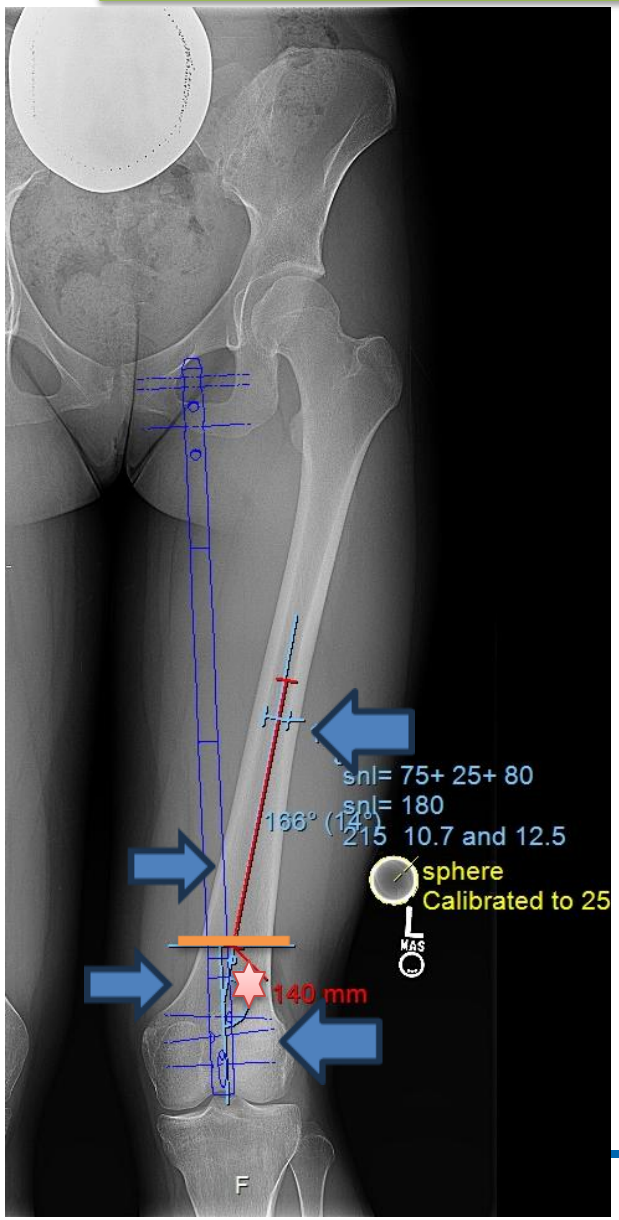
TECHNICAL REPORT

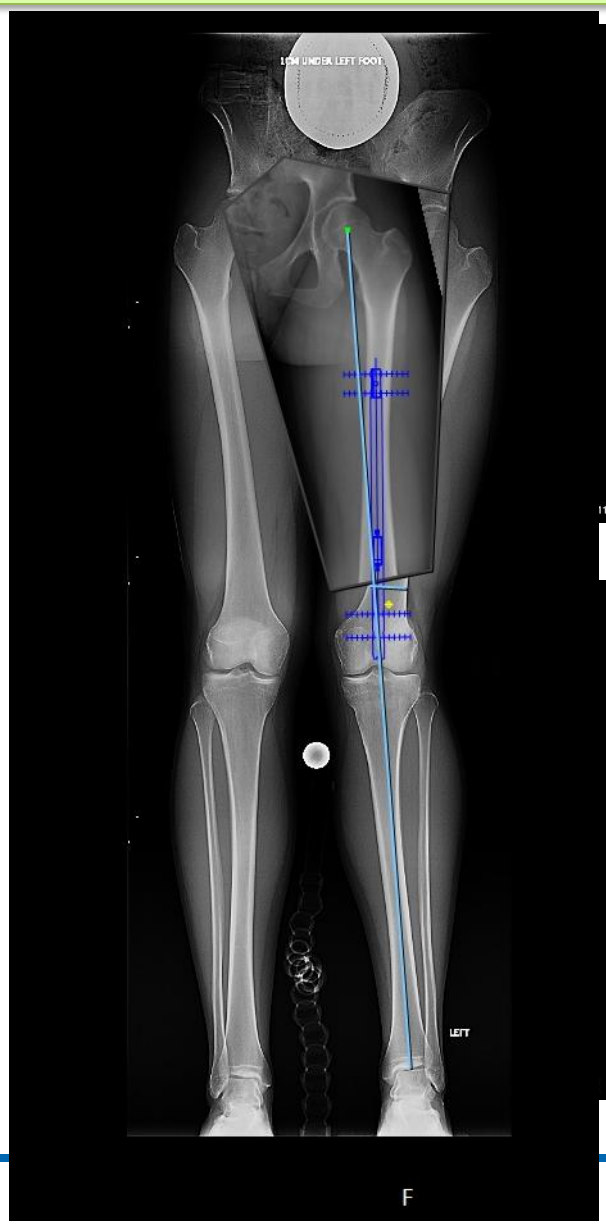
The use of blocking screws with internal lengthening nail and reverse rule of thumb for blocking screws in limb lengthening and deformity correction surgery

Saravanaraja Muthusamy[1] · S. Robert Rozbruch[2] · Austin T. Fragomen[2]

Received: 12 June 2015 / Accepted: 11 September 2016

Fixator assisted blocking screw (FABS)





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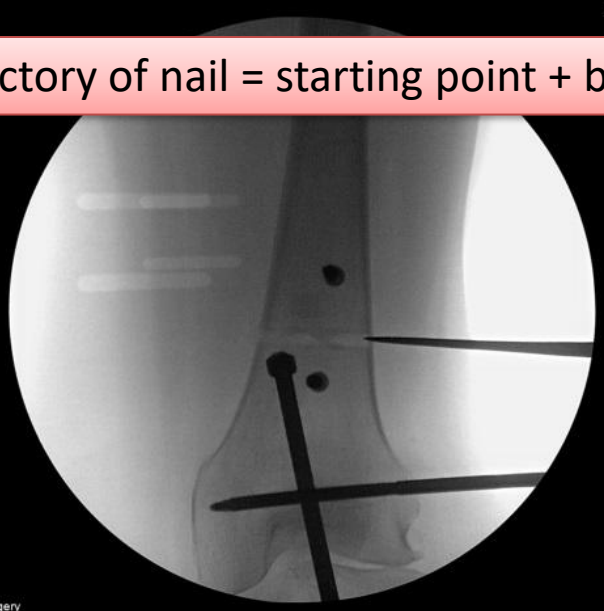
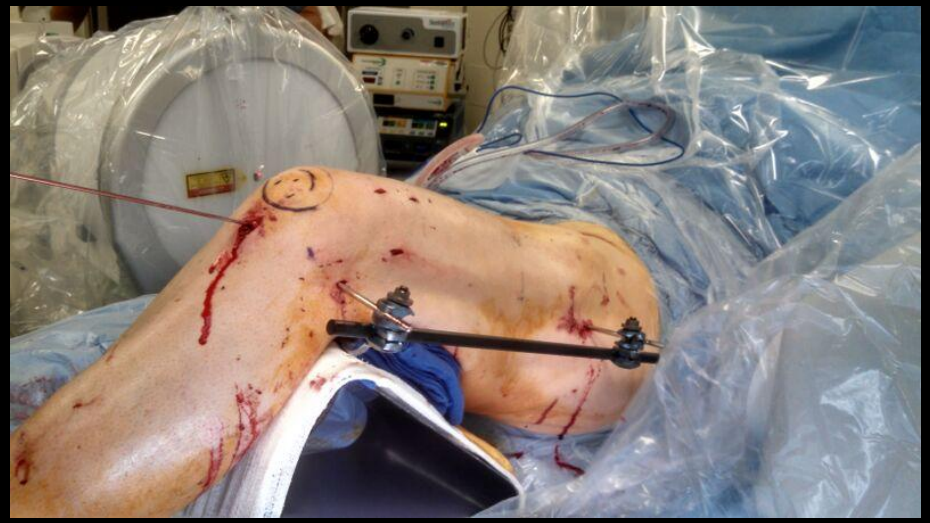
Trajectory of nail = starting point + blocking screw





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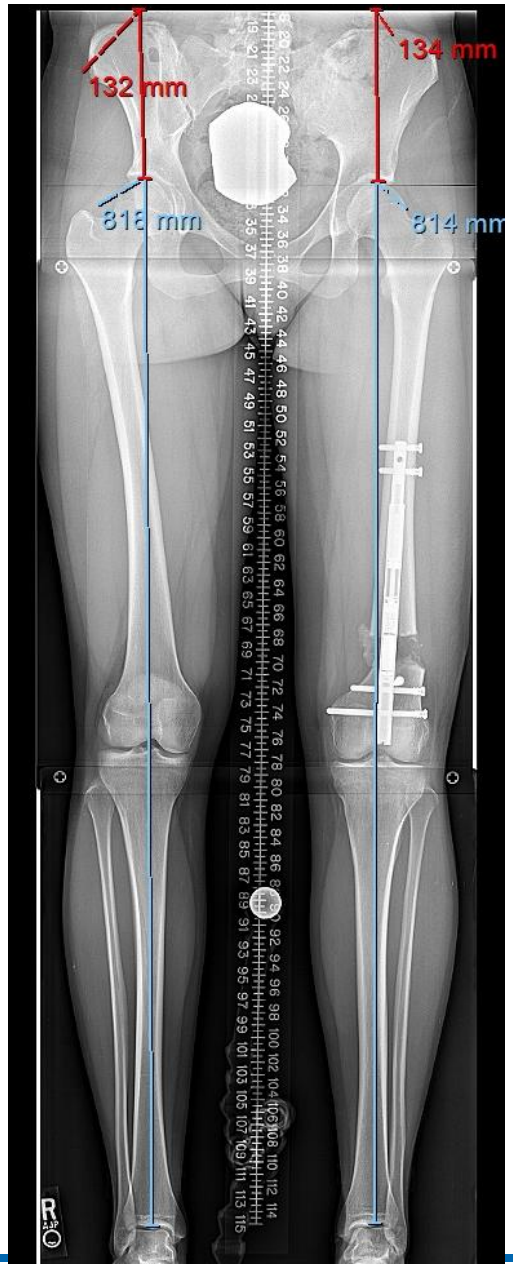
132 mm
134 mm
816 mm
814 mm


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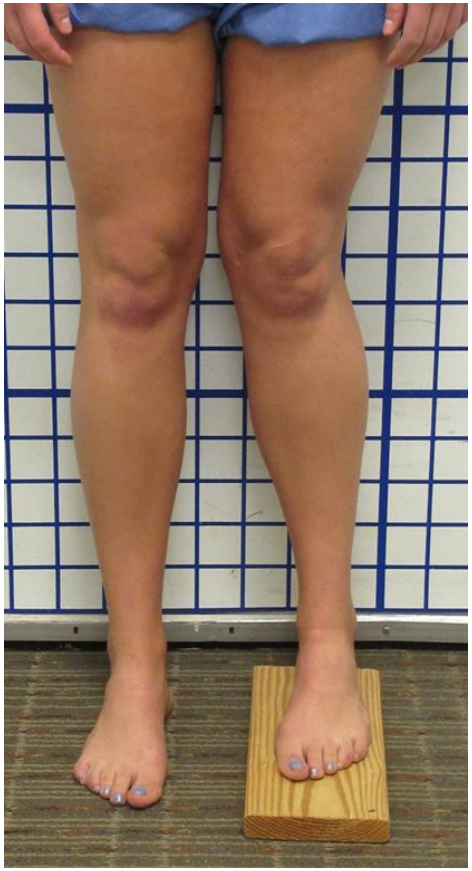


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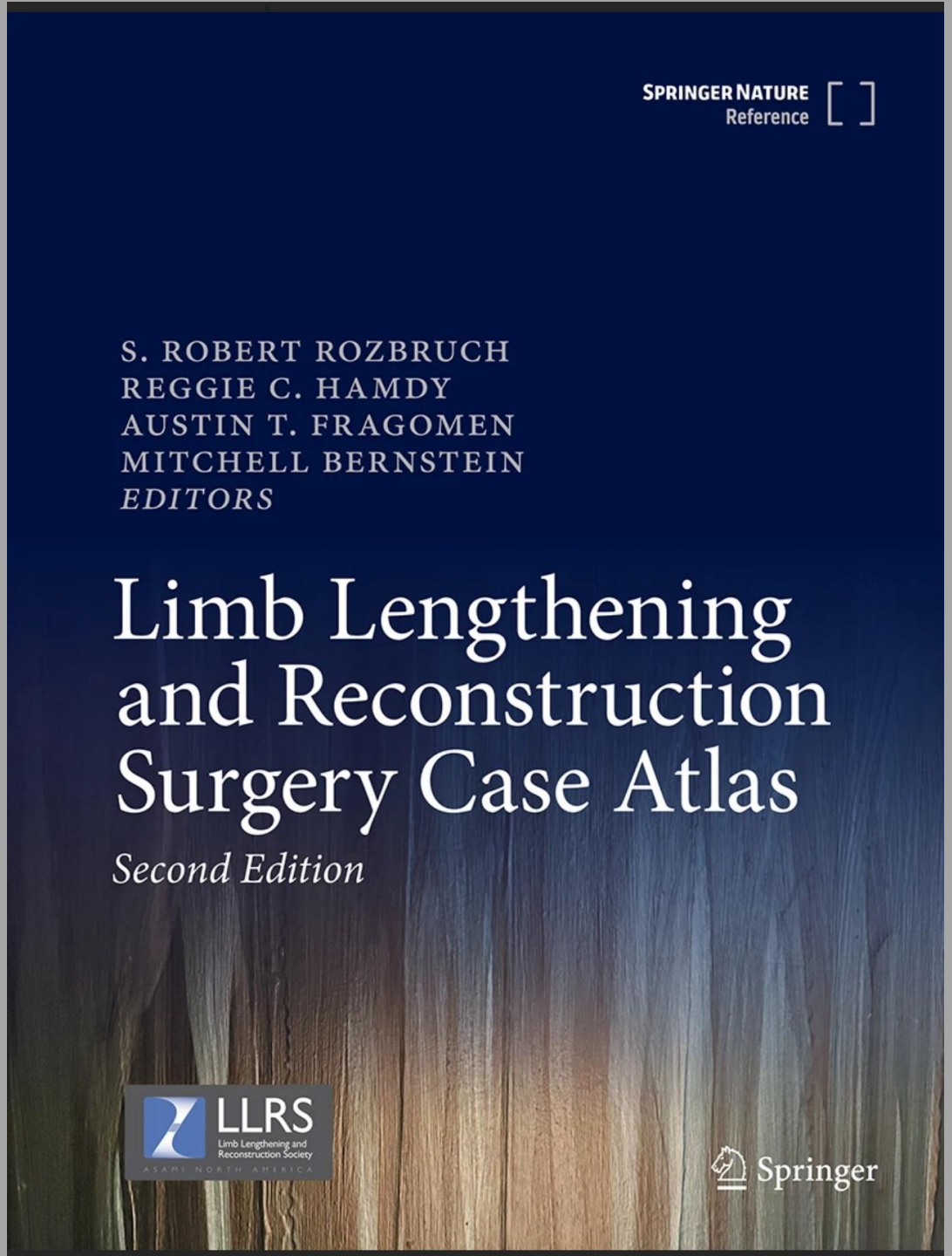
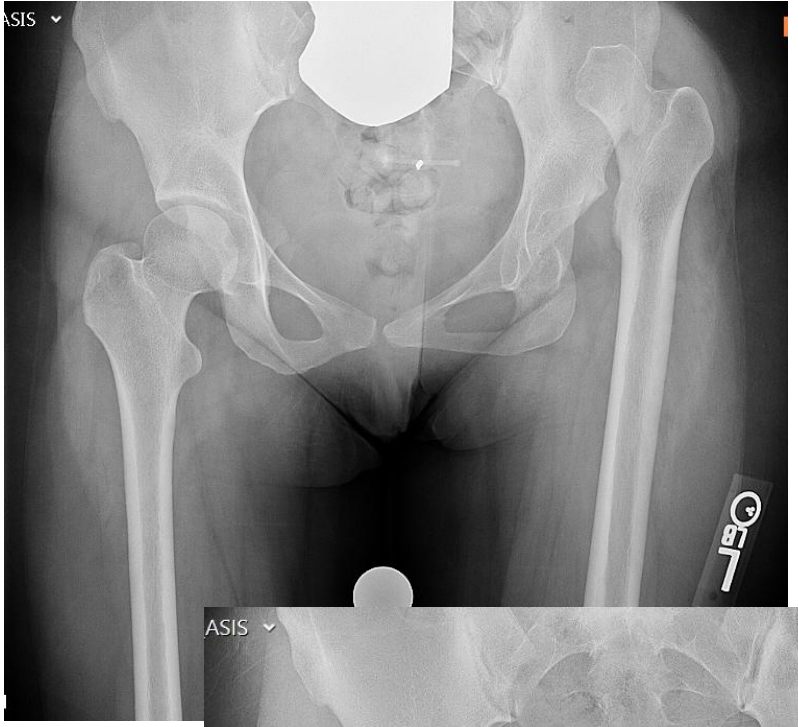
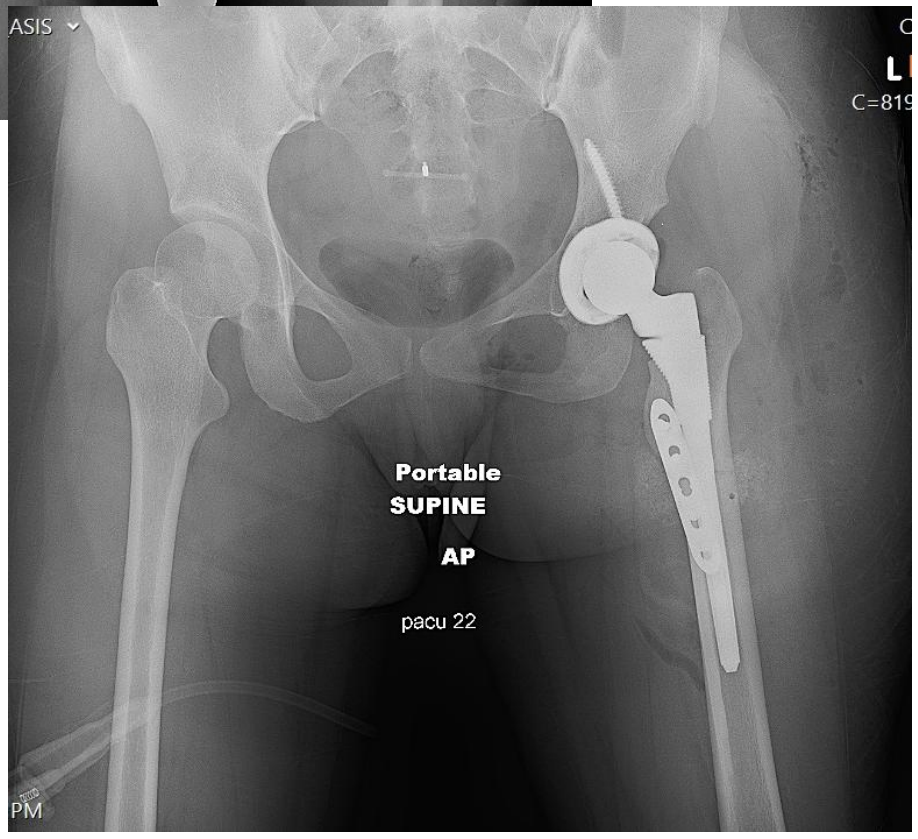
3 Volumes

