Hip Fracture Fixation With Nails
Thoughts, Techniques and Tips

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COI Disclosure

ZimmerBiomet: Consultant, Inventor, Trauma, ETEX, Knee Creations
Smith & Nephew, Nails and Plates, Memphis, TN

Intellectual Property Contracts
Textbook Contracts: Hip Fractures. Techniques in Orthopaedic Surgery 2nd Ed, Lippincott
Williams and Wilkins, Surgical Treatment of Orthopaedic Trauma 2nd Ed, Thieme
Publishers, New York, Rockwood and Green’s Fractures in Adults 8th Ed, Lippincott
Williams and Wilkins.

Next 20 Years
What We Will Learn

* How To Differentiate Fractures
* How To Reduce Fractures
* How To Functionally Stabilize Fractures
* How to Monitor Fracture Healing
* How To Optimize Patient Recovery
The Proximal Femur IS NOT as Solid As We Think

Medullary Canal Begins Below Lesser Trochanter in Young Patients
Above Lesser Trochanter in Old

With Nail Techniques, A Path Must Be Created Through This Cancellous Bone

The Proximal Femur IS NOT A Solid Structure

- Subtrochanteric
- Pertrochanteric
- Femoral Neck

Harty M. The Calcar Femorale* and The Femoral Neck. JBJS 1957
Garden. Structure and Function of The Proximal Femur. JBJS 43B 1961
*Adam's Arch: Bartonicik

Four Major Components
Horizontal and Vertical Columns
Femoral Head and Shaft

Fig. 3. Inversion of the acetabulum with the quadriceps to the anterior and horizontal

Fig. 4. Anterior view of the acetabulum and the abductors to the anterior and horizontal

The structure of the femoral neck is formed with emphasis on the anterior and horizontal abduction of the acetabulum.
Narrowing of Antero-Superior Column With Age & Osteoporosis

Modern Failure Model
UniCortical Single Screw Permits Rotation

Rotation Combined With Sliding=Bone Erosion

Instability

Collapse

Distortion of Hip Mechanics

Pain, Disability and Death

Cephalomedullary Nail Constructs

Y-Nail Class (Impaction)

Gamma Class (Dynamic Compression)
Single Large Lag Screw
Large Head Nail

Reconstruction Class (Dynamic Compression)
Two Lag Screws
Small Head Nail

InterTan Class (Linear Compression)
Two Integrated Screws
Trapezoid Nail

Küntscher Y-Nail (Synthes)

Gamma Nail (Stryker-Howmedica)
IMHS (Smith+Nephew)

Reconstruction Nail (Smith+Nephew) InterTan Nail (Smith+Nephew)

Russell Classification 2010
**Küntscher/Pohl Y-Nail 1940’s**

![Image](image1.png)

**2001 Impaction Type Nails**

![Image](image2.png)

**Functional And Radiographic Outcomes Of Intertrochanteric Hip Fractures Treated With Calcar Reduction, Compression, and Trochanteric Entry Nailing**

Paul D; Barker, AU; Lane, JA; Hofert, DJ; Lorich DG

J Orthop Trauma 2012 Mar;26(3):148-54

- *30 Patients Level IV Study.*
- **CONCLUSIONS:** Satisfactory Functional Outcomes With Near-normal Gait Restoration Can Be Achieved In Cases Of Intertrochanteric Hip Fractures With An Emphasis On Calcar Reduction And Compression After Fixation With Trochanteric Entry Nail.
Gamma Nail Class 1, 2, 3
1986-2011 Grosse & Kempf

- 1950's: Gamma Nail 10 Degree Proximal Bend Lat Port
- Drs. Arlene Grosse & Ivan Kempf
- Initially for Pertrochanteric Fractures
- Subsequent Design Changes
- Newest

Reconstruction Nail Class
Russell, Taylor and Brumfeld 1985

Reconstruction Nails: (Double Lag Screw)
First Integral Variable Section Modulus Cannulated Intramedullary Stainless Steel Nails
Smaller Head Diameter

2004 InterTan Class
Russell, Sanders, Grusin, Faber, Mimes, Ferrante

- Designed to Increase Hip Fracture Stability
- Trapezoidal Cross Section
- Integrated Proximal Compression Screws
- Flat Lateral Side to Relieve Trochanteric Stress
- 5 Degree Lateral Bend
- Short and Long

Smith & Nephew, Memphis
Rotational Instability Leads To Cut-Out


Single Screw Instability

Varus Collapse 8.5±7.7 Degrees
Rotation 7.2±6.4 Degrees

Clinically Realistic Multiplanar Loading Vectors
Significantly Affects Implant Migration, And Therefore Should Be Considered When Evaluating The Fixation Strength Of Hip Screw Implants.