1. Pediatric Deformity
2. Trauma
   Foot and Ankle
3. Adult Reconstruction
   Tumor
   Upper Extremity



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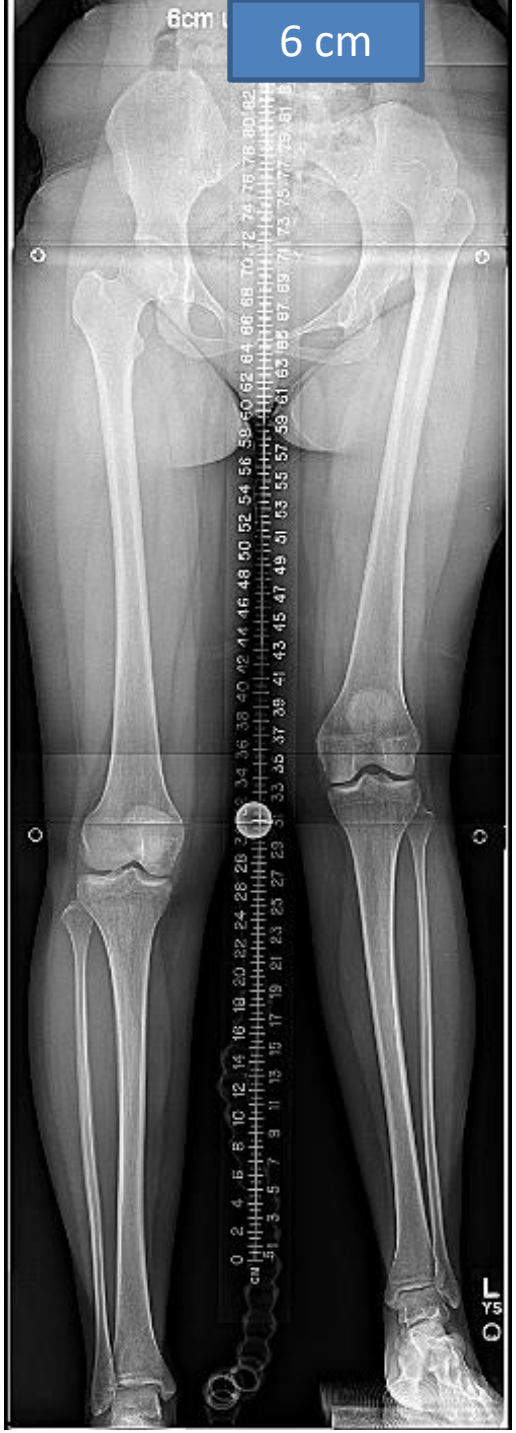
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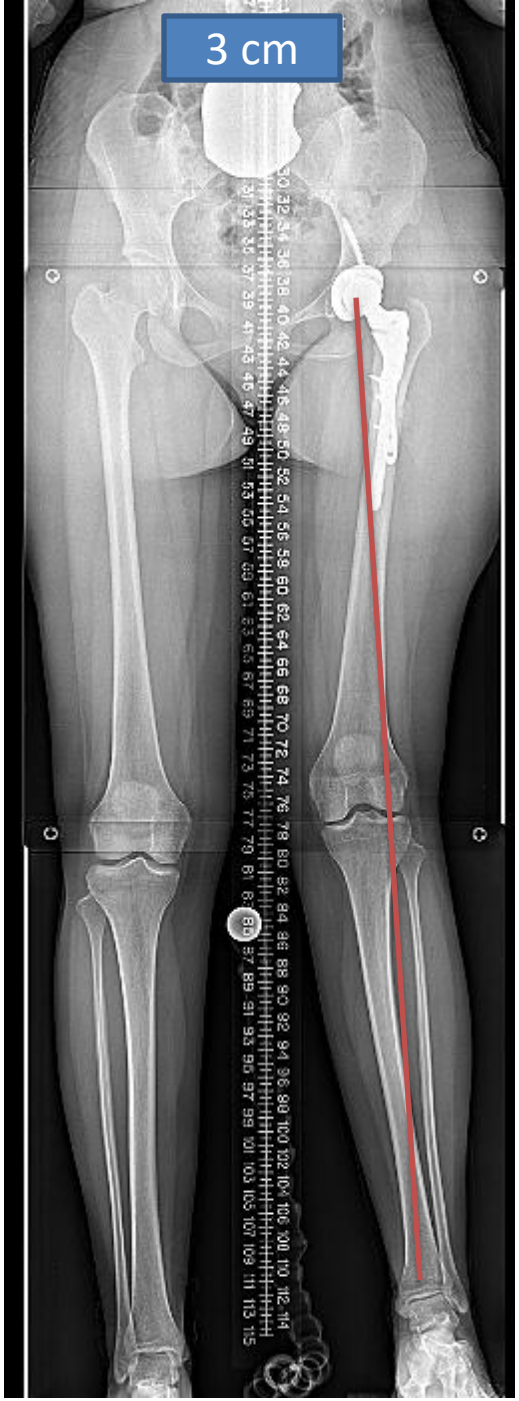
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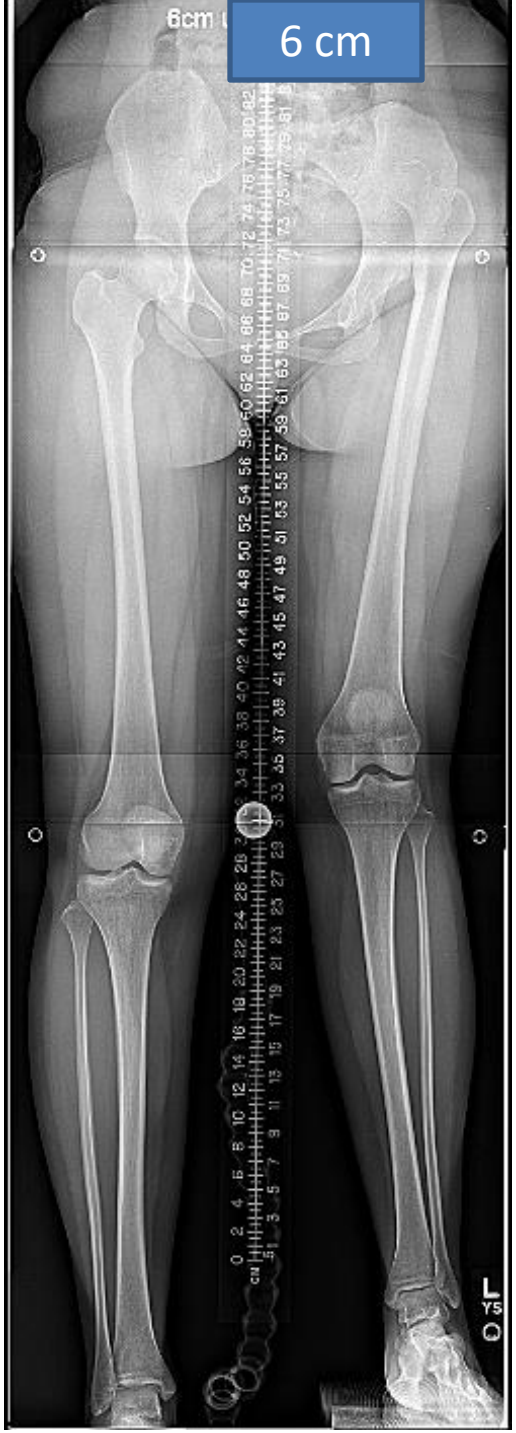
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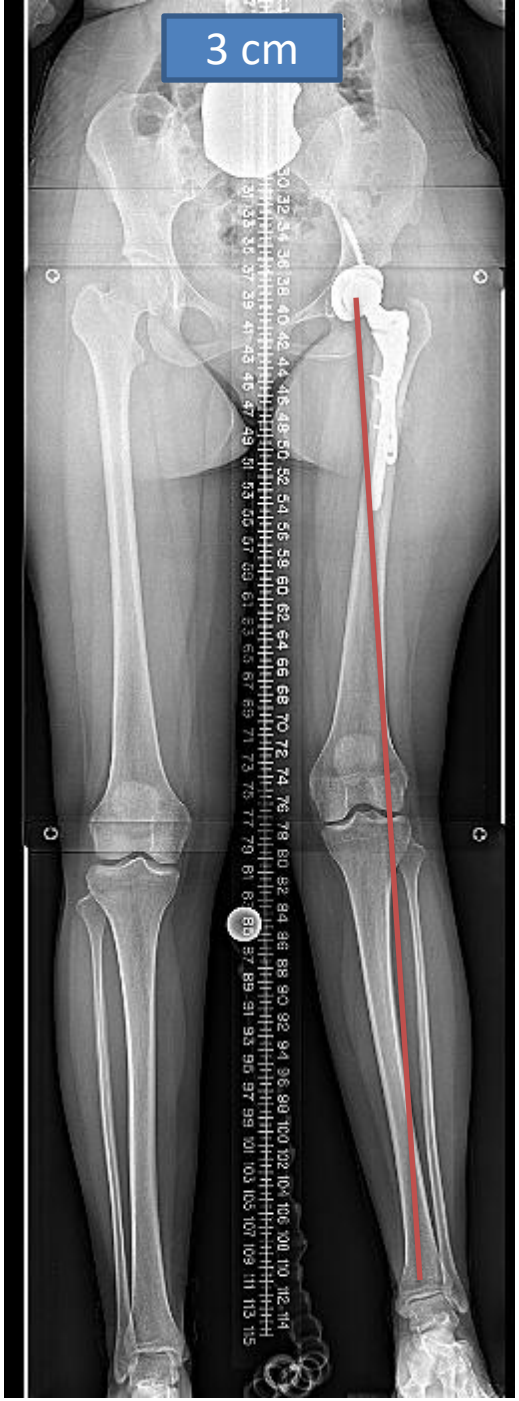
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Humerus Lengthening With the PRECICE Internal Lengthening Nail

Anton M. Kurtz, MD a*

Background: Deformity and growth arrest of the humerus i children may result as sequelae of proximal humerus fractures an unicameral bone cysts, or as complications of their treatment. A approximately 80% of the growth of the humerus arises from th proximal physis, the resultant upper limb-length discrepancy ca be substantial. Benefits to lengthening the shortened arm hav been previously demonstrated with the use of external fixatio devices. To our knowledge, no reports have been published on th use of intramedullary implants for this purpose.

Methods: A 15-year-old girl with humeral shortening secondar to proximal humeral growth disturbance following treatment fo a unicameral bone cyst was treated with humeral osteoplast and gradual lengthening with an off-label use of a fully im plantable motorized intramedullary lengthening nail. A varu proximal humeral deformity and lateral starting point allowe for avoidance of the rotator cuff insertion.

Results: Humeral lengthening (5 cm) was achieved at 9 weeks with bony union at 7 months, and hardware removal at 9½ months. Shoulder and elbow motion was maintained during an after treatment.

Conclusions: This is the first case report of humeral lengthenin using a fully implantable motorized intramedullary lengthenin nail. Although some technical limitations remain when com pared with other methods, the procedure was well tolerate throughout the course of treatment.

Level of Evidence: Level IV—case report.

Key Words: growth arrest, humerus, lengthening, intra medullary, PRECICE

(*J Pediatr Orthop* 2017;37:e296–e300)

Deformity and growth arrest of the humerus in chil dren may result as sequelae of proximal humeru fractures and unicameral bone cysts, or as complication

From *MaineOrtho, Portland, ME; and †The Limb Lengthening an Complex Reconstruction Service, Department of Orthopedic Sur gery, Hospital for Special Surgery, Weill Medical College of Cornel University, New York, NY.

A.M.K. and S.R.R: conception and design of the study and approval o the manuscript. A.M.K.: drafting the manuscript: S.R.R.: revisin the manuscript.

Neither author received financial support for this study.

S.R.R. serves as a paid consultant for Nuvasive. A.M.K. declares n conflicts of interest.

Reprints: Anton M. Kurtz, MD, MaineOrtho, 1601 Congress Street Portland, ME 04102. E-mail: akurtz@maineortho.com.

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HSSJ (2017) 13:217–223
DOI 10.1007/s11420-017-9552-x

HSS Journal®
The Musculoskeletal Journal of Hospital for Special Surgery

ORIGINAL ARTICLE

Humeral Lengthening with the PRECICE Magnetic Lengthening Nail

Ahmed I. Hammouda, MD · Shawn C. Standard, MD · S. Robert Rozbruch, MD · John E. Herzenberg, MD

Received: 1 September 2016/Accepted: 3 March 2017/Published online: 21 April 2017

Abstract *Background:* Different types of external fixators have been used for humeral lengthening with successful outcomes reported in literature. Motorized intramedullary (IM) lengthening nails have been developed as an alternative to external fixators for long bone lengthening in the lower extremity. *Questions/Purposes:* This case series reports on using the new technology of IM lengthening nails for humeral lengthening. We assessed the radiological healing and functional outcomes after using the PRECICE IM nail for humeral lengthening. *Methods:* This multicenter retrospective study included a total of six humeri in five patients (mean age was 20 years) that underwent lengthening with the magnetic IM PRECICE nail in two centers in the USA. The etiology was humeral growth arrest post-bone cyst (two segments), post-septic growth arrest (two segments), and multiple hereditary exostosis (bilateral segments in one patient). The outcomes measured were the length achieved, distraction index (DI; the length achieved in mm divided by the duration of lengthening in days), consolidation index (CI; number of days from surgery until consolidation divided by the length of the regenerate in cm), complications encountered, and functional outcomes (shoulder and elbow range of motion, the upper extremity functional index (UEFI), and QuickDASH functional scores). *Results:* The mean follow-up period was 1.8 years (0.9 to 2.4 years). All segments achieved the goal of lengthening; the mean was 5.1 cm (4.5 to 5.8 cm). Mean DI was 0.7 mm/day (0.5 to 0.8). Mean CI was 36 days/cm (25 to 45 days/cm). No complications were observed. At the last follow-up, all patients maintained their preoperative range of motion (ROM) except one patient had reduced shoulder ROM. QuickDASH score and upper extremity functional index showed postoperative improvement compared to the preoperative scores. *Conclusion:* IM lengthening nails can provide successful and safe humeral lengthening. Specifically, the PRECICE nail has accurate control over the lengthening process.

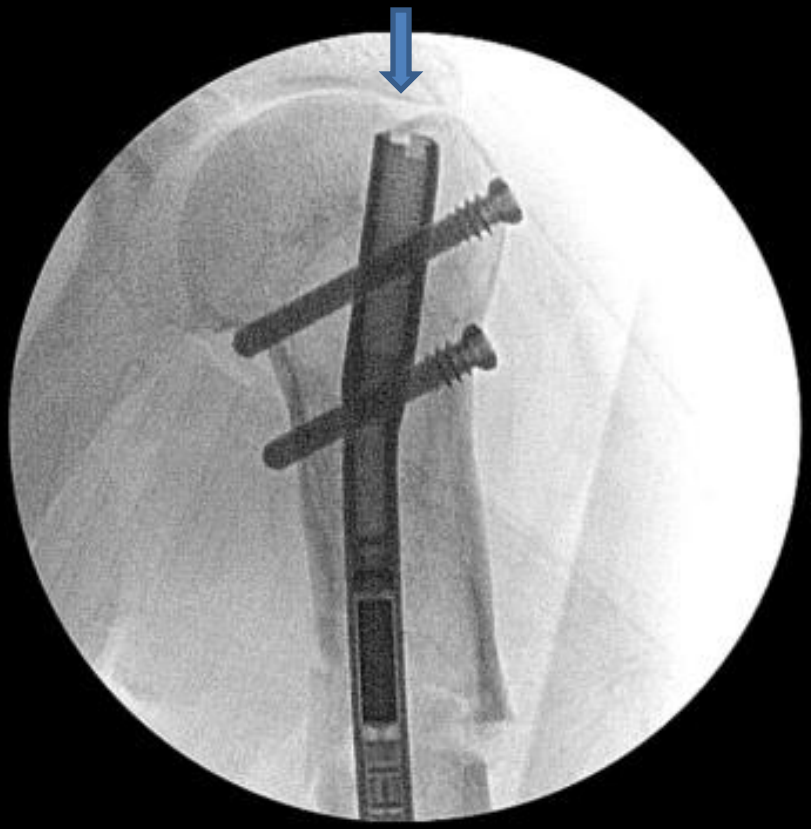
Keywords humerus · intramedullary · lengthening · PRECICE nail

Level of Evidence: Level IV

Study performed at Sinai Hospital of Baltimore, Baltimore, MD, USA, and Hospital for Special Surgery, New York, NY, USA.

Electronic supplementary material The online version of this article (doi:10.1007/s11420-017-9552-x) contains supplementary material, which is available to authorized users.

Preop, etiology bone cyst



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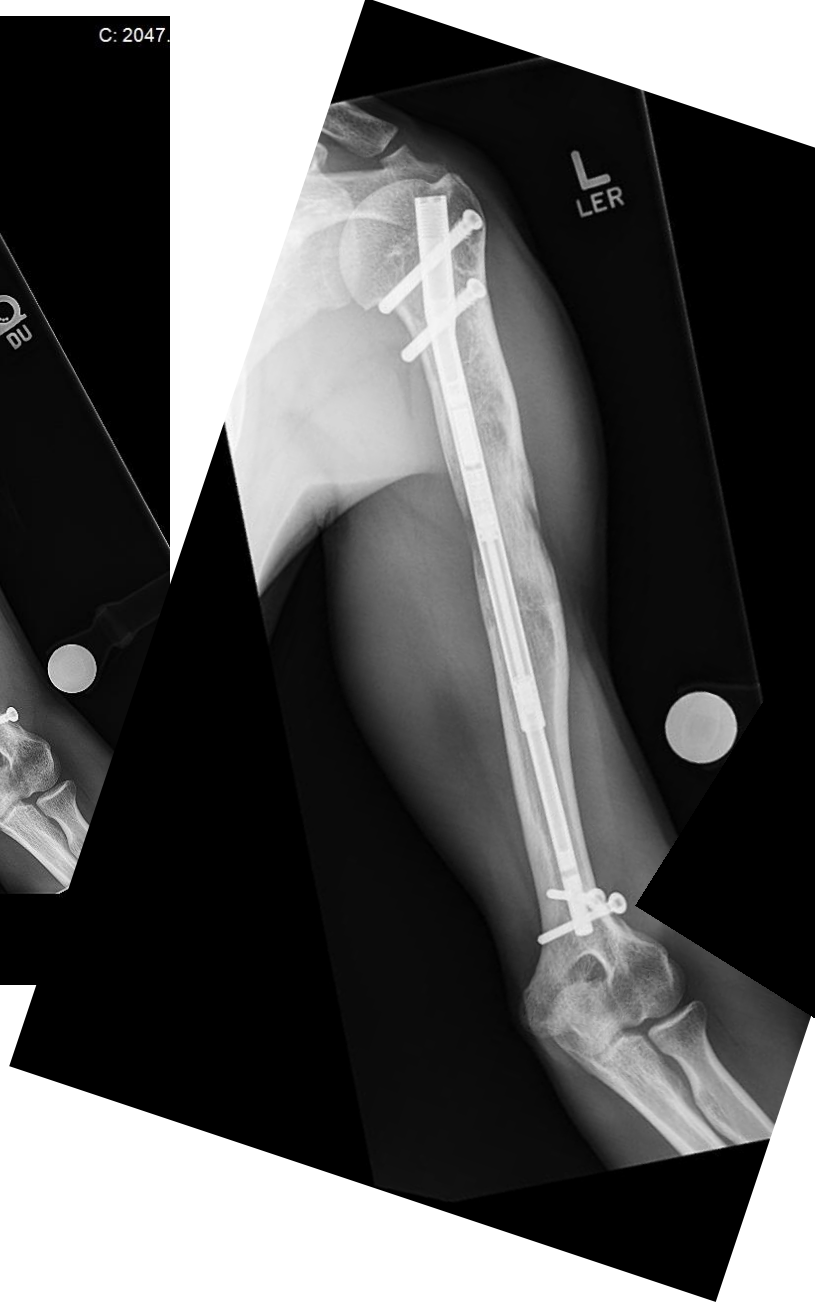
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preop


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Review Article

Ankle Distraction Arthroplasty: Indications, Technique, and Outcomes

Mitchell Bernstein, MD, FRCSC
Jay Reidler, MD, MPH
Austin Fragomen, MD
S. Robert Rozbruch, MD

Abstract

Ankle distraction is an alternative to ankle arthrodesis or total ankle arthroplasty in younger patients with arthritis. Ankle distraction involves the use of external fixation to mechanically unload the ankle joint, which allows for stable, congruent range of motion in the setting of decreased mechanical loading, potentially promoting cartilage repair. Adjunct surgical procedures are frequently done to address lower-extremity malalignment, ankle equinus contractures, and impinging tibiotalar osteophytes. Patients can bear full weight during the treatment course. The distraction frame frequently uses a hinge, and patients are encouraged to do daily range-of-motion exercises. Although the initial goal of the procedure is to delay arthrodesis, many patients achieve lasting clinical benefits, obviating the need for total ankle arthroplasty or fusion. Complications associated with external fixation are common, and patients should be counseled that clinical improvements occur slowly and often are not achieved until at least 1 year after frame removal.

From the Department of Orthopaedic Surgery, Loyola University Chicago Stritch School of Medicine, Chicago, IL (Dr. Bernstein), the Department of Orthopaedics, Johns Hopkins University, Baltimore, MD (Dr. Reidler), and the Department of Orthopaedic Surgery, Hospital for Special Surgery, Cornell University, New York, NY (Dr. Fragomen and Dr. Rozbruch).

J Am Acad Orthop Surg 2016;0:1-11

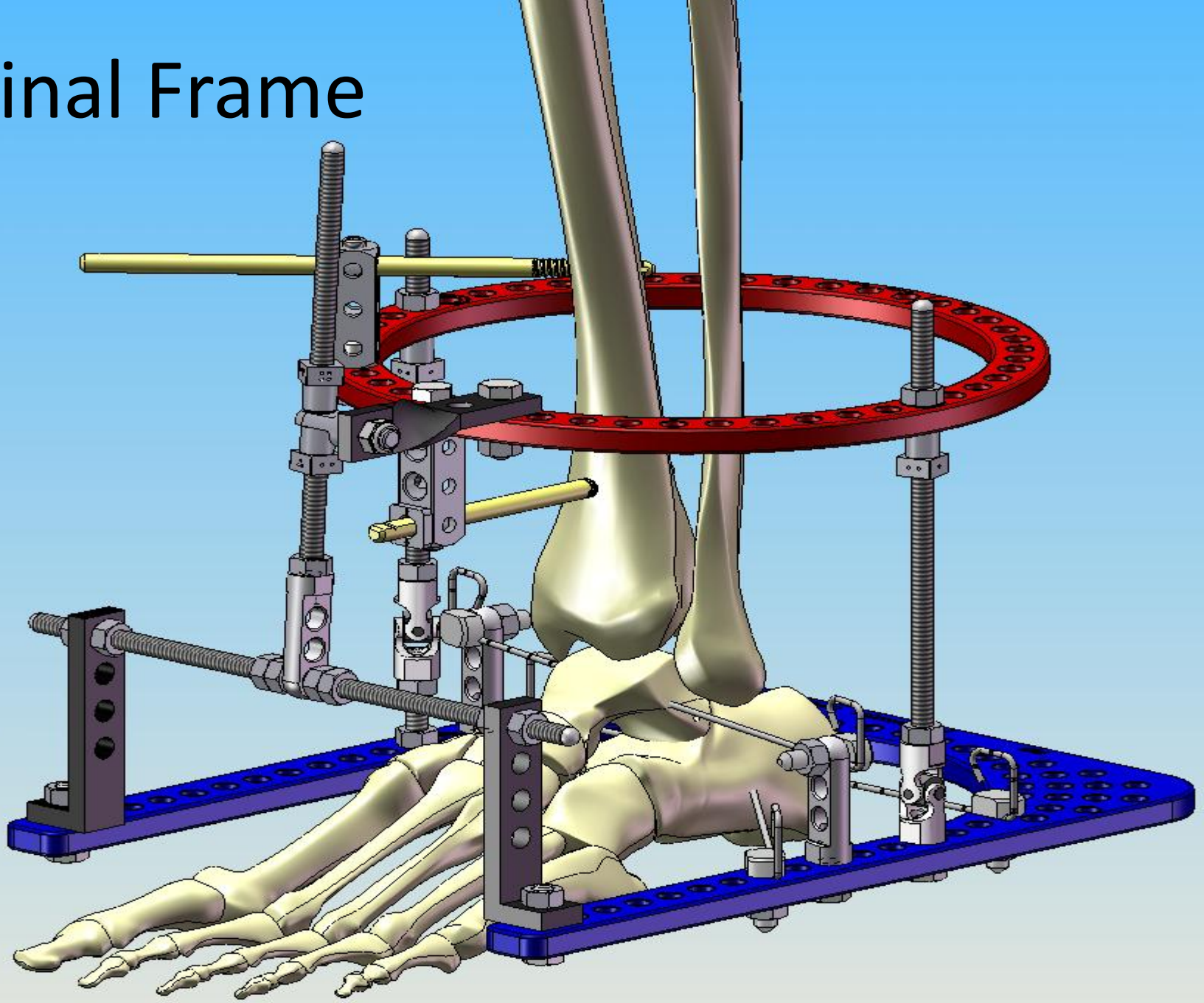
DOI: 10.5435/JAAOS-D-14-00077

Ankle osteoarthritis is generally a progressive condition, most commonly the result of high-energy tibial plafond fractures, bimalleolar ankle fractures, recurrent ankle instability, and neuropathy.[1-3] Lower-extremity posttraumatic arthritis has an estimated cost of $12 billion annually in the United States.[4] It is often disabling, predominantly affects young, active persons, and has a negative effect on quality-of-life measures that is comparable to that of hip and knee arthritis.[1] The mainstay of surgical treatment of advanced ankle arthritis has traditionally included ankle arthrodesis or total ankle arthroplasty (TAA).

Ankle arthrodesis reliably provides pain relief. However, loss of ankle motion, increased stress at adjacent joints that leads to degeneration, and increased energy expenditure with ambulation do occur.[5] Unlike fusion, TAA does not affect range of motion (ROM); however, its use in young active patients may be contraindicated because of wear, failure, and subsequent revisions.[6]

In contrast to the aims of TAA and ankle fusion, the aim of distraction arthroplasty is to optimize the body's regenerative capacity and the function of the diseased joint.[7,8] An external fixator is used to mechanically unload the ankle to relieve pain, preserve ROM, and potentially delay or even partially reverse the effects of arthritis (Figure 1). The surgeon should be aware of this treatment option, as well as its indications, outcomes, and potential adverse effects for ankle arthritis. Recent short- and intermediate-term evidence suggests that distraction arthroplasty may be a viable surgical

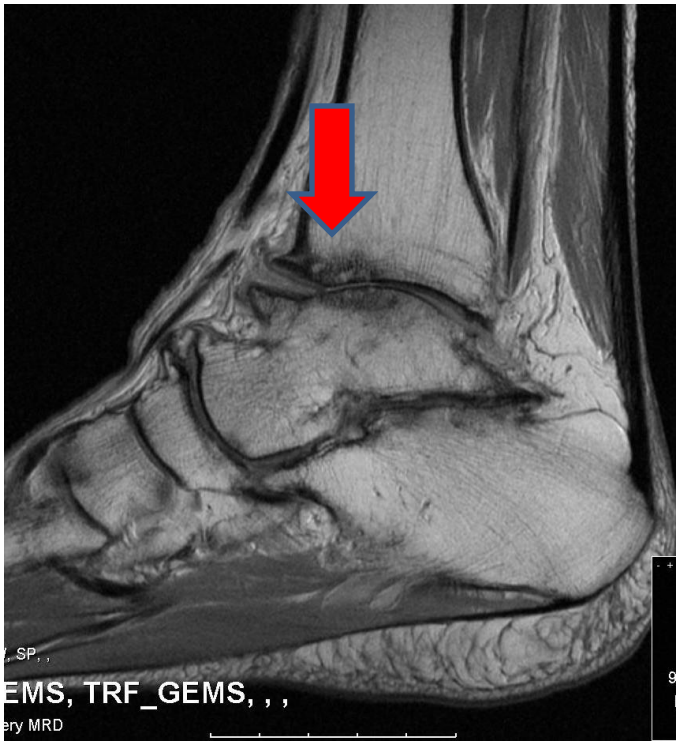
Final Frame



preop

1.3 years later

1. Cartilage Regeneration
2. Subchondral bone Remodeling



Paul preop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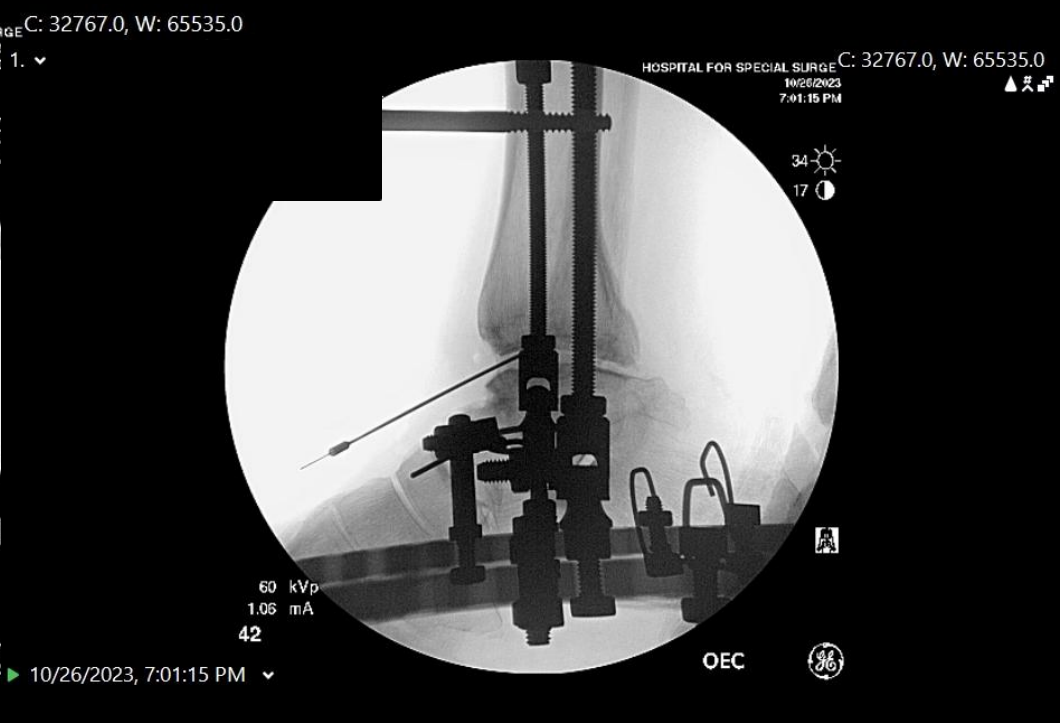
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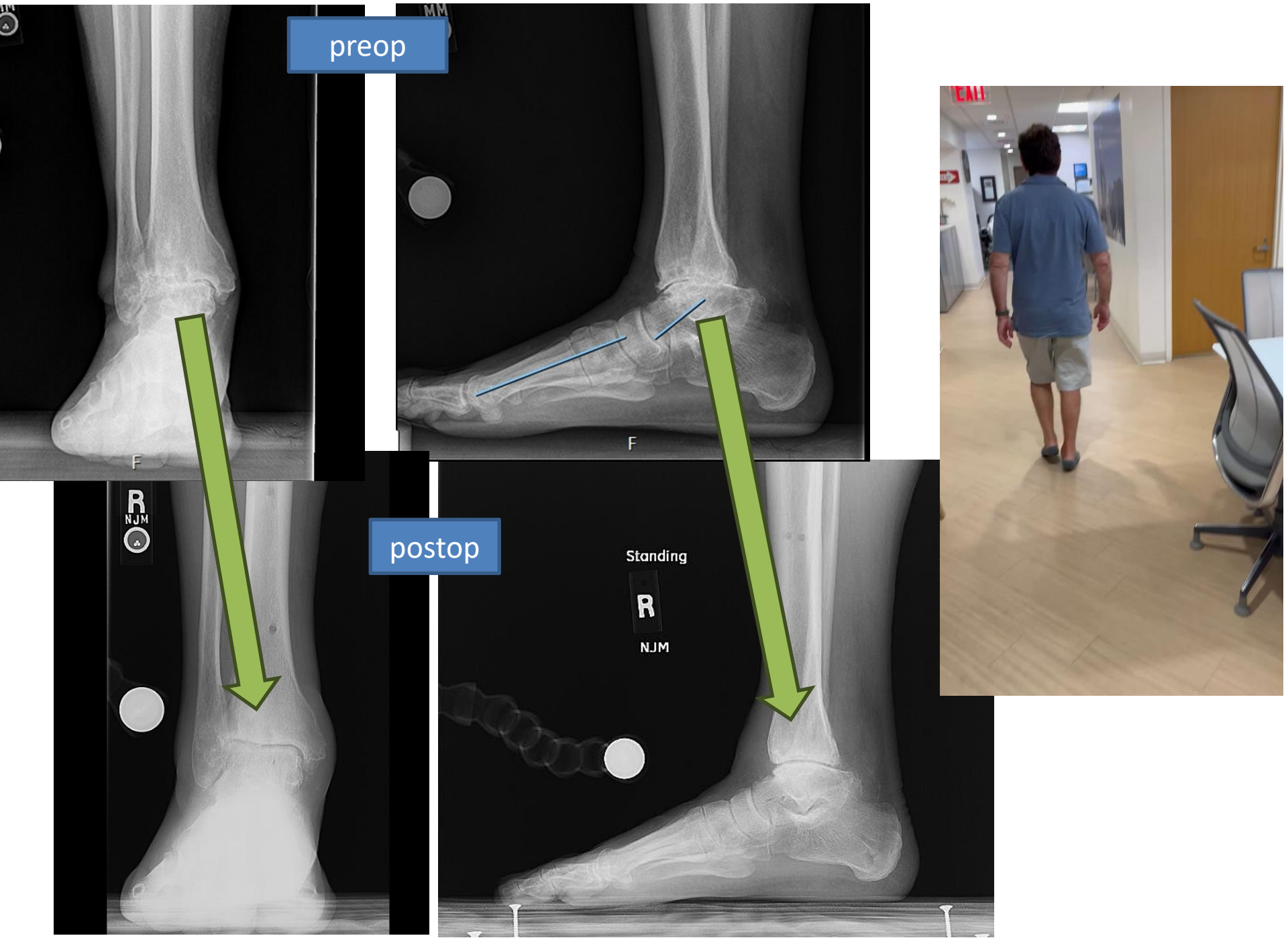
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ORIGINAL ARTICLE

Ankle Distraction Arthroplasty for Ankle Osteoarthritis: A Survival Analysis

Stephen Greenfield[1], Kelsey M Matta[2], Thomas H McCoy[3], S Robert Rozbruch[4], Austin Fragomen[5]

Abstract

Aim: The treatment algorithm for end-stage ankle arthritis is imperfect. Young or active patients are challenging to treat as fusion and replacement carry predictable consequences. Ankle distraction arthroplasty is a less commonly utilized surgical procedure for the treatment of osteoarthritis of the ankle. The purpose of this study was to report intermediate-term survival of ankle distraction and to identify factors associated with earlier time to failure.

Materials and methods: A single-centre, multi-surgeon cohort of 258 cases of ankle arthritis, treated with ankle distraction or ankle distraction with supramalleolar osteotomy (SMO), was identified. Patients were contacted by phone to determine the status of the ankle (natural vs fused/replaced). Data were collected through chart review. This included patient demographics, medical comorbidities, surgical procedure, and X-ray characteristics including pattern and severity. A Cox regression model was used to determine factors associated with failure during 10 years of follow-up. Risk factors were analysed as hazard ratios (HRs) and 95% confidence intervals (CIs). Time to failure was illustrated with Kaplan–Meier (KM) curves.

Results: In total, 144 cases were successfully contacted with median follow-up of 4.57 years. In total, 16.7% of ankles failed (24/144). The 5-year survival was 84% (95% CI: 78–91%). In adjusted Cox regression, female sex (HR = 2.68, $p = 0.049$) and avascular necrosis (AVN) of the talus (HR = 3.77, $p = 0.041$) were significantly associated with failure risk.

Conclusion: Avascular necrosis of the talus and male/female gender differences in survival were found to be significant. Our experience shows that ankle distraction is a valid and effective operation for the treatment of end-stage ankle arthritis.

Clinical significance: This work is clinically significant in that it demonstrates excellent intermediate-term survival data for hinged ankle distraction for treatment of osteoarthritis of the ankle. Additionally, it evaluated patient and disease characteristics allowing improved patient counselling with regard to survival longevity.

Level of evidence: IV cohort study.

Keywords: Ankle arthritis, Ankle distraction arthroplasty, Arthrodiastasis, Avascular necrosis, External fixation.

Strategies in Trauma and Limb Reconstruction (2019): 10.5005/jp-journals-10080-1429

Introduction

Ankle osteoarthritis is a debilitating condition often due to chronic instability or periarticular trauma affecting a wide age range. Treatment options for ankle arthritis are expanding. Ankle replacement has joined the historic gold standard of fusion as an accepted treatment option for some patients. As the natural history of long-term fusions[1] and subsequent challenges[2] has become increasingly evident, improvements in technology and surgeon comfort have increased making ankle replacement gain popularity. However, the latest generation of bone sparing ankle replacements, being championed for younger patients, is less than 5 years old with

[1]Department of Orthopaedic Surgery, Foot and Ankle and Limb Deformity and Reconstructive Surgery, OrthoIndy Hospital, Indianapolis, Indiana, USA

[2]Department of Orthopaedic Surgery, Geisinger Commonwealth School of Medicine, Scranton, Pennsylvania, USA

[3]Department of Orthopaedic Surgery, Harvard Medical School, Center for Quantitative Health, Massachusetts General Hospital and Harvard Medical School, Boston, Massachusetts, USA

[4,5]Department of Orthopaedic Surgery, The Hospital for Special Surgery, Weill Medical College of Cornell University, New York, USA

Figs 2A to D: Preoperative and 2-year postoperative X-rays: (A) Preoperative mortise X-ray categorized as "neutral" grade II; (B) Preoperative lateral X-ray categorized as "concentric" grade II; (C) Two-year postoperative mortise X-ray; (D) Two-year postoperative lateral X-ray. There is a modest increase in joint space noted on the postoperative images

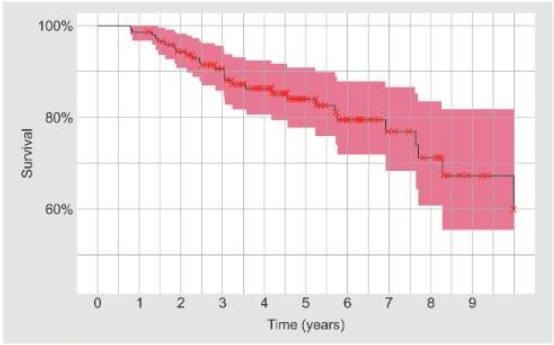
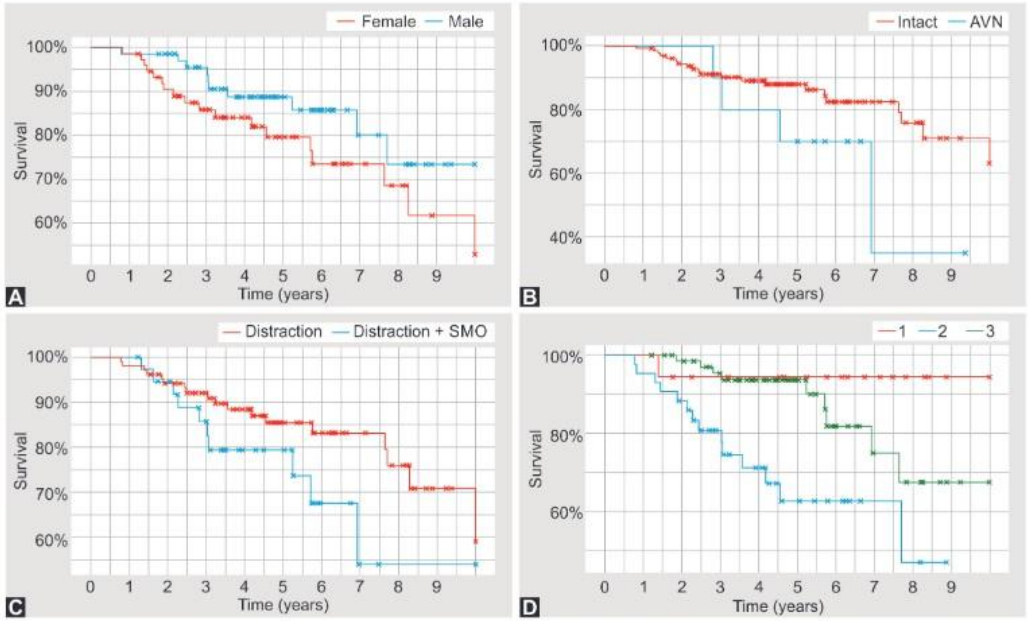


Fig. 3: Kaplan–Meier survival curve censored to 10 years

80% at 7 years

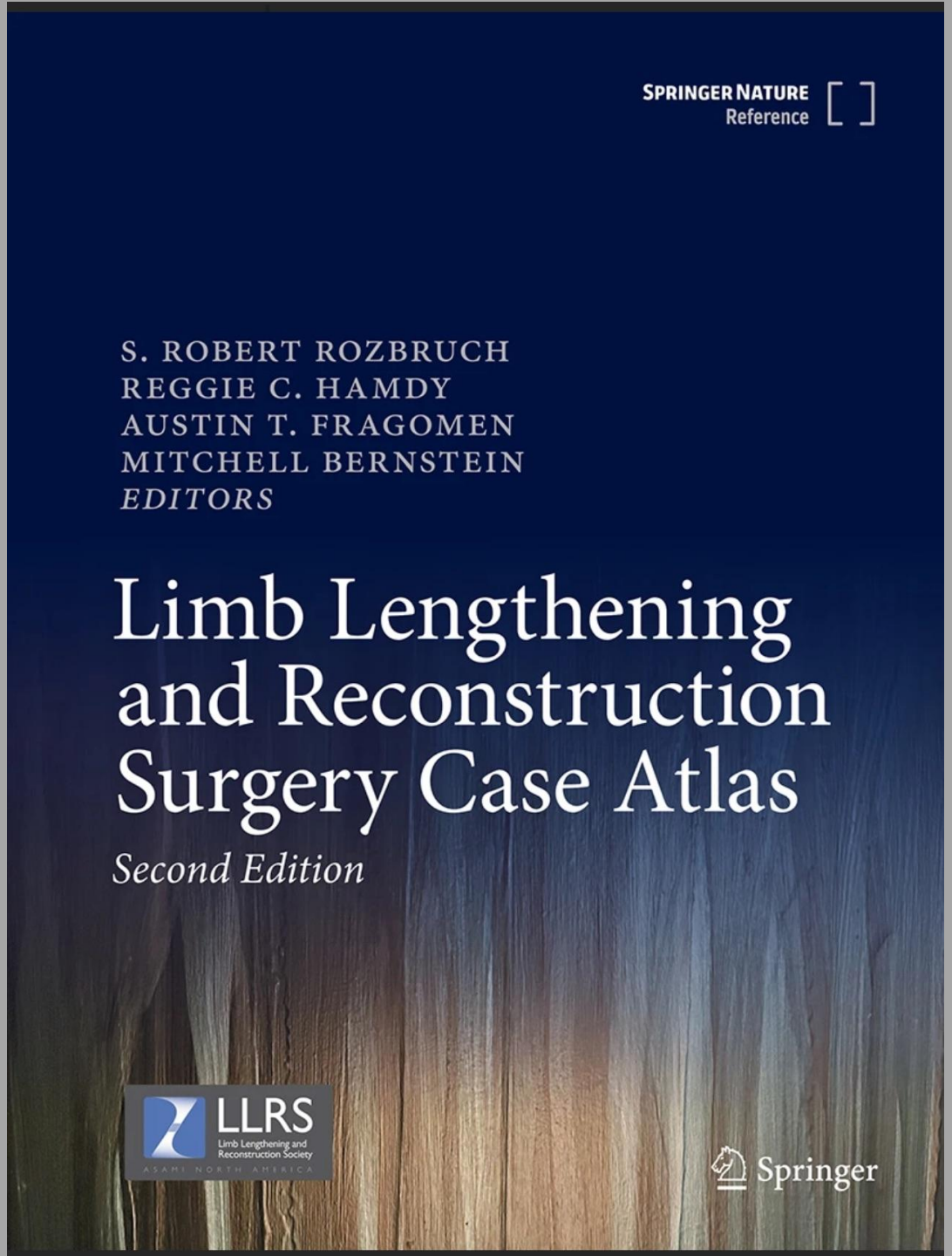


Figs 4A to D: Kaplan–Meier curve of 10-year ankle survival stratified by (A) Sex ($p = 0.049$); (B) Radiographic AVN status ($p = 0.041$); (C) Deformity requiring SMO ($p = 0.054$); (D) Maximum arthritis severity on X-ray ($p = 0.085$)

2025

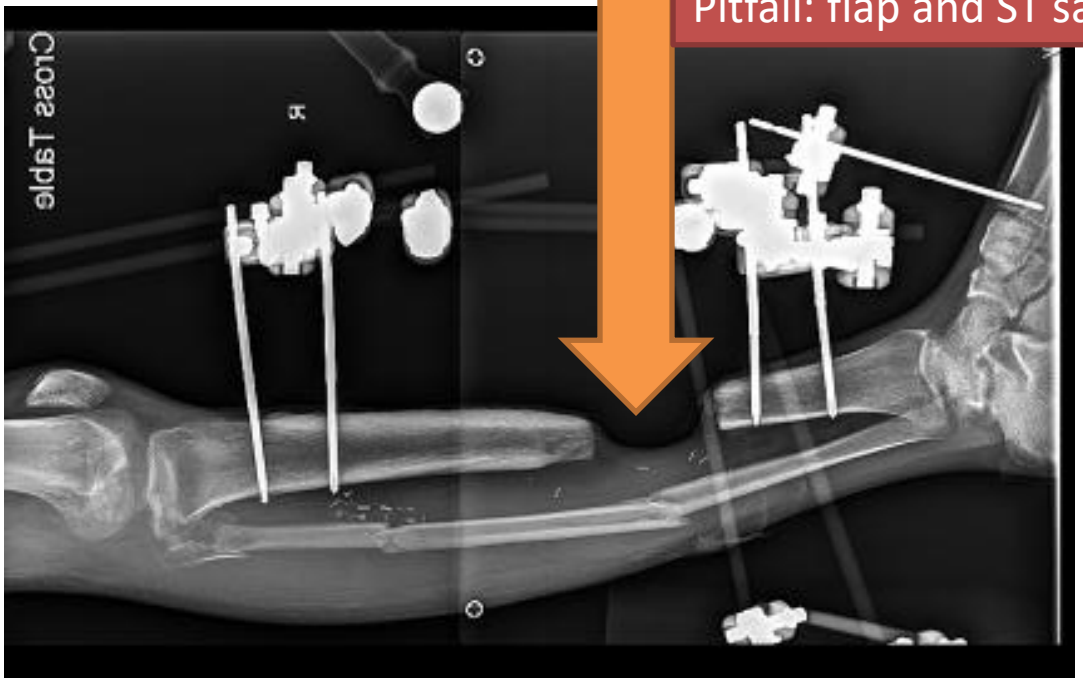
3 Volumes

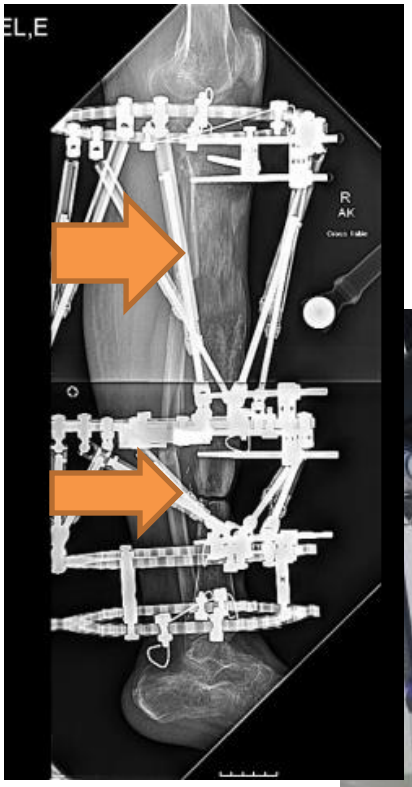
1. Pediatric Deformity
2. Trauma
   Foot and Ankle
3. Adult Reconstruction
   Tumor
   Upper Extremity