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Visualization of implant failure


Computational Analyses Of Implant Failure

Courtesy: Harry van Lenthe, KU Leuven

ORS Russell et al 2010
Construct Testing
Femoral Head Rotation and Varus Collapse
Single Vs Integrated Screws

- Santoni, Brandon G. PhD; Nayak, Aniruddh N. MS; Cooper, Seth A. MD; Smithson, Ian R. MD; Cox, Jacob L. MD; Marberry, Scott T. MD; Sanders, Roy W. MD
- Comparison of Femoral Head Rotation and Varus Collapse Between a Single Lag Screw and Integrated Dual Screw Intertrochanteric Hip Fracture Fixation Device Using a Cadaveric Hemi-Pelvis Biomechanical Model
- Journal of Orthopaedic Trauma: April 2016 - Volume 30 - Issue 4 - p.164-169

Surgical Technique
New Directions

1. Fracture Visualization
2. Entry Portal
3. Trajectory Control Of Reamers/Nail
4. Implant Matching
5. Implant Stability

Classic Supine Position
Leg Positioning

- Flexion 0-40 Degrees
  31-ST-0-15 Degrees
  32 FS 10-30 Degrees
  33 SC 0 Degrees
- Adduction 0-20 Degrees
- Rotation 0-+15 Degrees

Bad Set Up:
C-Arm Wrong Axis
Distal Fragment Flexed
Leg Extended
Classic Lateral Position
- Hip Flexion 30-40 Degrees
- Adduction -10-0+10
- Rotation
  - 15-30 Degree Internal Rotation Of Foot
- Best For Short Proximal Fragments And Reverse Obliquity Pattern
- OTA/AO A3 Types

Supine Positioning
- Supine
- Flex Leg 30-40 Degrees
- Abduction 0 Degrees
- Rotation 0-15 Degrees ER
- Position C-Arm In Reference To Hip
- Not Ideal For Piriformis Portal
- Trochanteric Portal More Efficient

Pertrochanteric Operative Pearls
- Exposure
- Radiographic Visualization in Correct Plane
- Place C-Arm Beam Perpendicular to Femur
Pertrochanteric Operative Pearls

- Exposure
- Radiographic Visualization in Correct Plane
- First Fix AP Alignment

Pertrochanteric Operative Pearls

- Radiographic Visualization in Correct Plane
- Second Fix Rotational Alignment

15 Up and 15 Over

Femoral Entry Portal

- Medial-Lateral Position
- Piriformis Portal
- Straight Nails
- Trochanteric Portal
- 4-10 Degree Proximal Angulation
- Lateral Trochanteric Portal Problem
- Tip to Medial Trochanteric Portal
Importance of Entry Site

- Nail entry site dictates the ultimate placement of the implant
- Starting points are made in reference to the neutral axis:
  - Anterior vs. Posterior
  - Medial vs. Lateral
  - Piriformis vs. Trochanteric


Nail Containment In Proximal Femur

Reamer Damaged Portal

JOT 2008
Medial Trochanteric Entry Precision Portal Placement

Perez, Juhangir, Russell JOT 2008

Trajectory Control Portal Protection

Reduction Technique

- Hibbs: 1900's 90-90 Traction
- Proximal Fragment Flexes, Abducts andExternally Rotates
- Bring Distal Fragment To Proximal Fragment
1963 Reduction
The Key To Success

- Sarmiento, "Weight-bearing on the fractured extremity is safe only if the fracture, whether simple or comminuted, has been reduced so that there is an accurate fit of the fragments at the anteromedial cortex of the femur.
- Failure to obtain such reduction because of the degree of comminution or technical difficulties precludes weight-bearing until bone union is complete.
- Anatomical reduction of the medial and anterior cortices is of great importance since the stability of the fracture and the efficiency of the nail depend on the reduction of this portion of the bone."

Sarmiento, A. Intertrochanteric Hip Fractures. JBJS 1963;45(4):706-722

Anteromedial Reduction


Open Reduction
Always An Option

- Watson-Jones Approach
- Key Deep Interval Is Origin Of Vastus Lateralis Muscle: Optimal Place For Cerclage Wire Or Clamp
Lateral Shaft Alignment

Nail Follows Path Of Reamer On Lateral Radiograph

Reamer Trajectory In Proximal Fragment Dictates Reduction

Reduction Maneuvers

- Fracture Table Manipulation
- Percutaneous Reduction
- TriGen Reducer
- F Wrench (H.O.Thomas Wrench: Liverpool)
- Femoral Distractor
- Open Reduction
Reduction Tactics
Percutaneous Reduction

External Fixation Pin and Ball Spike Pusher
Reduces Flexion And External Rotation Proximal Segment

Pertrochanteric Operative Pearls

- Reduction
- No Varus
- Approximate Anterior Cortex At Fracture Site
- Open or Percutaneous Joy Sticks As Needed
- Wire Cerclage?

RT 2A
Long Vs. Short Nail

- No Difference in Incidence of Peri-implant Failure With Short Compared to Long Nail <1%
- Distal Locking Decreases Risk
- Unlocked Nails Risk Increases to 10% at 5 Years
- Cost of Implants Equivalent

Unstable Proximal Femur Nail Containment Difficult

Proximal Locked Plate For Highly Unstable Fractures

Short Versus Long Cephalomedullary Nails for the Treatment of Intertrochanteric Hip Fractures in Patients Older than 65 years. Kleweno et al. JOT 2014


Hou Z et al. Treatment of peritrochanteric fractures (OTA 31-A1 and A2) long versus short cephalomedullary nailing. JOT 2014

Unstable Proximal Femur Nail Containment Difficult

Not ideal for Nail

Proximal Locked Plate For Highly Unstable Fractures

The Lateral Distal Approaches for Complex Femur Fractures: Stability Using Plate Osteosynthesis and Plate Fixation

Connelly and Archdeacon JOT 2012

Streibel et al JOT 2012 37% Failure Rate In As Fx 3 Screw Synthes PFP
Future of Implant Design

- Better Appreciate The Complexity of the Femur
- Reduction and Implant Stability Improvements
- Decrease Pain and Improve Early Functional Recovery
- Augmentation of Optimized Nail Designs