Traumatic bone defect

Pitfall: flap and ST sagging into defect

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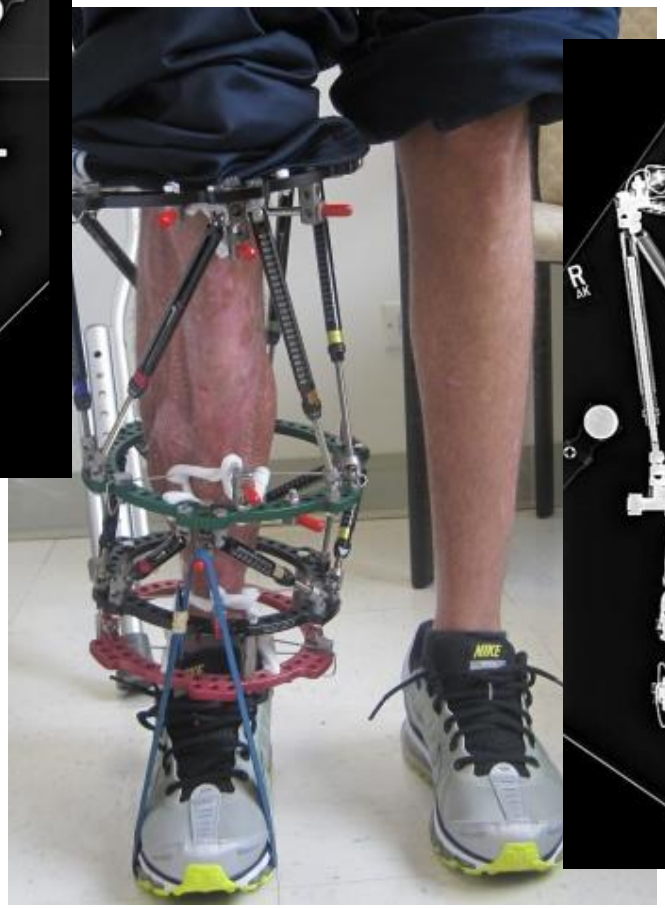
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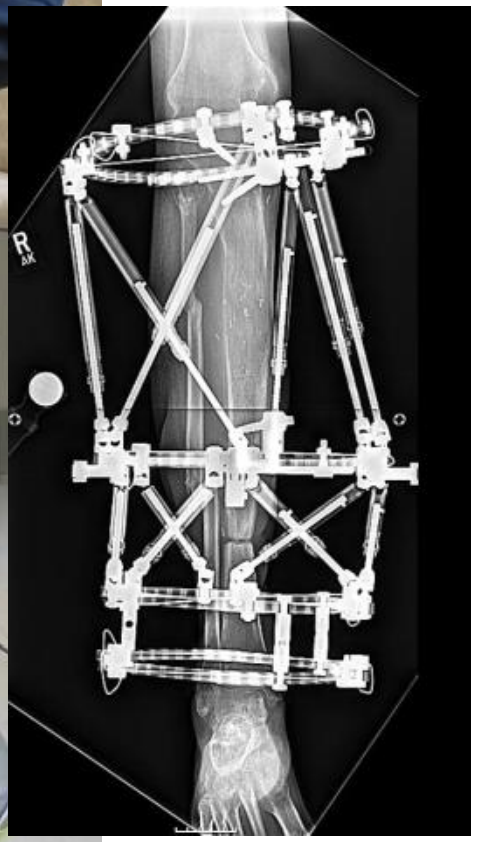
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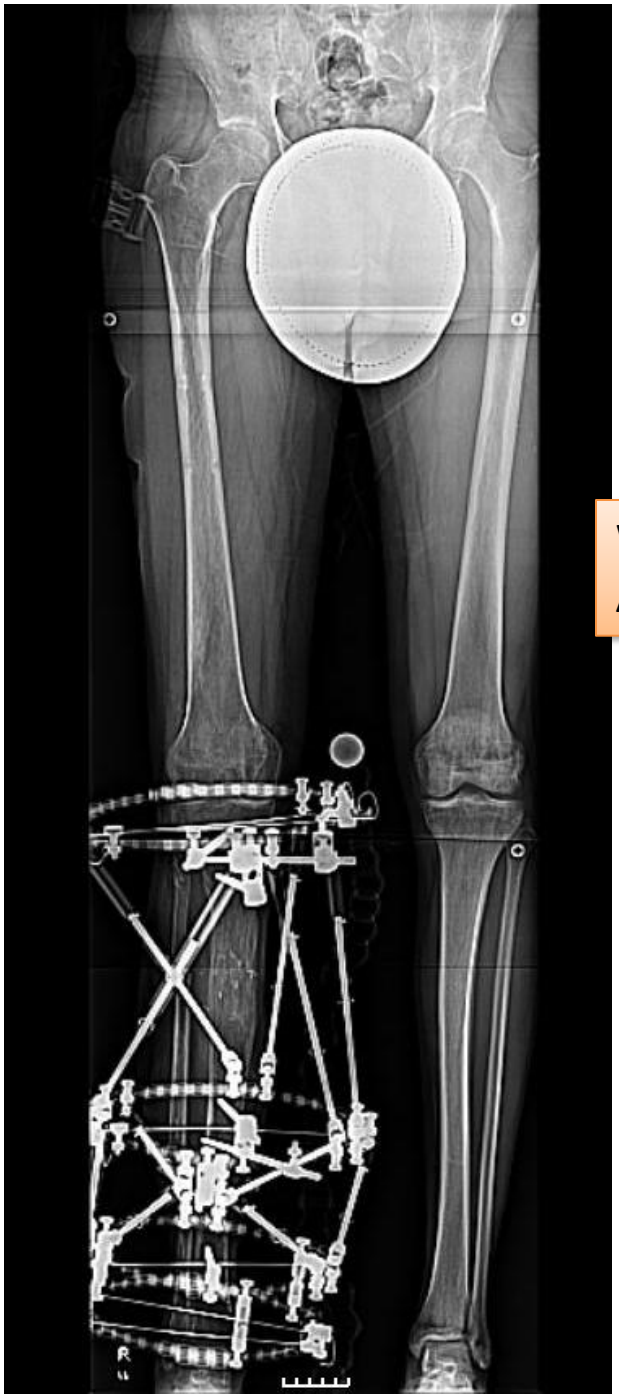

Well aligned
And with equal leg lengths


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Clin Orthop Relat Res
DOI 10.1007/s11999-015-4326-6

Clinical Orthopaedics and Related Research®
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SYMPOSIUM: 2014 ANNUAL MEETING OF THE LIMB LENGTHENING AND RECONSTRUCTION SOCIETY

Does Integrated Fixation Provide Benefit in the Reconstruction of Posttraumatic Tibial Bone Defects?

Mitchell Bernstein MD, Austin T. Fragomen MD, Samir Sabharwal BA, Jonathan Barclay BA, S. Robert Rozbruch MD

Abstract

Background Limb salvage in the presence of posttraumatic tibial bone loss can be accomplished using the traditional Ilizarov method of distraction osteogenesis with circular external fixation. Internal fixation placed at the beginning of the consolidation phase, so-called integrated fixation, may allow for earlier removal of the external fixator but introduces concerns about cross-contamination from the additional open procedure and maintenance of bone regenerate stability.

Questions/purposes Among patients deemed eligible for integrated fixation, we sought to determine: (1) Does integrated fixation decrease the time in the external fixator? (2) Is there a difference in the rate of complications between the two groups? (3) Are there differences in functional and radiographic results between integrated fixation and the traditional Ilizarov approach of external fixation alone?

Methods Between January 2006 and December 2012, we treated 58 patients (58 tibiae) with posttraumatic tibial bone loss using the Ilizarov method. Of those, 30 patients (52%) were treated with the "classic technique" (external fixator alone) and 28 (48%) were treated with the "integrated technique" (a combination of an external fixator and plating or insertion of an intramedullary nail). During that period, the general indications for use of the integrated technique were closed physes, no active infection, and a healed soft tissue envelope located at the intended internal fixation site; the remainder of the patients were treated with the classic technique. Followup on 30 (100%) and 28 (100%) patients in the classic and integrated techniques, respectively, was achieved at a minimum of 1 year (mean, 3 years; range, 1–8 years). Adverse events were reported as problems, obstacles, and complications according to the

One of the authors (ATF) lists the following relevant financial activities outside of this work and/or any other relationships or activities that readers could perceive to have influenced, or that give the appearance of potentially influencing, this manuscript: consultant for Smith & Nephew, Inc (Memphis, TN, USA), and Synthes (Paoli, PA, USA) in the amount of less than USD 10,000. One of the authors (SRR) lists the following relevant financial activities outside of this work and/or any other relationships or activities that readers could perceive to have influenced, or that give the appearance of potentially influencing, this manuscript: Smith & Nephew, Inc in the amount of less than USD 10,000.

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

M. Bernstein (✉)
Department of Orthopaedic Surgery & Rehabilitation, Stritch School of Medicine, Loyola University Medical Center, 2160 S First Avenue, Maywood, IL 60153, USA
e-mail: mitchell.bernstein@lumc.edu

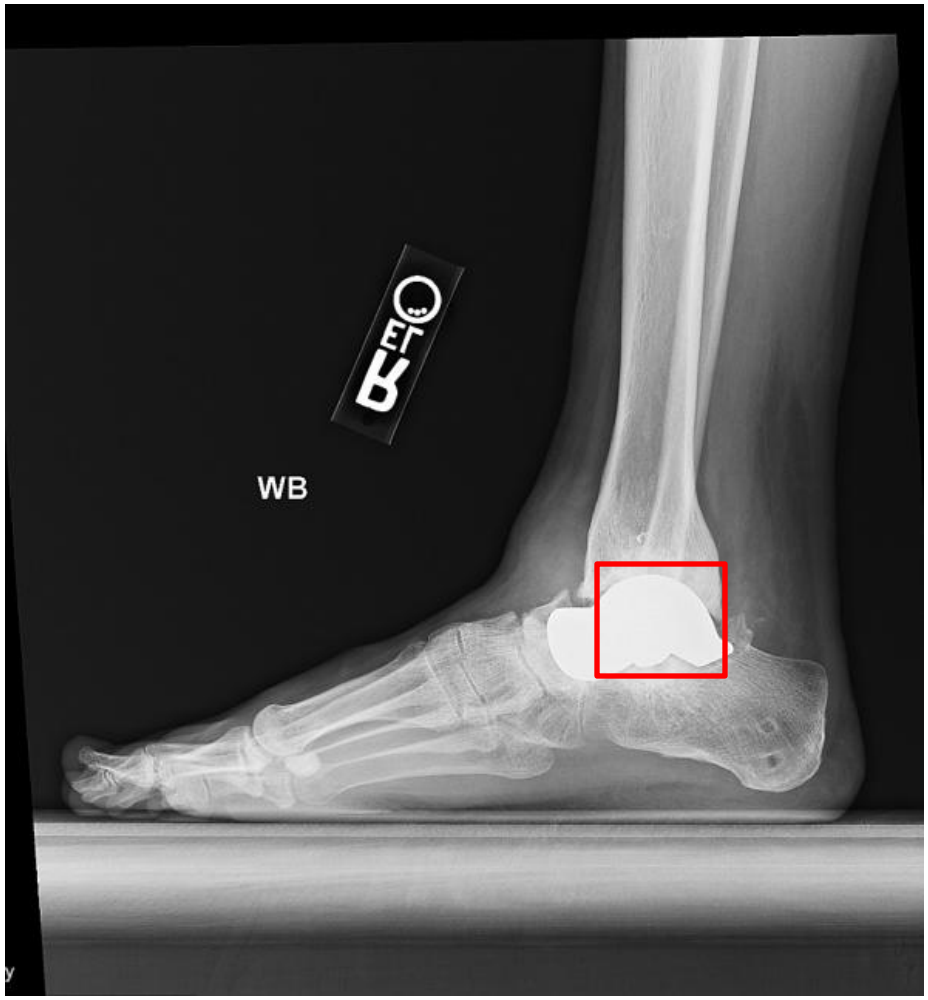
A. T. Fragomen, S. R. Rozbruch
Limb Lengthening and Complex Reconstruction Service, Hospital for Special Surgery, New York, NY, USA

S. Sabharwal
Rutgers–New Jersey Medical School, Newark, NJ, USA

J. Barclay
Cornell Medical College, New York, NY, USA

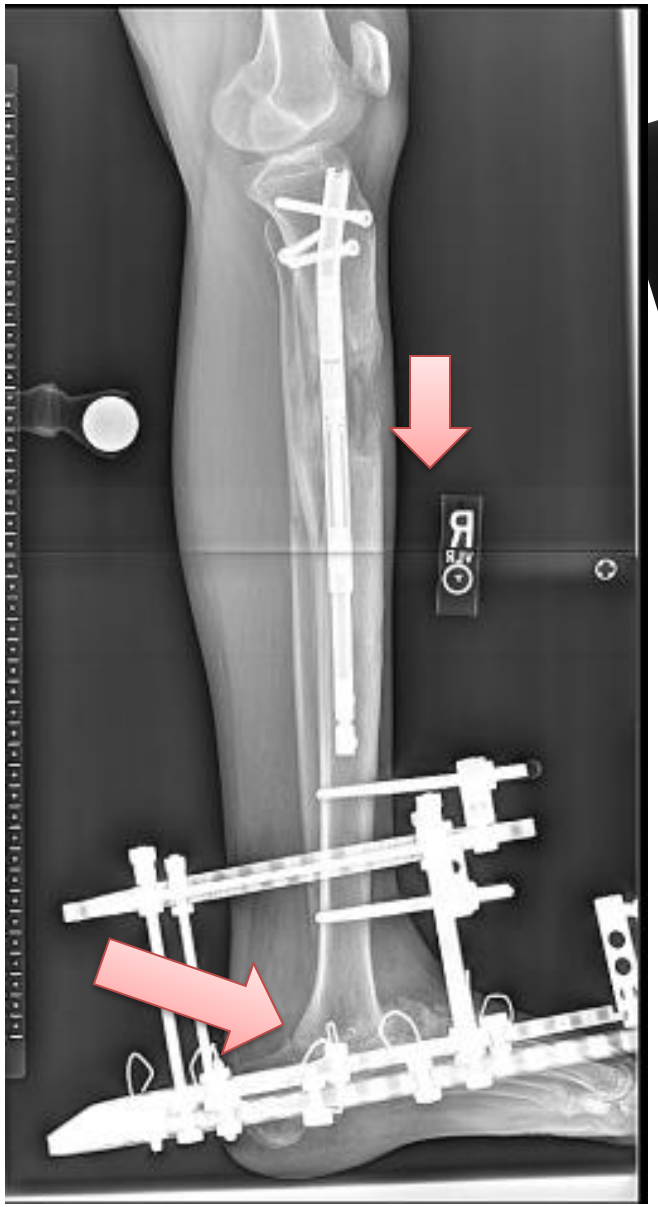
Published online: 05 May 2015

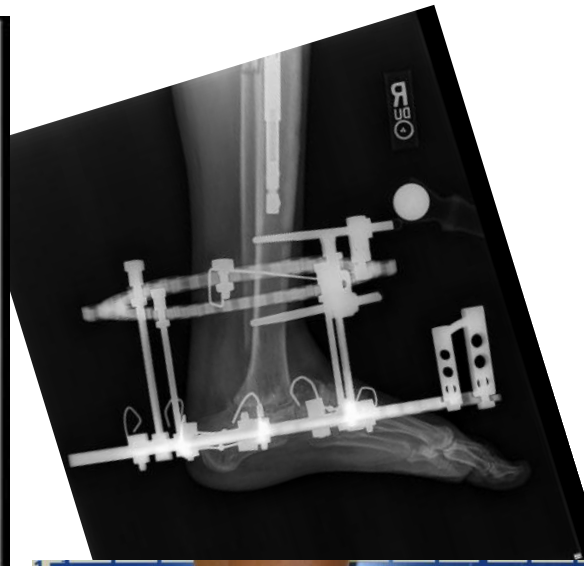
Frame + Lengthening nail



bone LOSS=
12 mm LLD +
38 mm defect

= 50 mm



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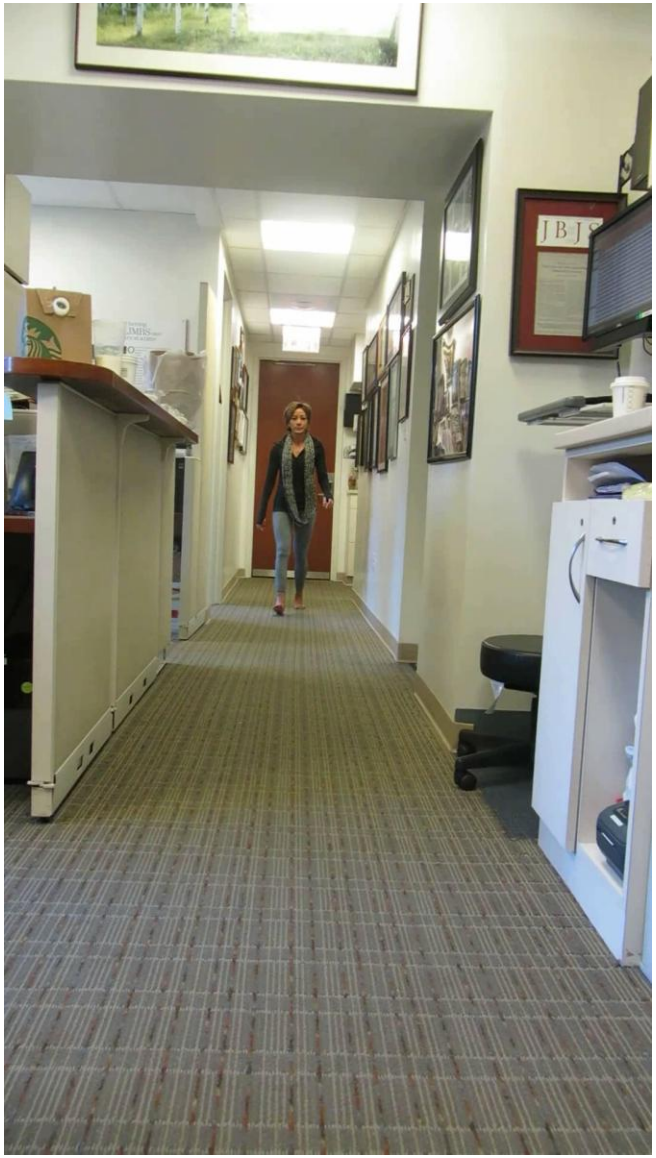
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Research Article

OPEN

Plate-assisted Bone Segment Transport With Motorized Lengthening Nails and Locking Plates: A Technique to Treat Femoral and Tibial Bone Defects

Ulrik Kähler Olesen, MD
Tobias Nygaard, MD
Daniel E. Prince, MD, MPH
Matthew P. Gardner, MD
Upender Martin Singh, MD
Martin A. McNally, MB, BCh, MD, FRCS (Orth)
Connor J. Green, MB, BC, BAO, MSc, MCh, FRCSI
John E. Herzenberg, MD, FRCSC

Correspondence to Dr. Kähler Olesen: ulrik.kaehler@gmail.com

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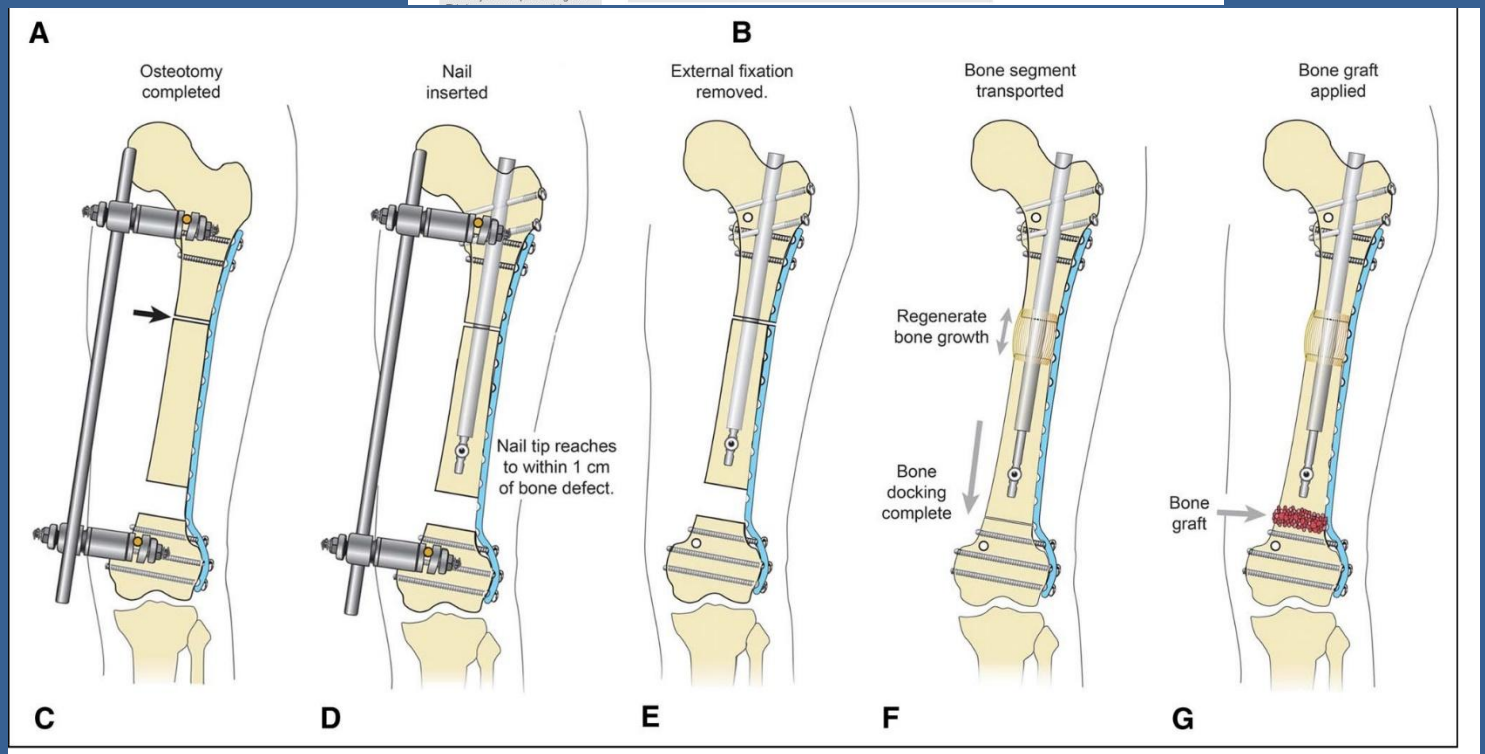
Abstract

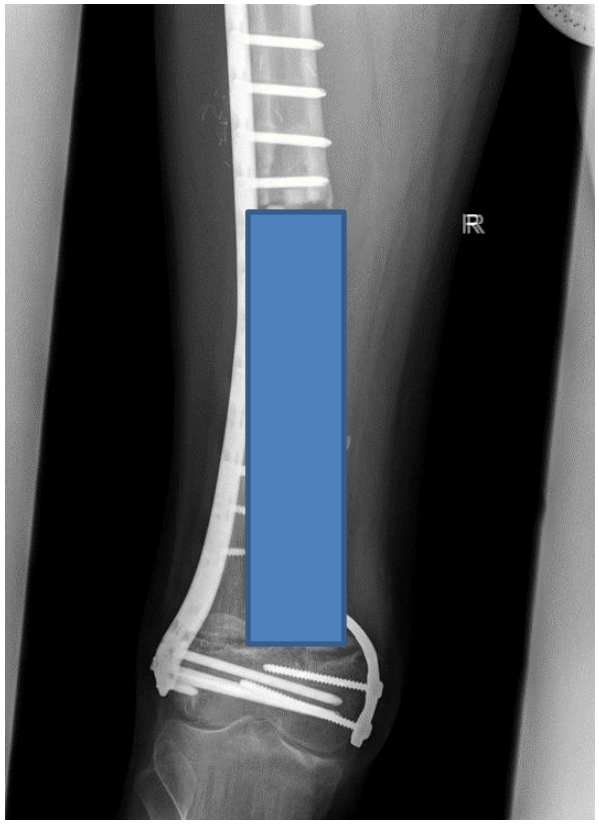
Background: This article describes a new bone transport technique for femoral and tibial bone defects using lengthening nails combined with locking plates. We term it plate-assisted bone segment transport (PABST).

Methods: Nine patients with five femoral and four tibial bone defects from open fractures or malignancies were treated between 2016 and 2018. Mean femoral defect length was 9.3 cm (range 7 to 11.5). Mean tibial defect was 8.9 cm (range 4.8 to 15). The patients were evaluated for time to weight bearing, consolidation index, mechanical axis deviation, and limb length discrepancy.

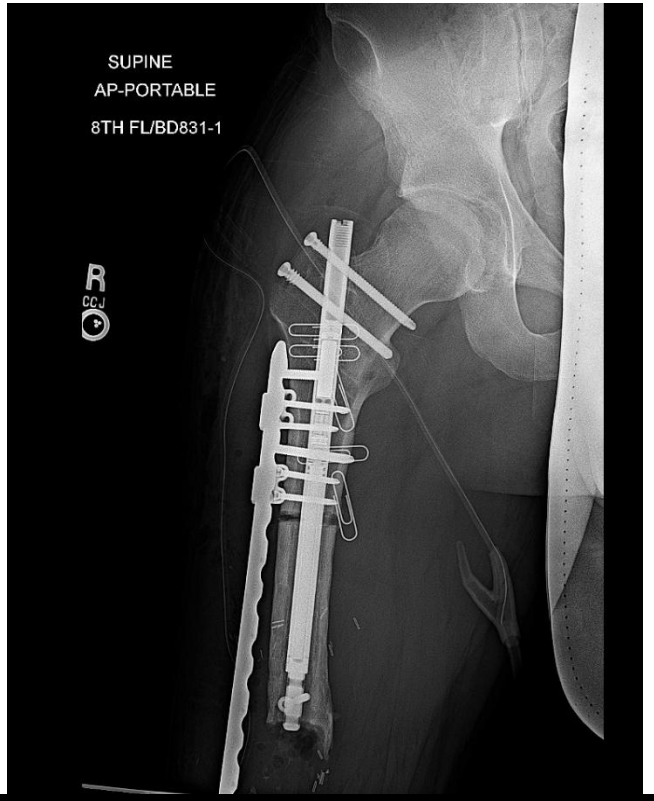
Results: Seven of nine patients have fully consolidated. The mean consolidation time was 6.6 months. The consolidation index was 0.9 (femur) and 1.26 (tibia) mo/cm. Two patients required supplementary lengthening. One patient had mild varus, one mild valgus; the remainder had a normal mechanical axis. Limb length discrepancy remained acceptable in all patients. The main complications were heterotopic ossification, delayed healing, and reduced knee motion.

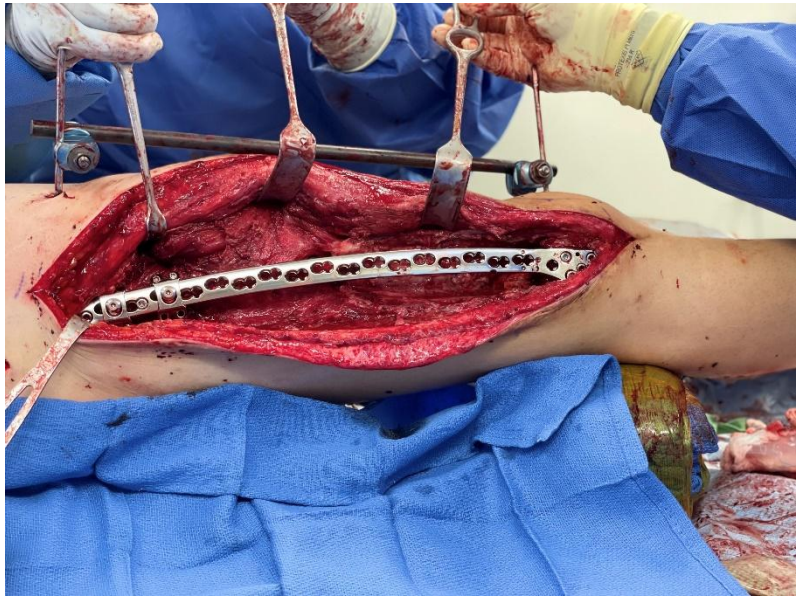
Conclusion: Bone transport with lengthening nails and locking plates is an effective and patient-friendly way of treating bone defects, eliminating the adverse effects of external fixation and reducing treatment time. The plate provides stability during transport and docking; it can address concomitant fractures and facilitates acute shortenings.





16 cm
PABST


SUPINE
AP-PORTABLE
8TH FL/BD831-1
R
CCJ




1.
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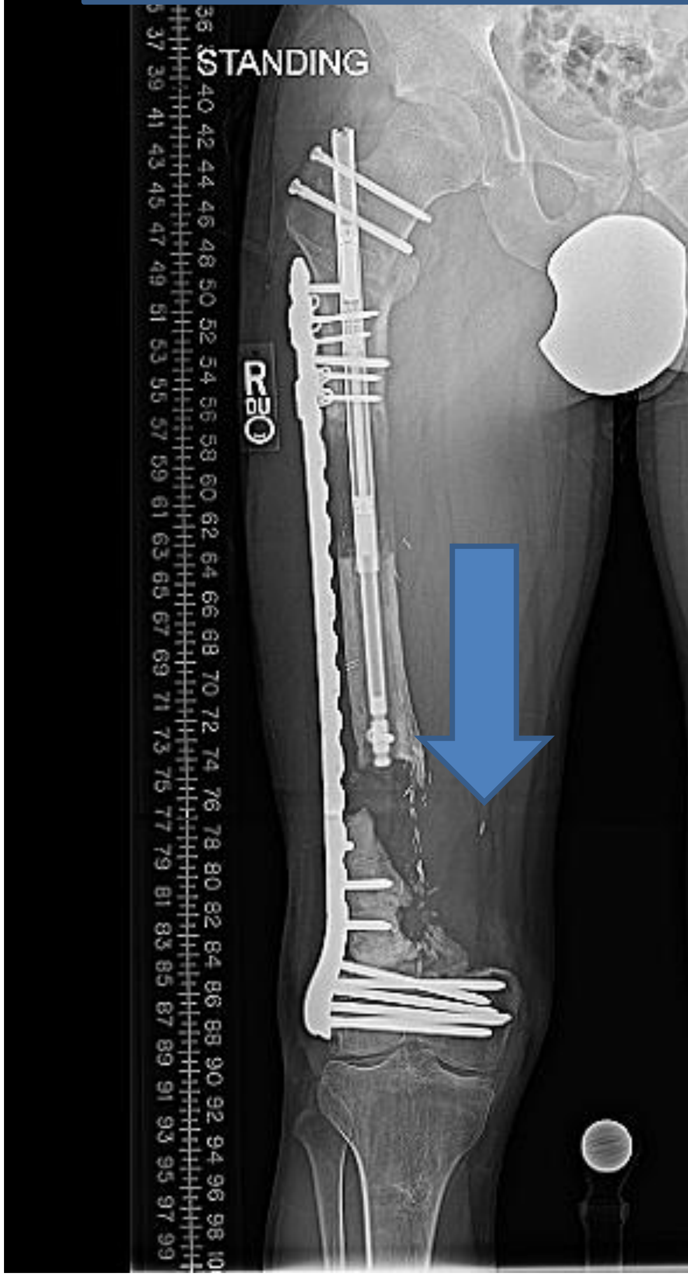
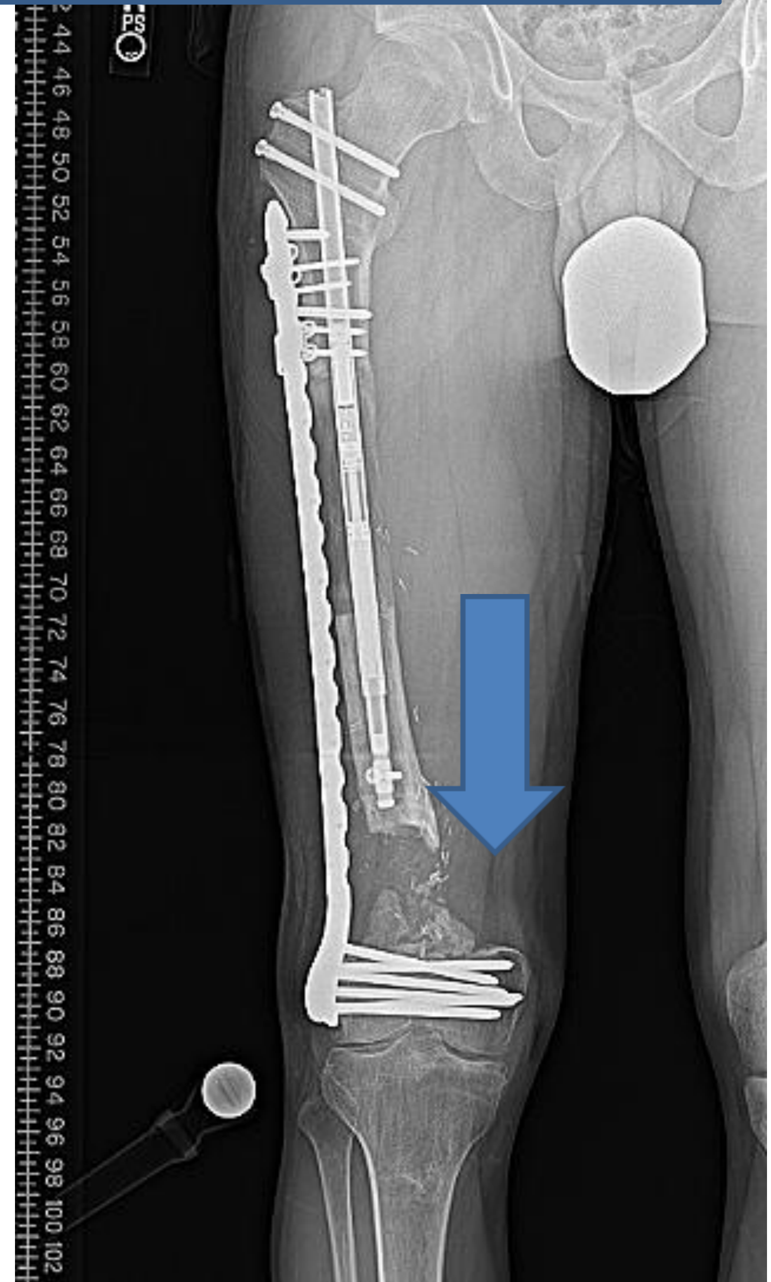
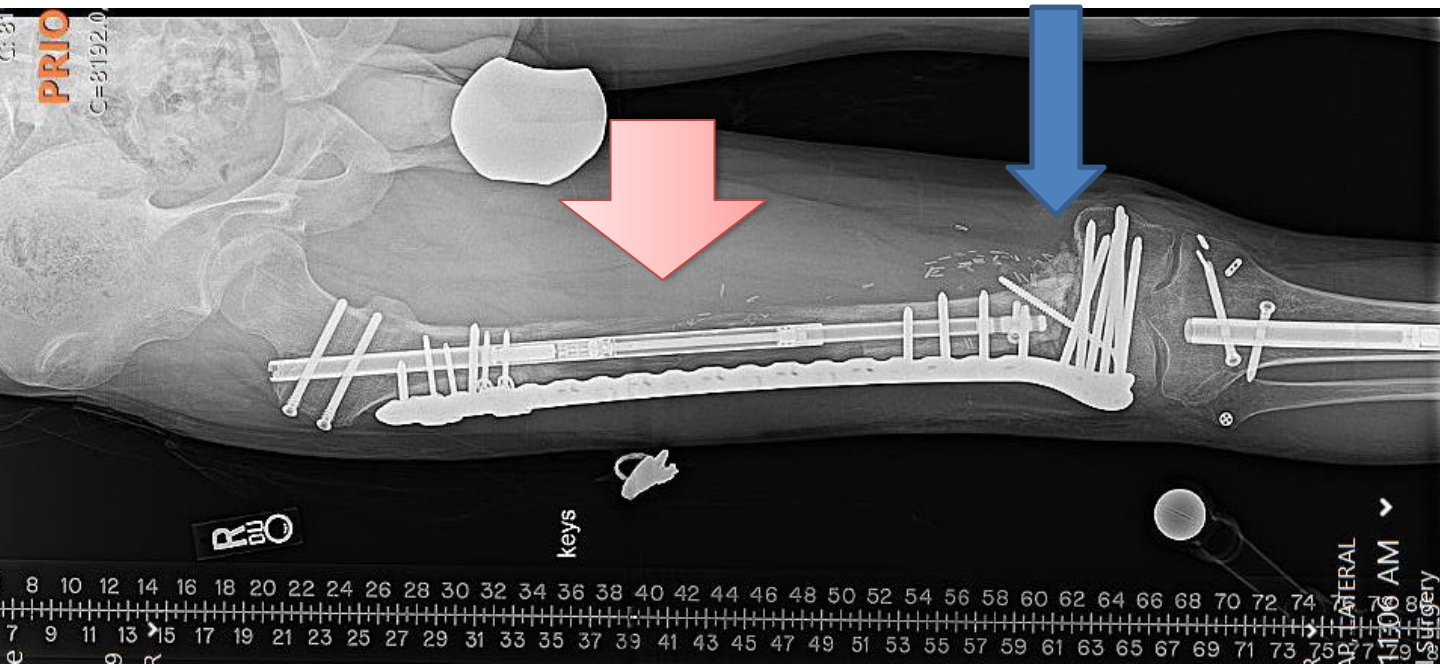
PLATE ASSISTED BONE SEGMENT TRANSPORT (PABST)



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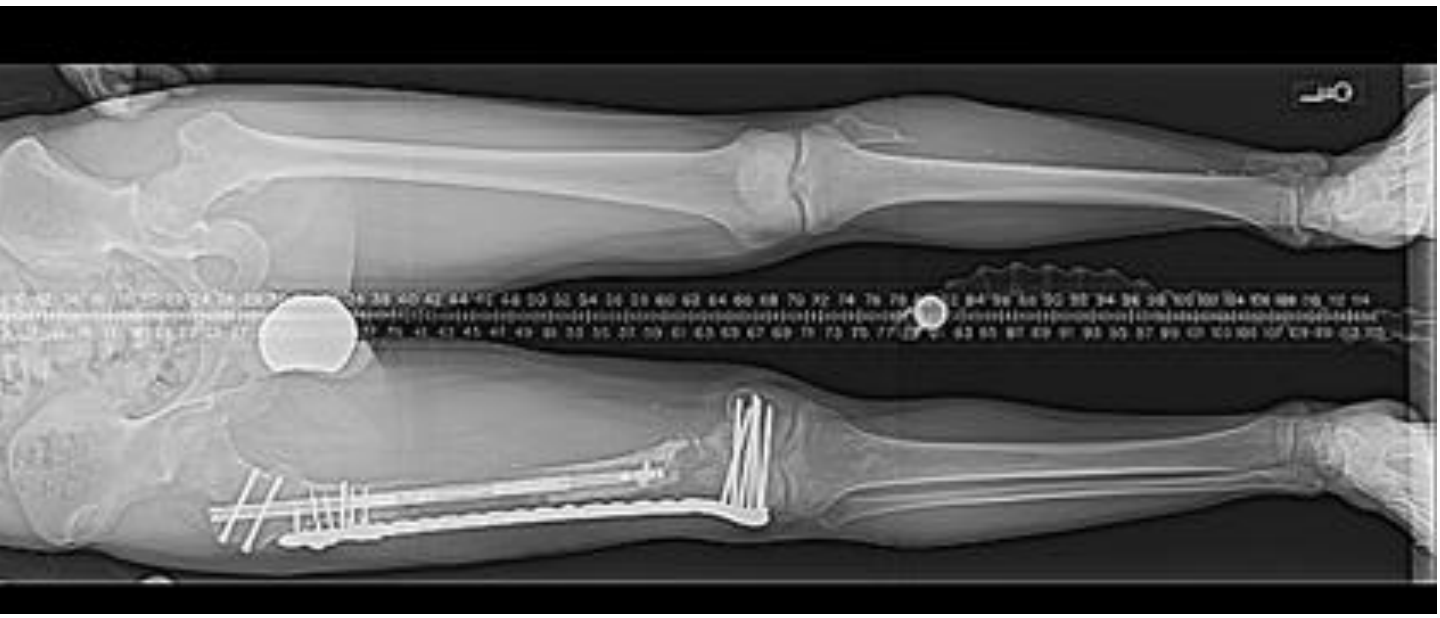
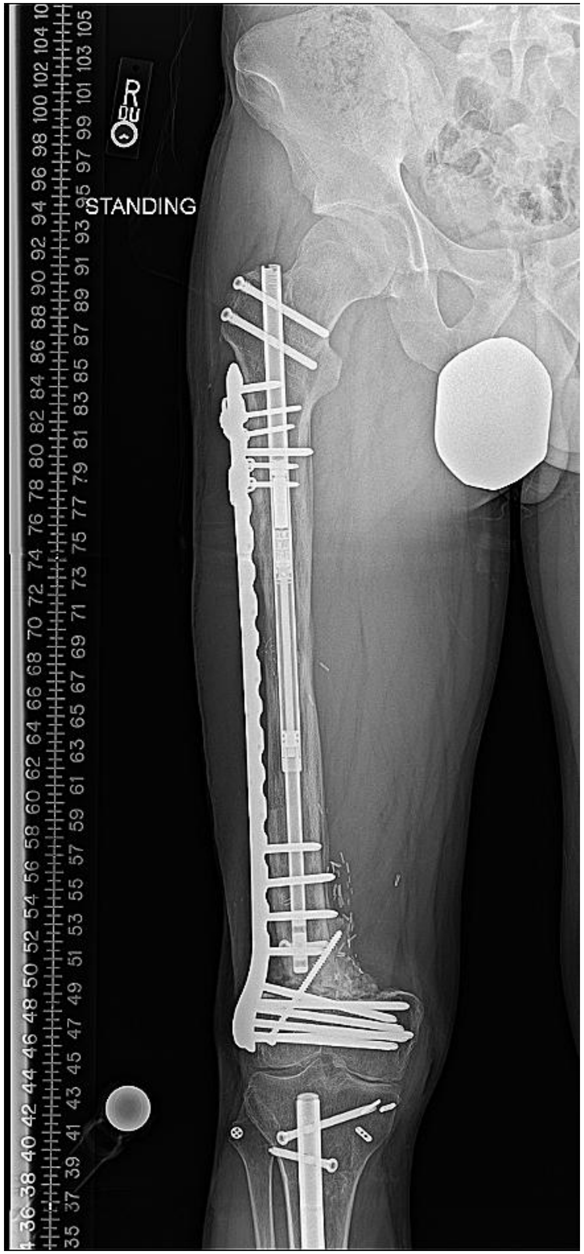
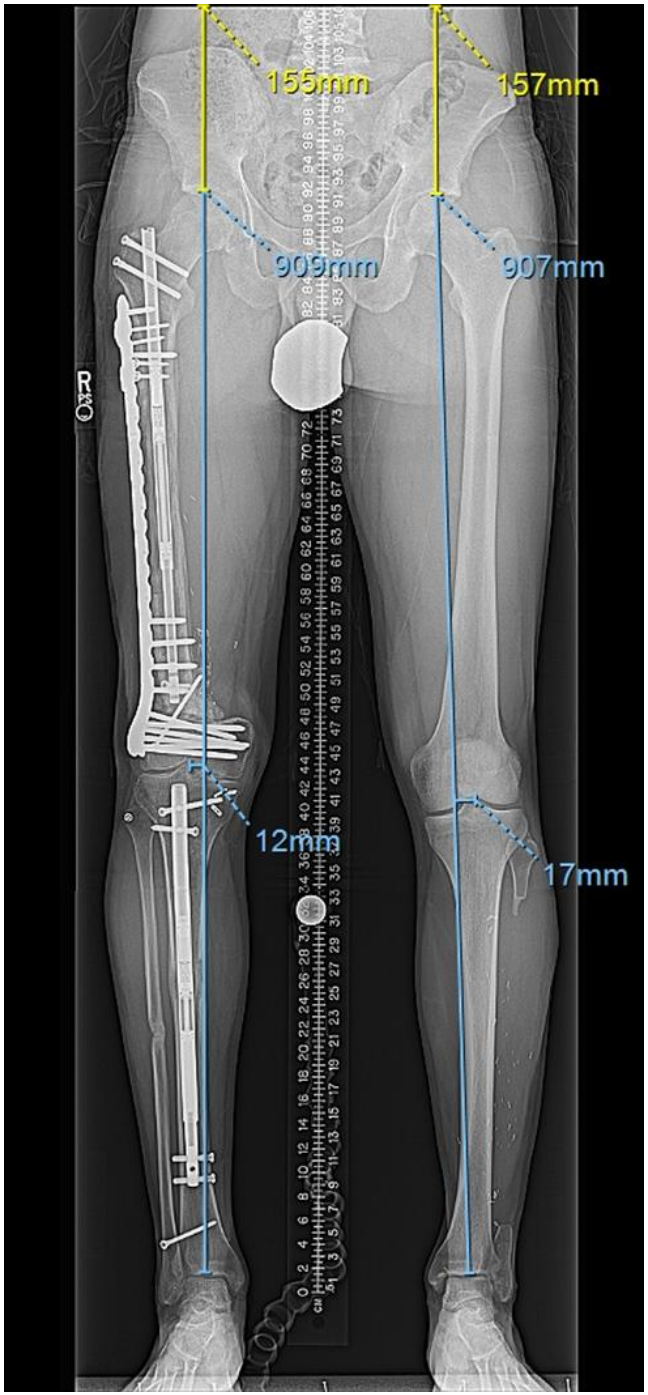
AM




STANDING


STANDING



limblengthening
Hospital for Special Surgery

Single Stage Osseointegration

Open Access Protocol

BMJ Open

Single-stage osseointegrated reconstruction and rehabilitation of lower limb amputees: the Osseointegration Group of Australia Accelerated Protocol-2 (OGAAP-2) for a prospective cohort study

Munjed Al Muderis,[1,2,3] William Lu,[4] Kevin Tetsworth,[5,6] Belinda Bosley,[3] Jiao Jiao Li[4]

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► Prepublication history for this paper is available online. To view these files please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2016-013508).

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ABSTRACT

Introduction: Lower limb amputations have detrimental influences on the quality of life, function and body image of the affected patients. Following amputation, prolonged rehabilitation is required for patients to be fitted with traditional socket prostheses, and many patients experience symptomatic socket–residuum interface problems which lead to reduced prosthetic use and quality of life. Osseointegration has recently emerged as a novel approach for the reconstruction of amputated limbs, which overcomes many of the socket-related problems by directly attaching the prosthesis to the skeletal residuum. To date, the vast majority of osseointegration procedures worldwide have been performed in 2 stages, which require at least 4 months and up to 18 months for the completion of reconstruction and rehabilitation from the time of the initial surgery. The current prospective cohort study evaluates the safety and efficacy of a single-stage osseointegration procedure performed under the Osseointegration Group of Australia Accelerated Protocol-2 (OGAAP-2), which dramatically reduces the time of recovery to ~3–6 weeks.

Methods and analysis: The inclusion criteria for osseointegrated reconstruction under the OGAAP-2 procedure are age over 18 years, unilateral transfemoral amputation and experiencing problems or difficulties in using socket prostheses. All patients receive osseointegrated implants which are press-fitted into the residual bone. Functional and quality-of-life outcome measures are recorded preoperatively and at

Strengths and limitations of this study

- This study is the first study to describe, as well as report on the safety and efficacy of, a single-stage procedure for the osseointegrated reconstruction of amputated limbs. This study may therefore have significant influence on the standard of treatment for patients with lower limb amputations undergoing osseointegration surgery, and reverse the concept that a two-stage procedure is required.
- This study has a relatively large sample size of 105 patients, which resembles one of the largest patient cohorts among studies published to date reporting on the outcomes of osseointegrated reconstruction of amputated limbs.
- This study does not directly compare the outcomes of using osseointegrated prostheses to the outcomes of using socket prostheses as the traditional method of treating patients with lower limb amputations.
- This study has a relatively short follow-up period of 2 years, which does not allow the examination of longer term outcomes and risk of adverse events.

be disseminated by publications in peer-reviewed academic journals and presentations at relevant clinical and orthopaedic conferences.

JB&JS
OPEN ACCESS

Early Experience with Femoral and Tibial Bone-Anchored Osseointegration Prostheses

Taylor J. Reif, MD, Nathan Khabyeh-Hasbani, BS, Kayla M. Jaime, MS, Gerard A. Sheridan, MCh, FRCS, David M. Otterburn, MD, FACS, and S. Robert Rozbruch, MD, FAAOS

Investigation performed at the Hospital for Special Surgery, New York, NY

Background: The use of bone-anchored osseointegration implants for amputation reconstruction continues to expand throughout the world. Benefits are thought to include the elimination of socket-related problems and improved control and proprioception of the prosthetic limb. Reported outcomes have been positive, but skepticism remains with regard to the risk of infection and implant failure. Further results from early adopters are therefore needed prior to widespread acceptance and regulatory approval.

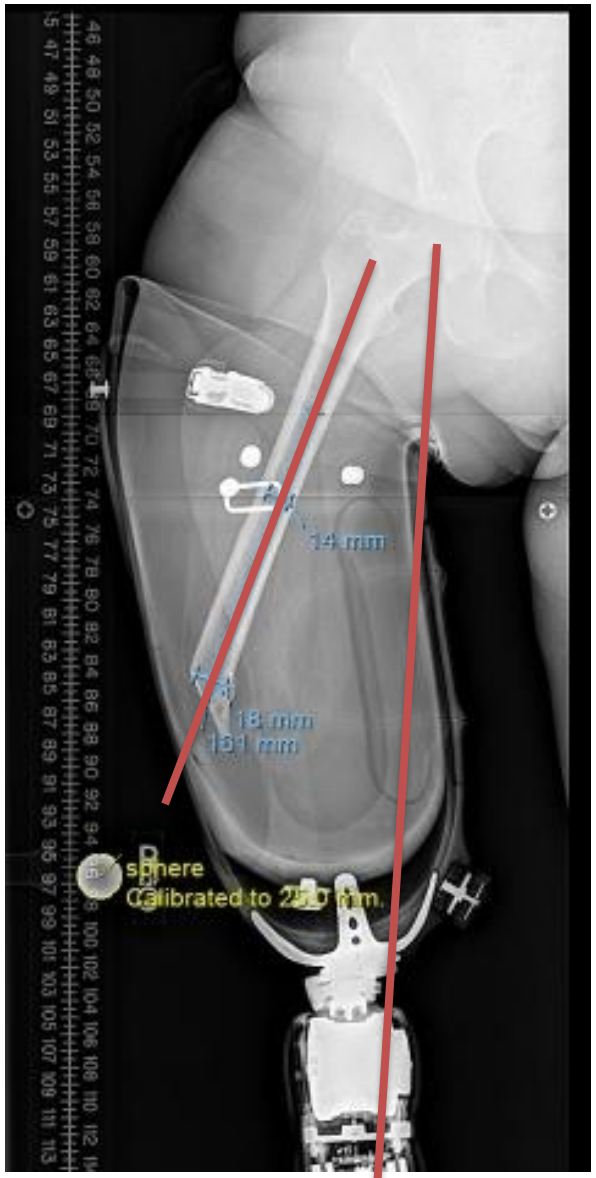
Methods: A retrospective review of the first 31 consecutive patients who underwent implantation of a press-fit osseointegration implant of the femur or tibia with follow-up of at least 6 months was performed. The primary outcome was the patient-reported Questionnaire for persons with a Transfemoral Amputation (Q-TFA) measured preoperatively and 6 to 12 months postoperatively. Patient-Reported Outcomes Measurement Information System (PROMIS) and Limb Deformity-Scoliosis Research Society (LD-SRS) scores, 2-minute and 6-minute walk tests, and complications were also recorded.

Results: In this study, 18 femoral reconstructions and 13 tibial reconstructions were performed, with a mean follow-up (and standard deviation) of 21.1 ± 9.2 months. Twenty-eight reconstructions were single-stage implantations. All Q-TFA domains improved significantly ($p < 0.001$) from preoperatively to postoperatively, including the global score (25.0 ± 17.4 to 81.2 ± 17.6 points), prosthetic use (50.2 ± 39.9 to 91.2 ± 18.7 points), prosthetic mobility (49.7 ± 26.9 to 81.4 ± 21.5 points), and prosthetic problems (46.4 ± 17.5 to 9.1 ± 6.6 points). The overall and functional outcome domains of the PROMIS and LD-SRS and the 2-minute walk test (243 ± 107 to 369 ± 151 ft [74 ± 33 to 112 ± 46 m]; $p = 0.022$) and 6-minute walk test (609 ± 323 to 1,054 ± 555 ft [186 ± 98 to 321 ± 169 m]; $p = 0.016$) also improved significantly. Serious adverse events included 2 periprosthetic hip fractures, 1 explantation for septic loosening, and 1 explantation for aseptic loosening, with an overall implant retention of 93%. The most common complication was low-grade, soft-tissue infection requiring oral antibiotics.

Conclusions: Similar to the early experience of other international centers, osseointegration implants improved the overall and functional experience of patients compared with socket prosthetics. Complications were present but manageable and were not a deterrent to ongoing support of the technology.

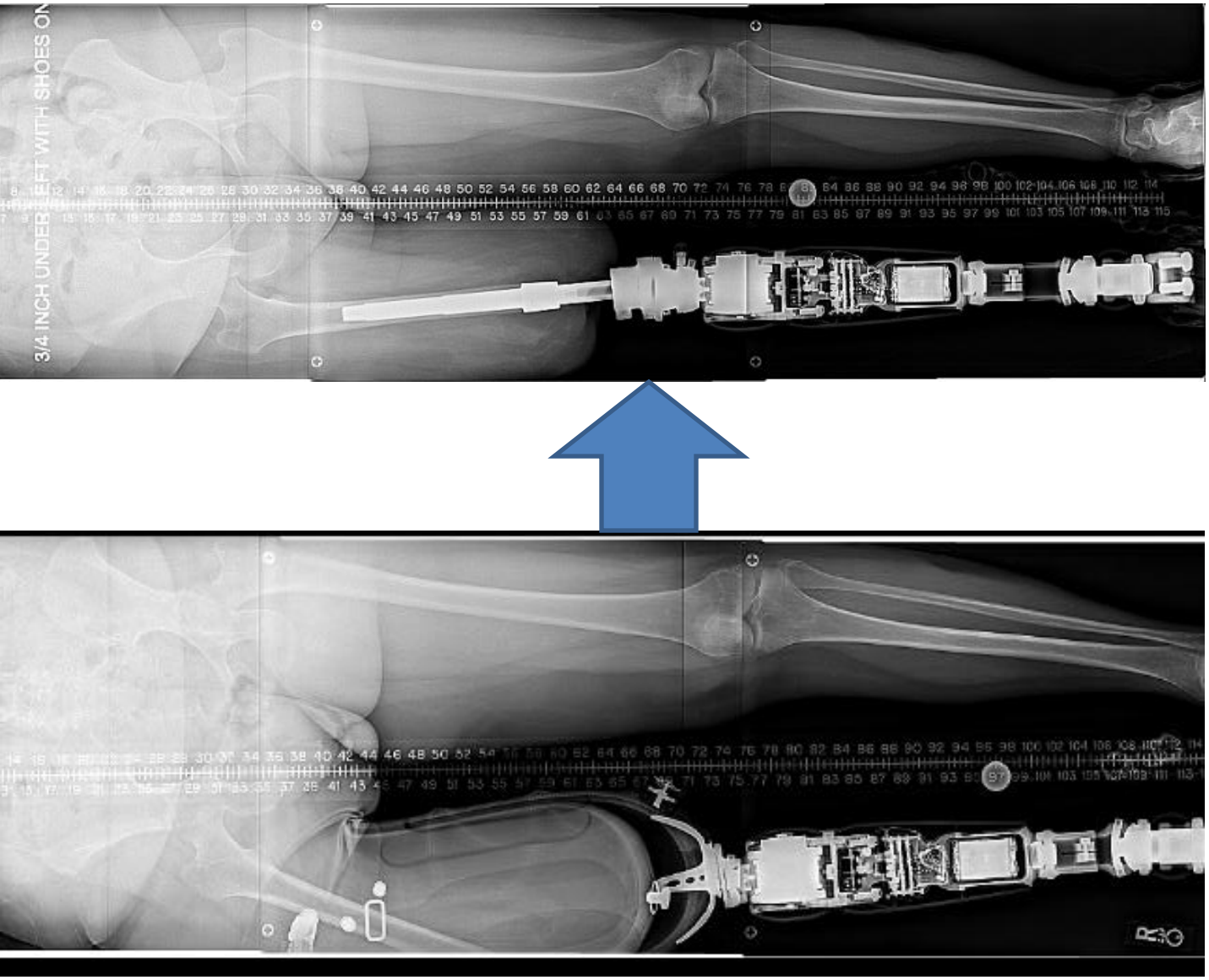
Level of Evidence: Therapeutic Level IV. See Instructions for Authors for a complete description of levels of evidence.

Excess soft tissue



SOCKET PROBLEMS
Skin ulcers, perspiration
Frequent refitting
Poor fit- residuum size fluctuation
7% fracture
Lack of confidence with mobility

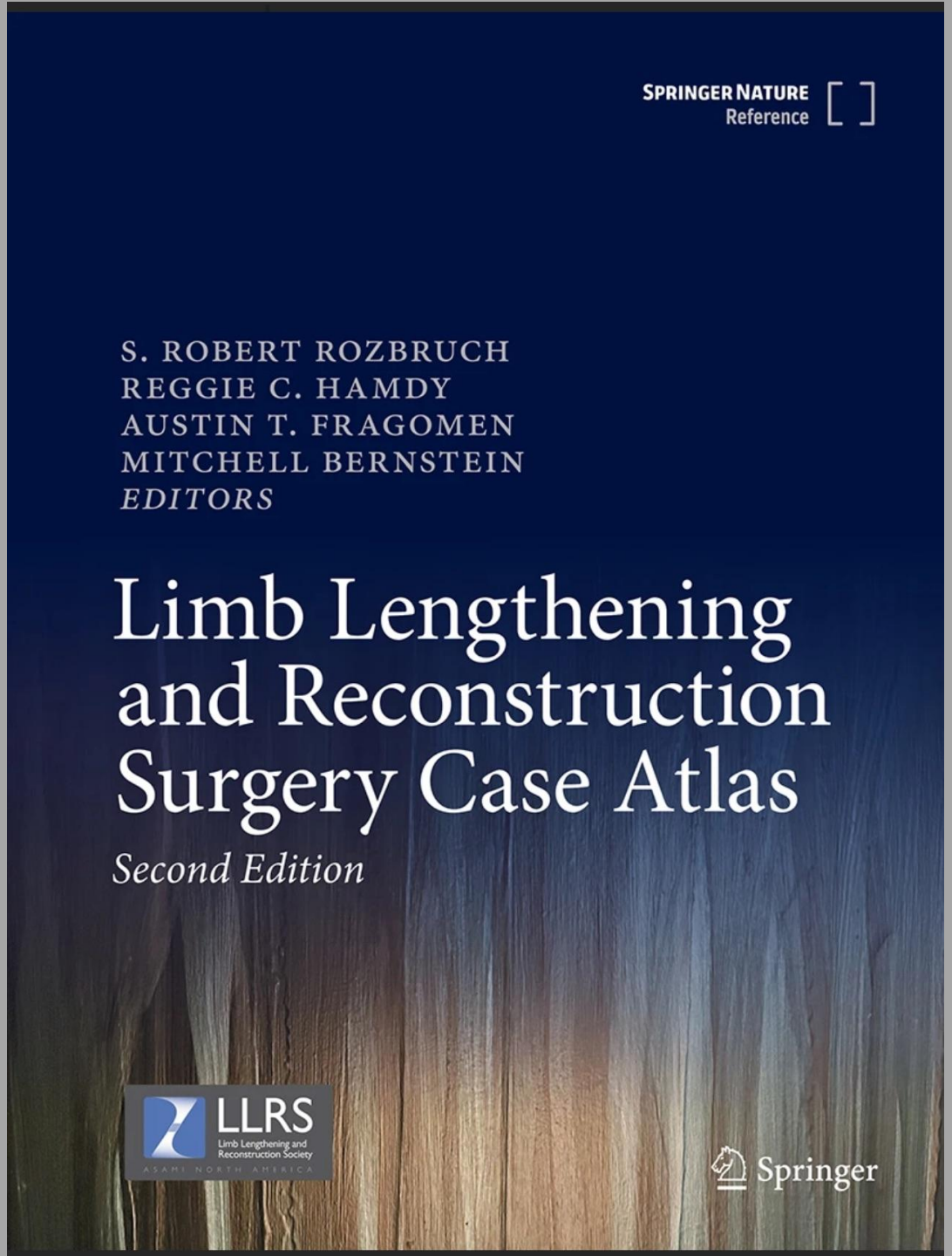
Poor fit; poor energy transfer
Mal-alignment bone-prosthesis


3/4 INCH UNDER

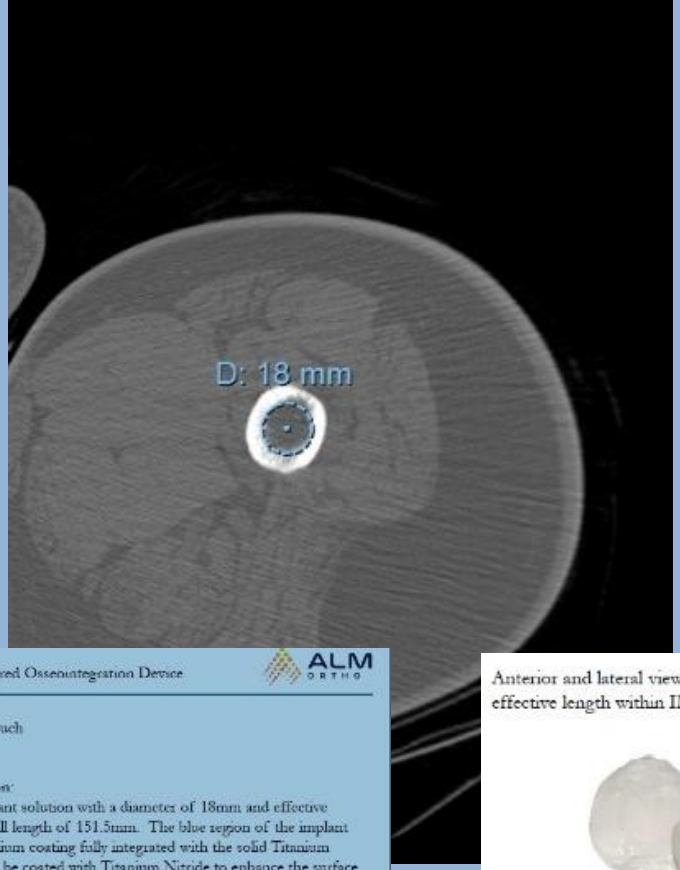
2025

3 Volumes

1. Pediatric Deformity
2. Trauma
   Foot and Ankle
3. Adult Reconstruction
   Tumor
   Upper Extremity



Preop: excessive soft tissue, poor control of leg

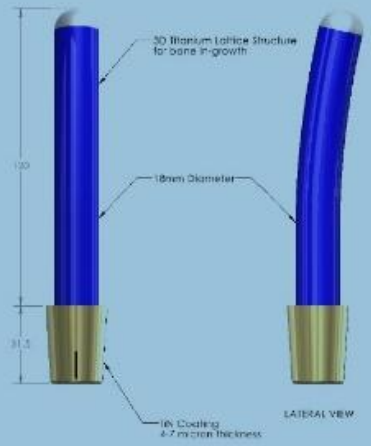


Custom-Made Bone-Anchored Osseointegration Device

ALM ORTHO

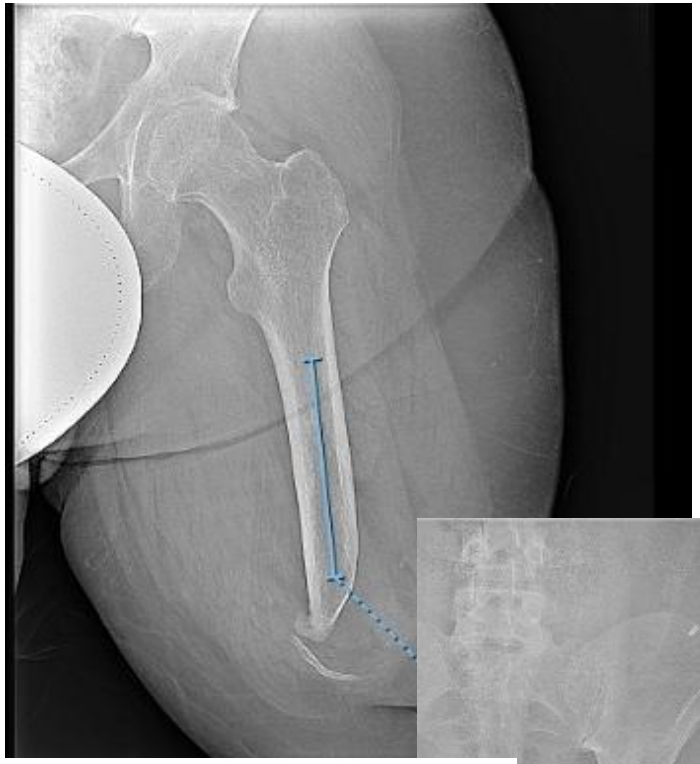
Surgeon: Dr. Robert Rozbruch
Case number: 031524.02

Proposed Implant Solution:
Below is the proposed implant solution with a diameter of 18mm and effective length of 120mm and overall length of 151.5mm. The blue region of the implant will have a 3D Porous Titanium coating fully integrated with the solid Titanium Stem. The taper region will be coated with Titanium Nitride to enhance the surface condition of the implant, with a laser mark to orient implant during insertion.



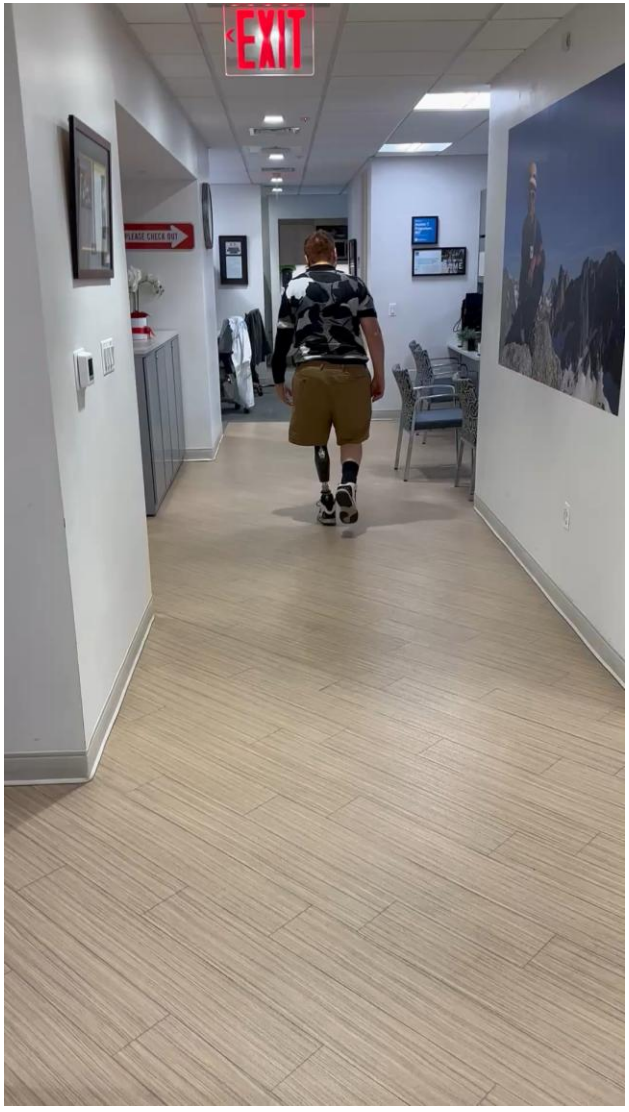
P/N: 031524.02A
(18mm Implant)
Material: Titanium Alloy per ASTM F3001
Qty: (2)

Anterior and lateral view of implant in bone. 18mm implant diameter, 120mm effective length within IM canal.



Anterior and lateral view of implant in bone. 18mm implant diameter, 120mm effective length within IM canal.

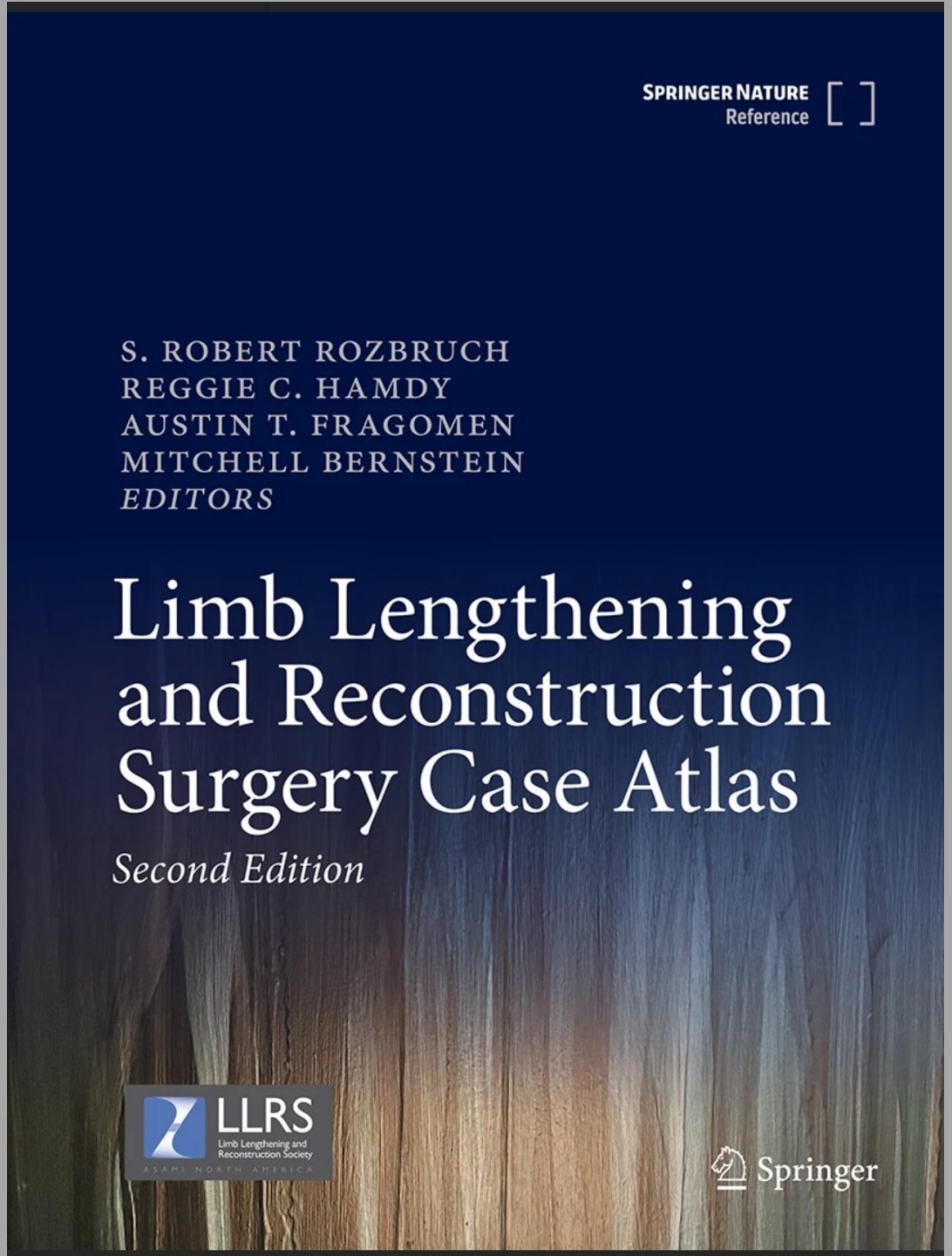
6 weeks after getting leg



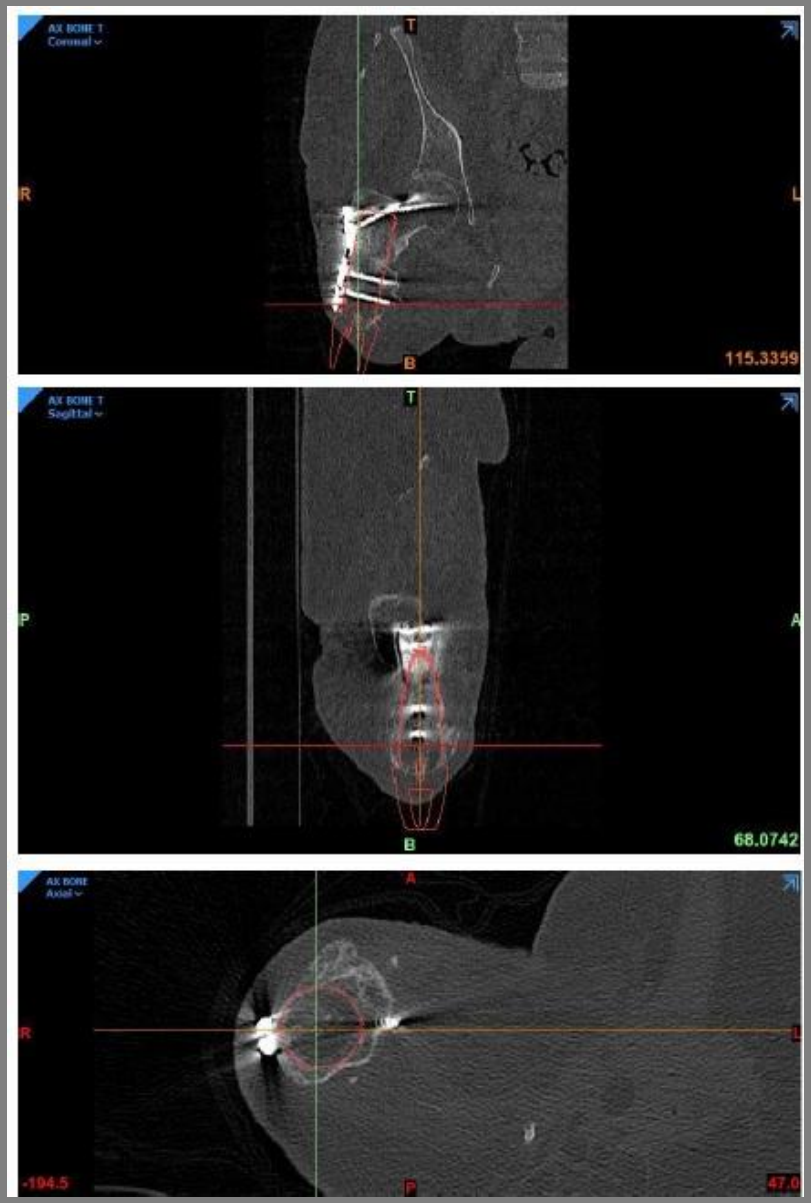
2025

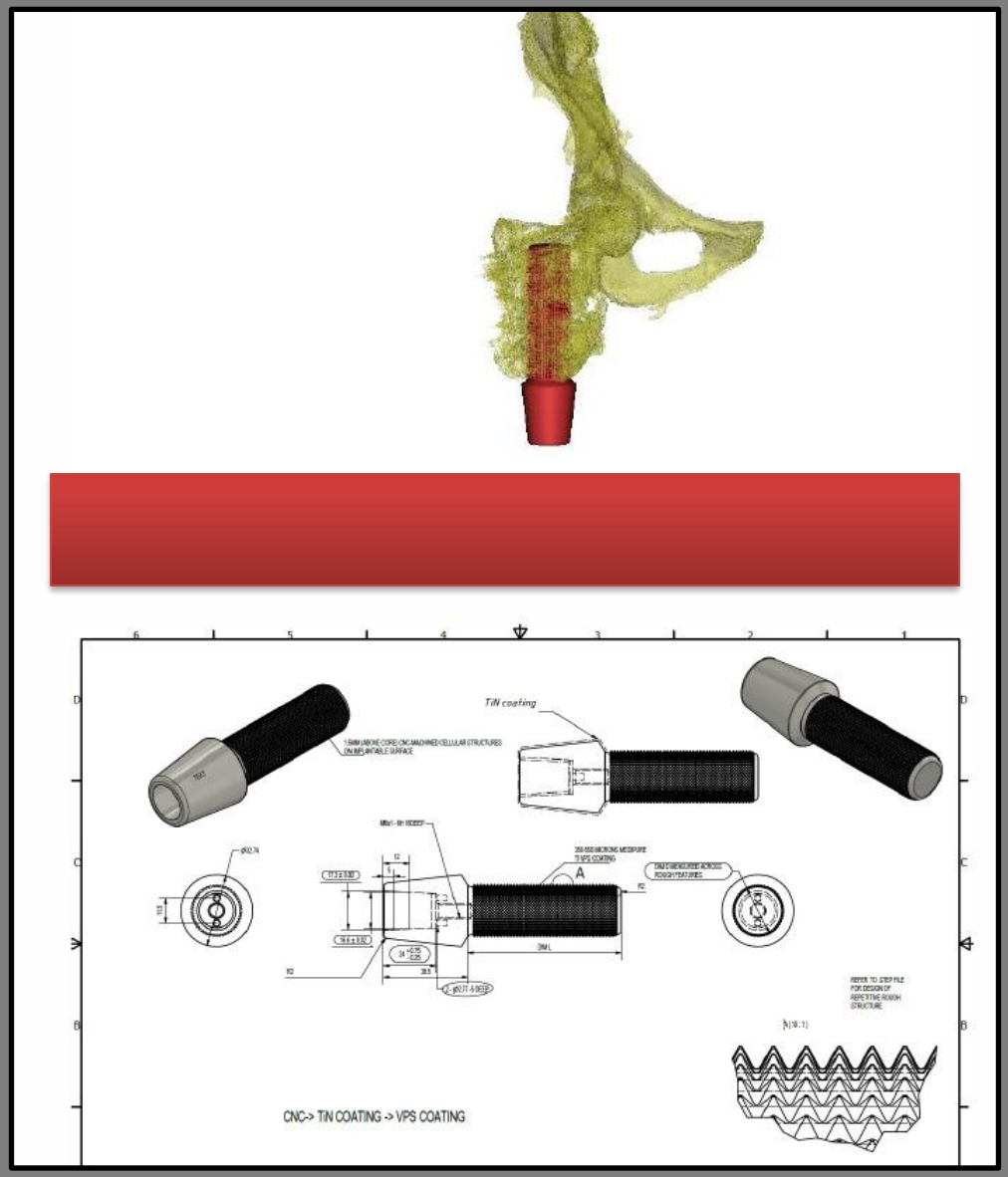
3 Volumes

1. Pediatric Deformity
2. Trauma
   Foot and Ankle
3. Adult Reconstruction
   Tumor
   Upper Extremity



Emily preop
extremely short femur


AX BONE T
Coronal
T
R
L
B
115.3359
AX BONE T
Sagittal
T
P
A
B
68.0742
AX BORE
Axial
A
R
L
P
-194.5
47.0


TiN coating
CNC-> TIN COATING -> VPS COATING

1.

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ORTHOPEDICS TODAY

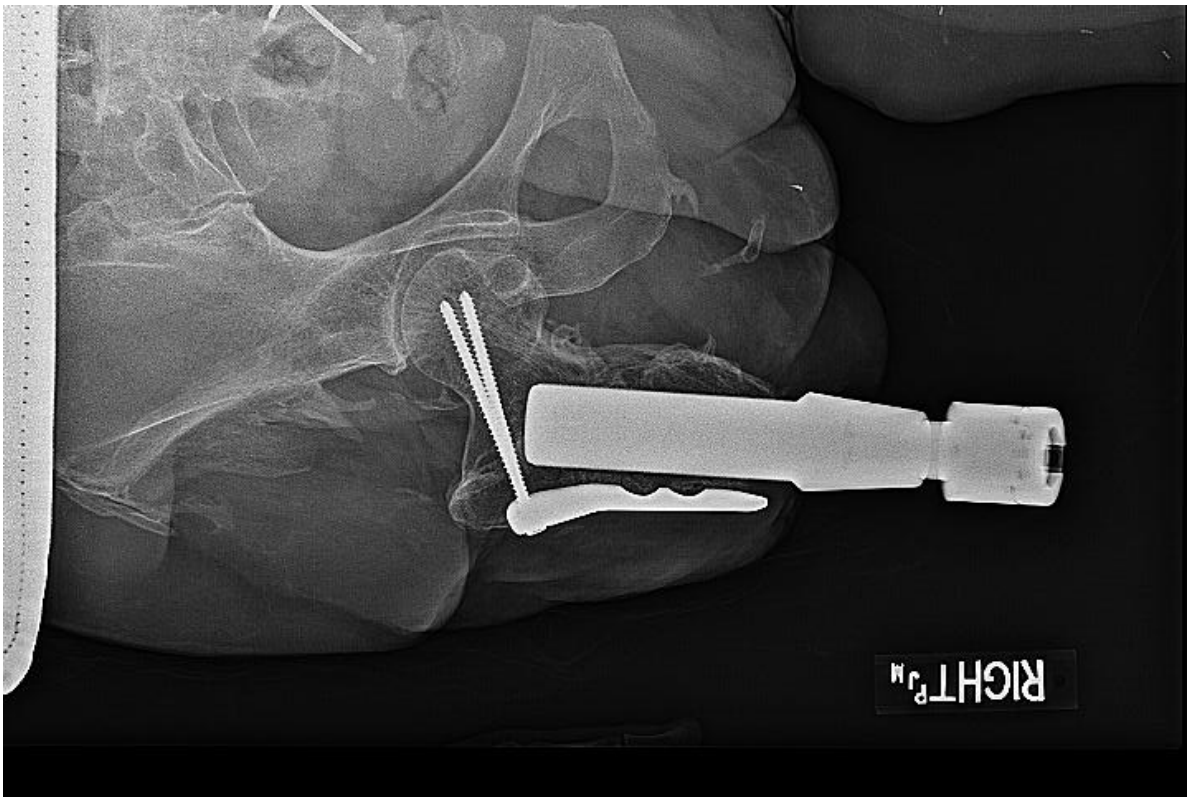

EXIT

2:50

LIMBLENGTHENING
Posts

Liked by **briandevoyfield** and **347 others**

limblengthening Emily thanks for sharing that you climbed an Adirondack high peak. You are... more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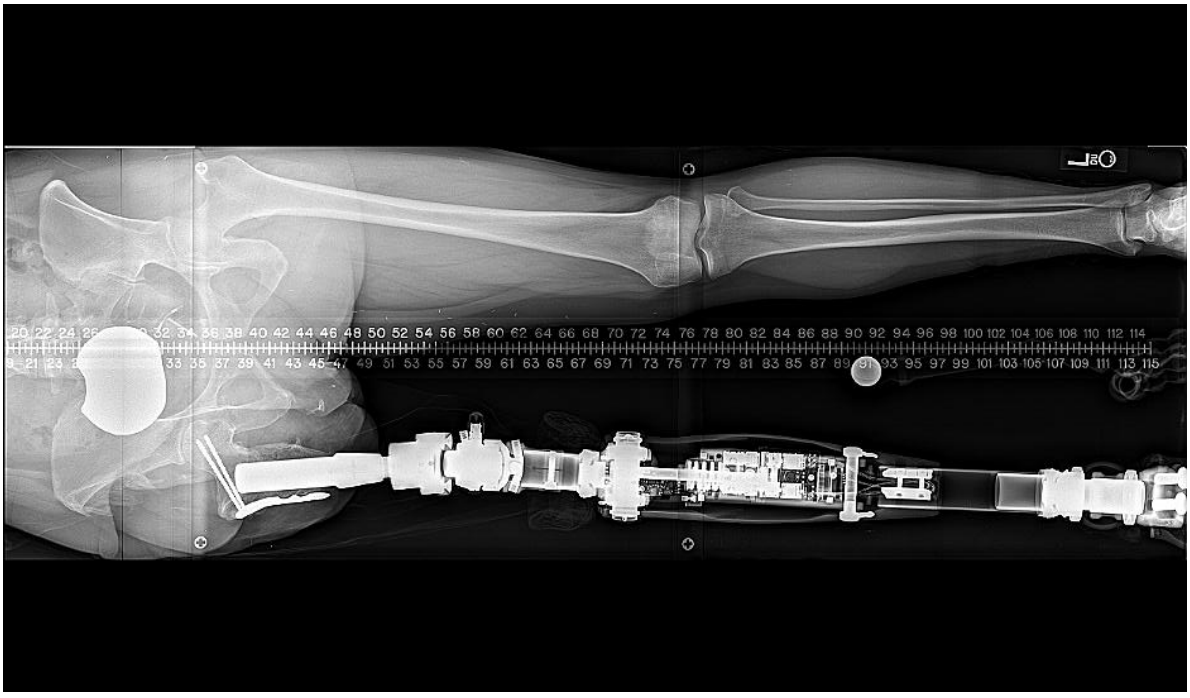
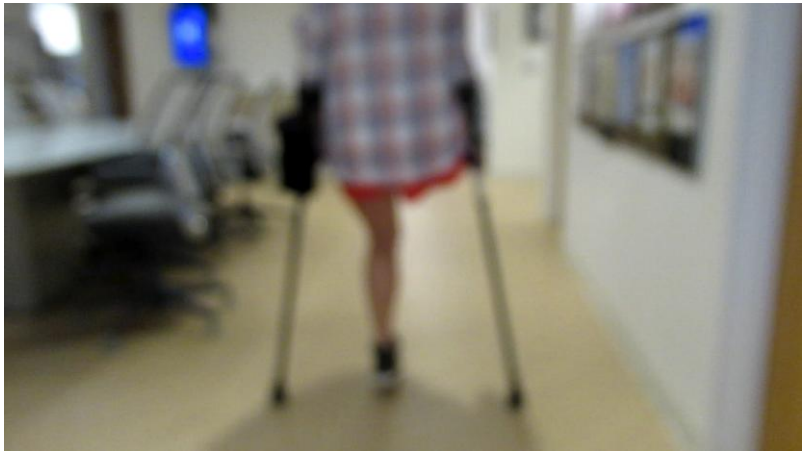


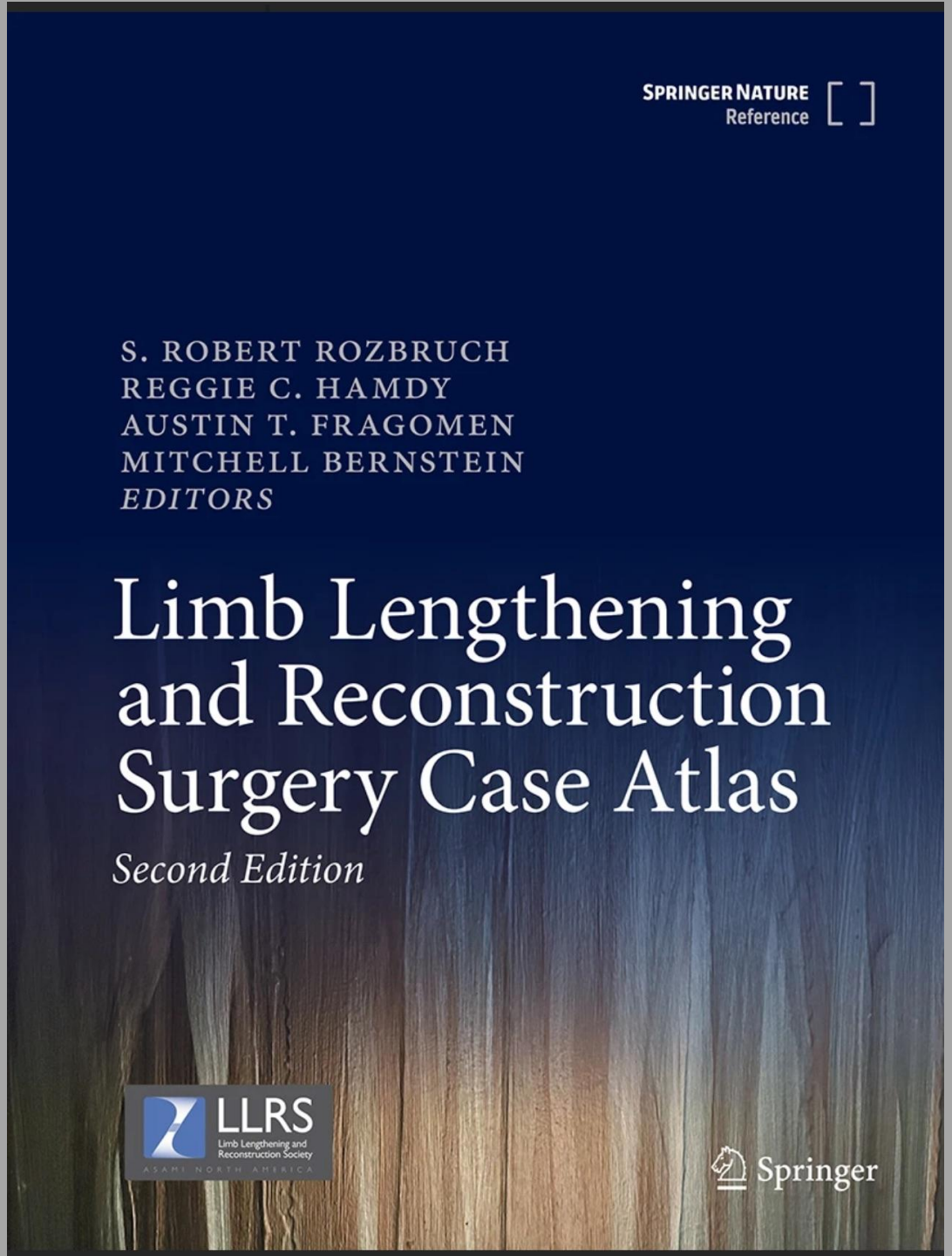
Preop → 1.5 years postop



2025

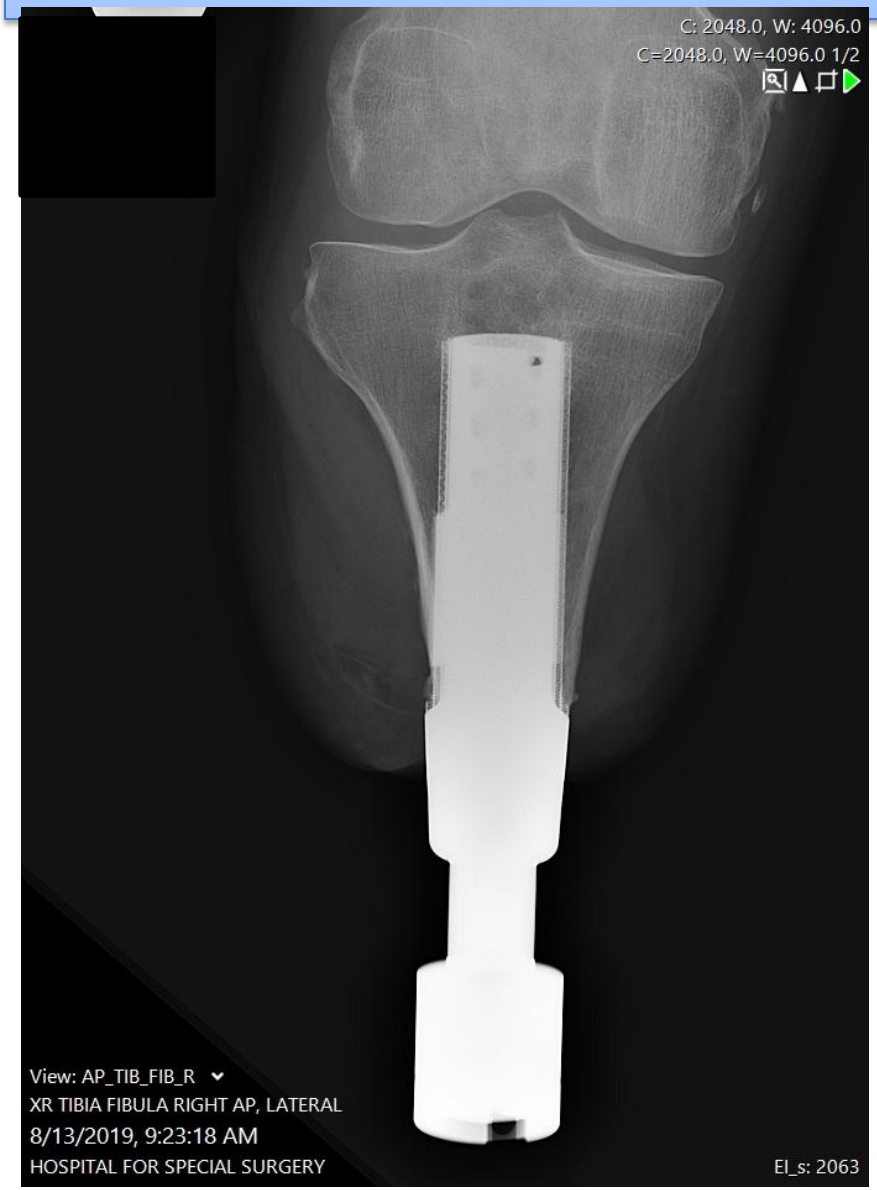
3 Volumes

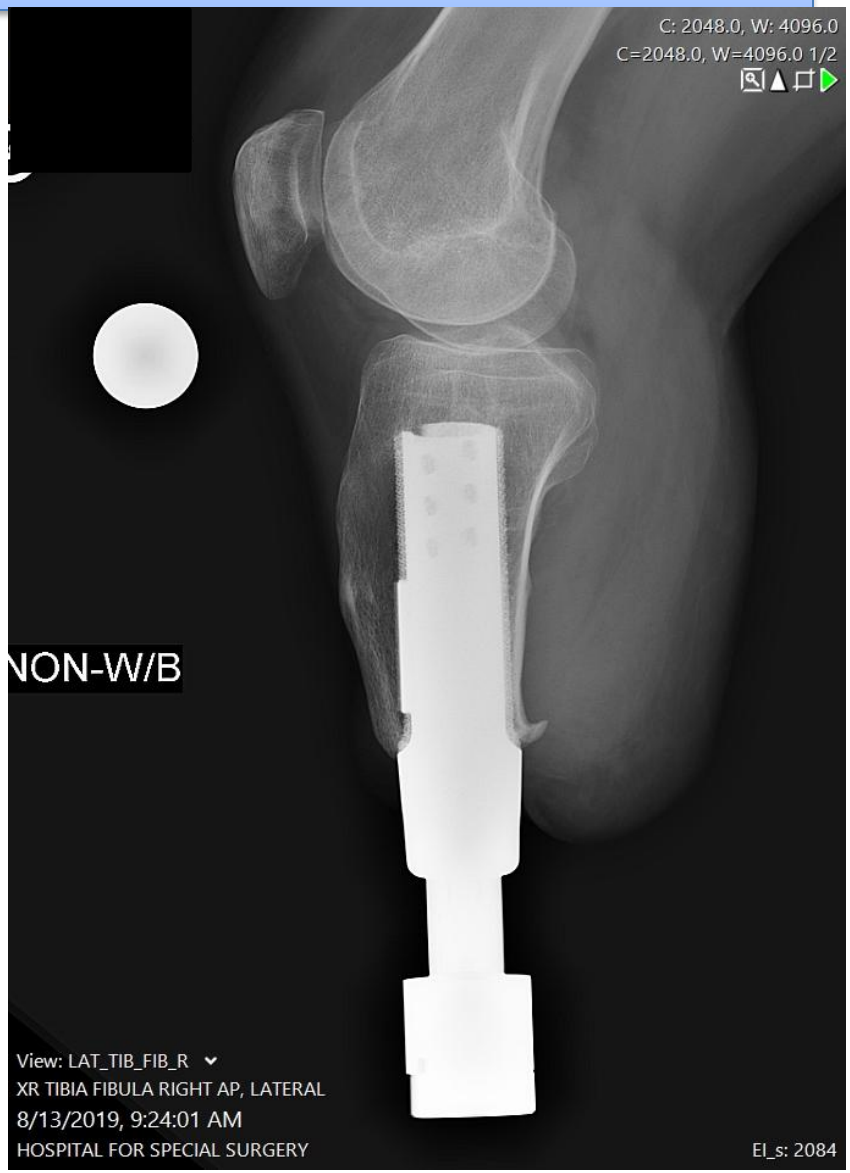
1. Pediatric Deformity
2. Trauma
   Foot and Ankle
3. Adult Reconstruction
   Tumor
   Upper Extremity



Jesse F., 33 y/o male

8 year follow-up

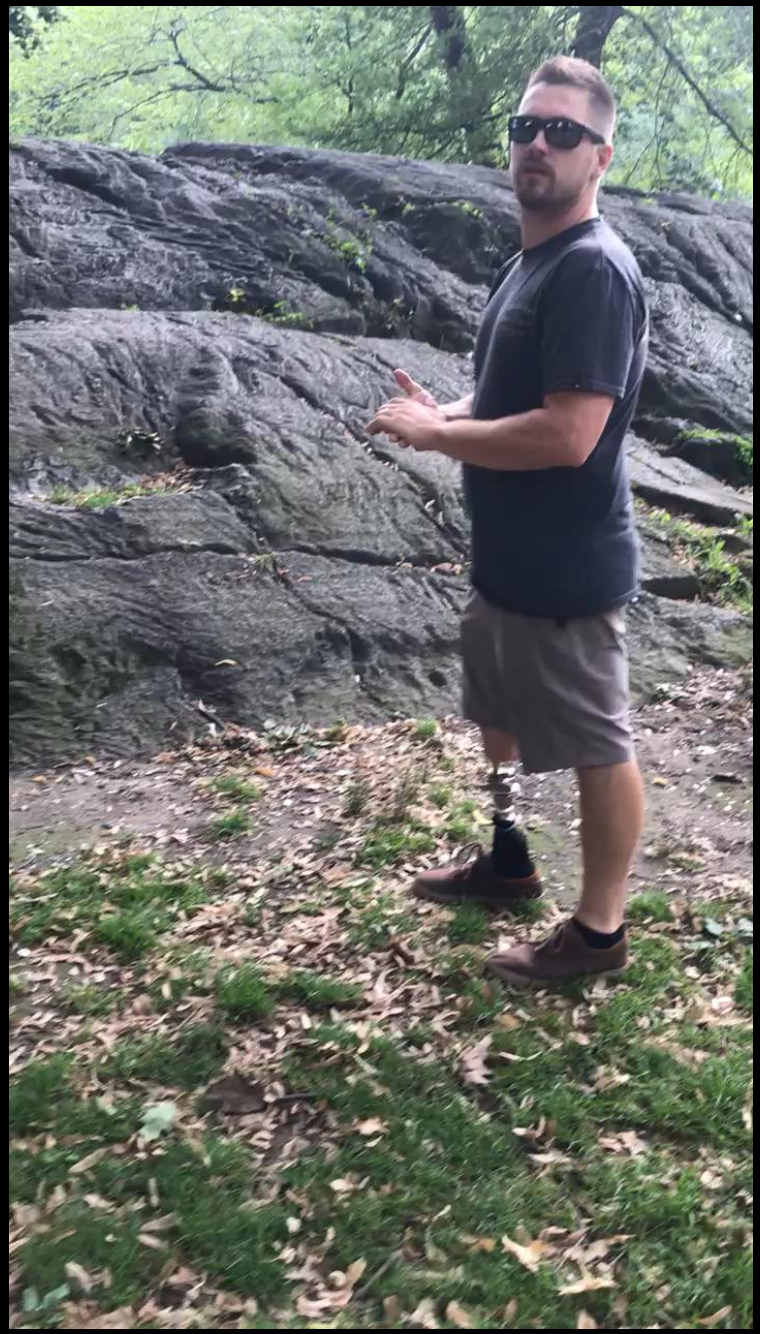





QUIKSILVER


OPL


Hanes

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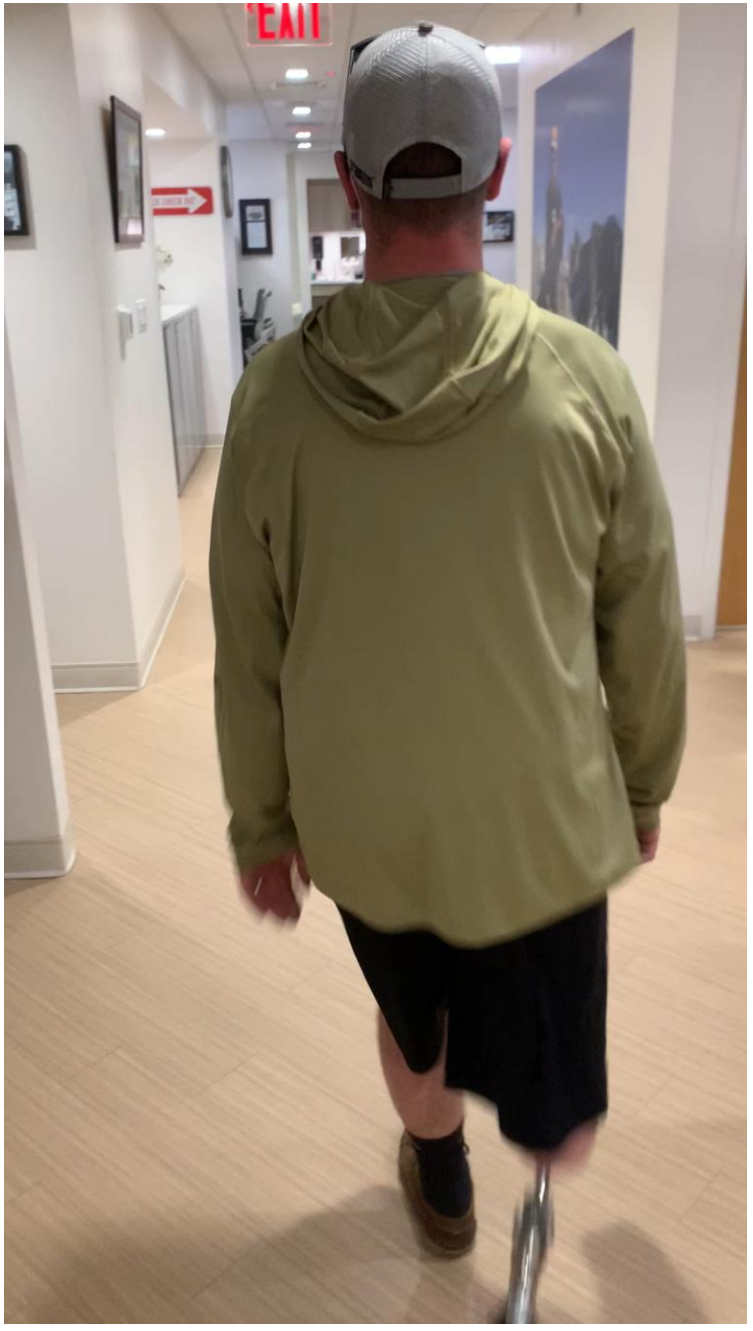
EXIT

2025

3 Volumes

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2. Trauma
   Foot and Ankle
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   Tumor
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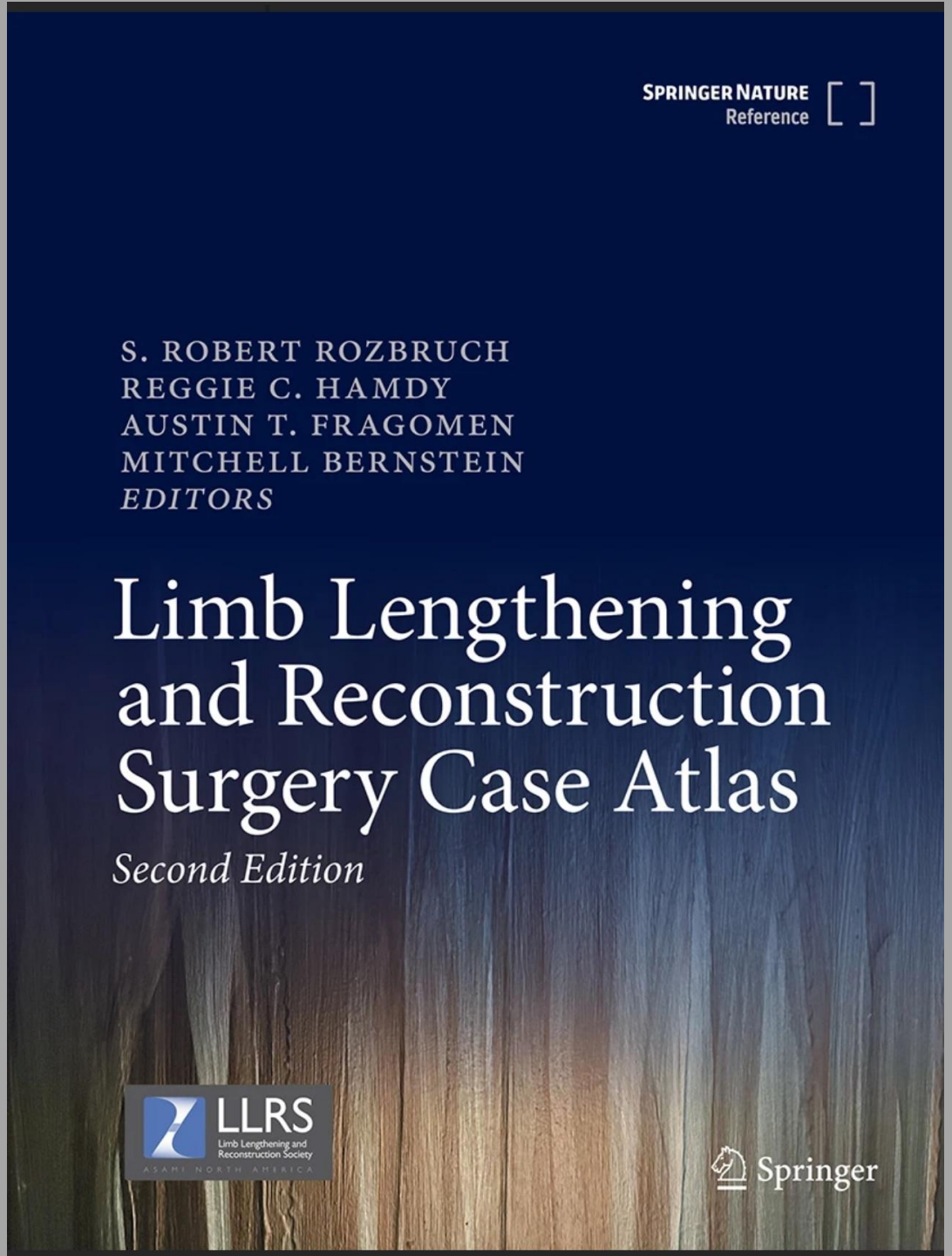
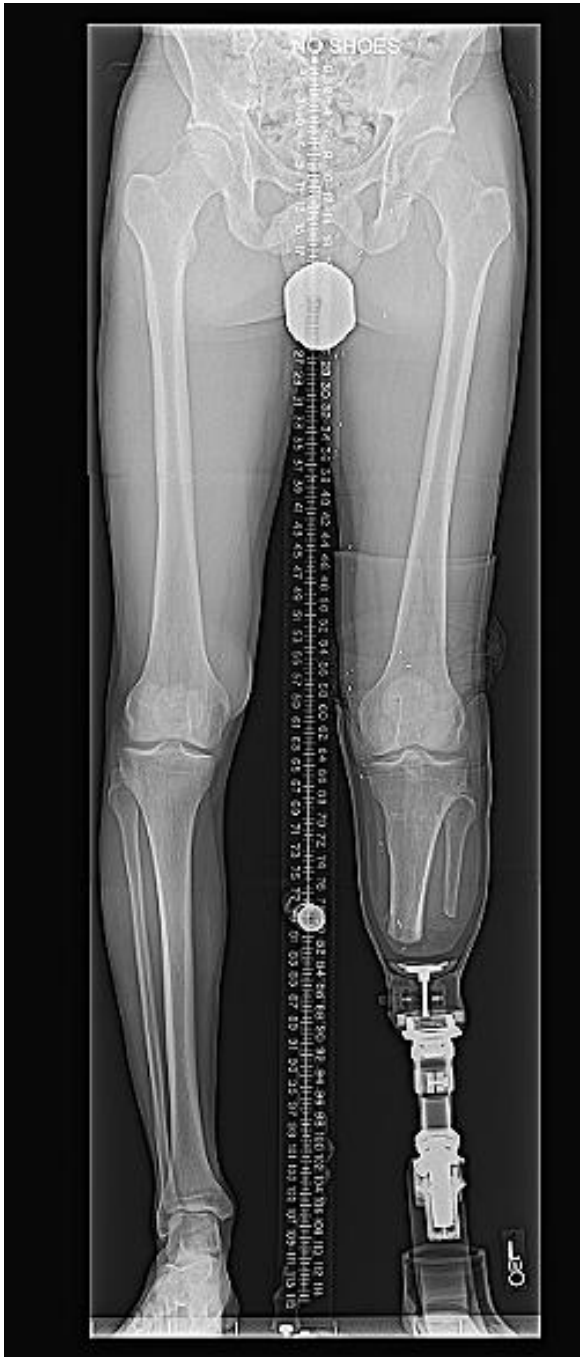
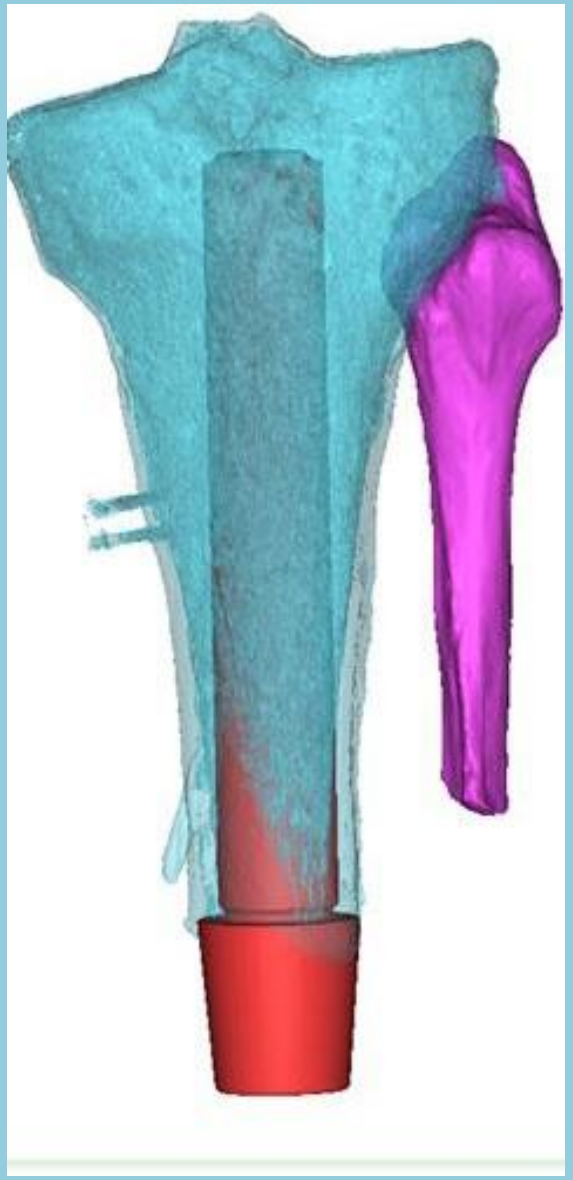


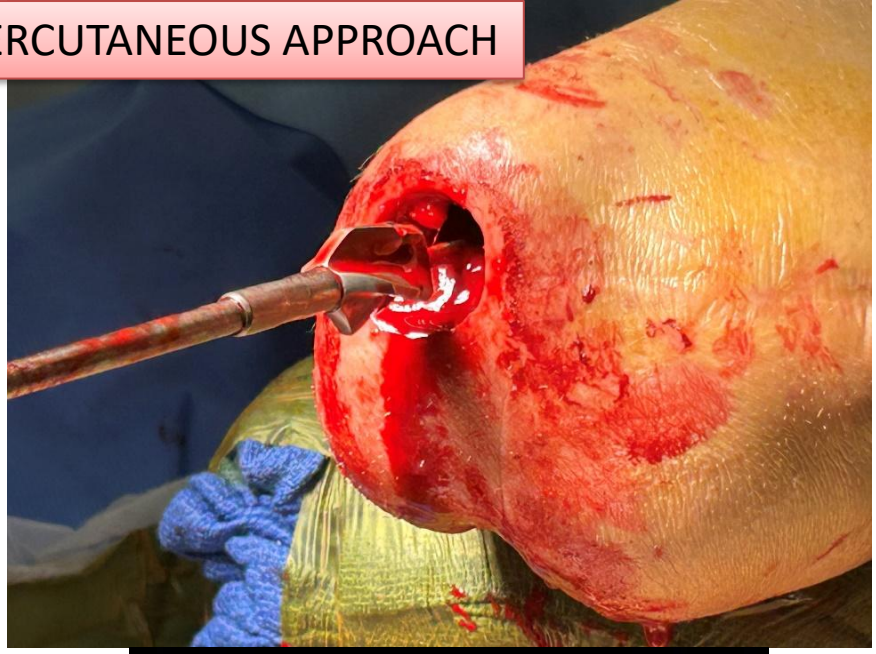

NO SHOES

Planning and Prep of tibia

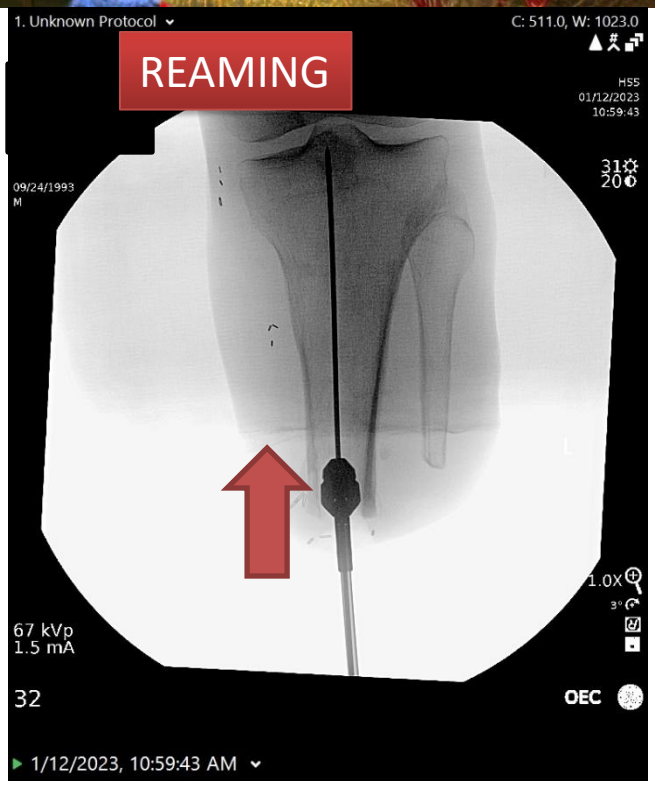
- Percutaneous approach
  - No need for removal bone
  - Bone right under skin
  - Do not anticipate soft tissue impingement
- Funnel shaped with bottle neck
- 20 x 130 planned
- Distal 2 cm is diaphyseal
  - Reaming important
  - Stability relies on diaphyseal fit
- More proximal tibia is wide
  - Impaction important
  - Stability in metaphyseal bone relies on bone impaction



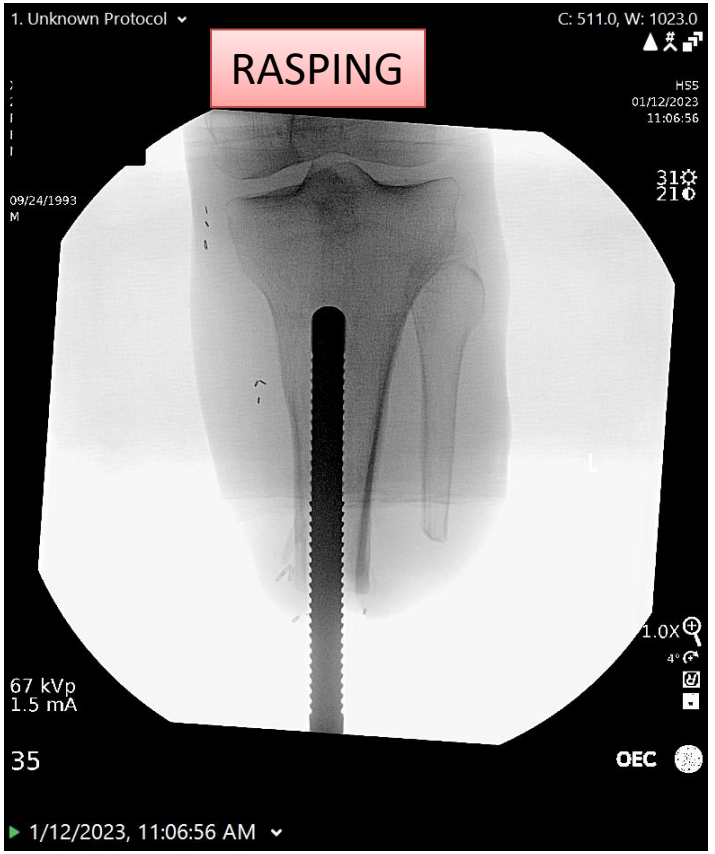
PERCUTANEOUS APPROACH



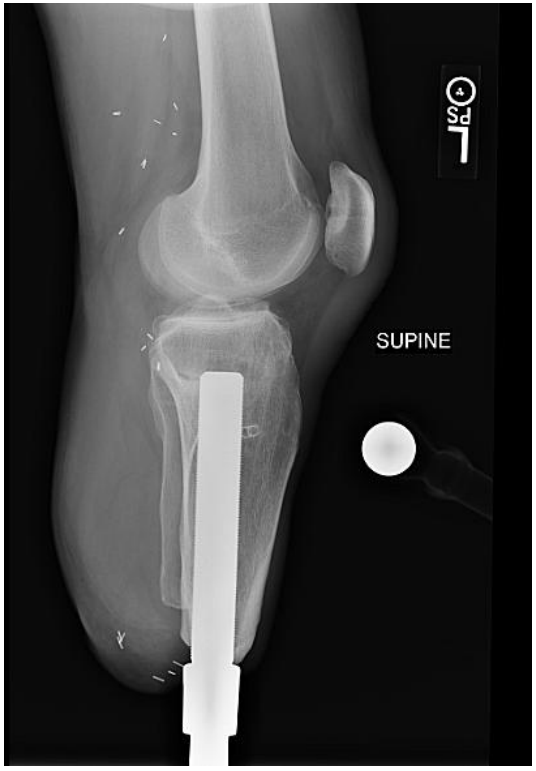
REAMING



RASPING




SUPINE

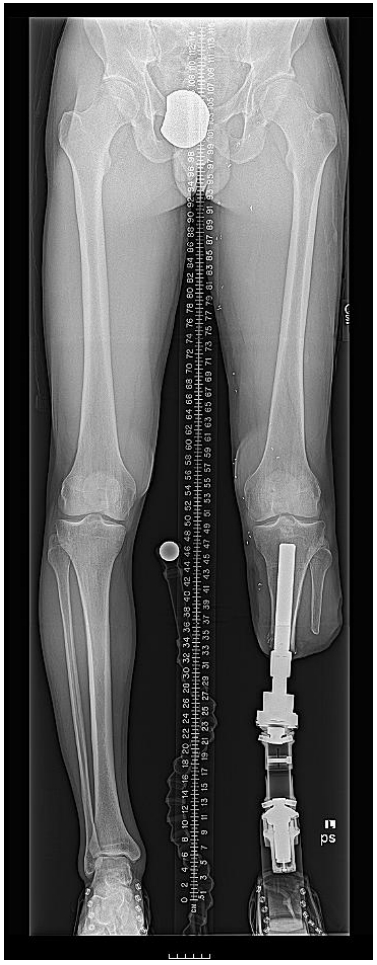

SUPINE

9 and 22 months post OI

impossible after... more

3 minutes ago

noquit24_7
St. George, Utah



- Change is the law of life. And those who only look to the past or present are certain to miss the future

- Change is inevitable. Progress is optional
  - John Maxwell

THANK YOU

WEILL CORNELL MEDICAL COLLEGE
CORNELL UNIVERSITY

LIMB LENGTHENING.COM

HSS