

## Hip Fractures: Pearls of Treatment

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Chief Orthopedic Trauma & Adult Reconstruction  
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RWJ Barnabas Health

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## Disclosure

- Co-Founder / Consultant / Designer  
– Revision Technologies LLC
- Educational Consultant  
– AO, Stryker, Biomet
- Royalties  
– Biomet
- Design Team  
– Biomet  
– Synthes

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## It's How You Read the Xray

- Defining the "TYPE" of fracture
- Realizing the CHALLENGES
- Knowing the CORRECT PLAN to execute

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# Femoral Neck Fractures

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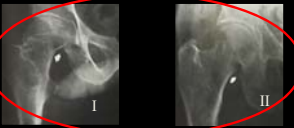
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*Non-Displaced*


**Classification**

- Garden [1961]
- I Valgus impacted or incomplete
- II Complete Non-displaced
- III Complete Partial displacement
- IV Complete Full displacement

\*\* Portends risk of AVN and Nonunion



*Displaced*



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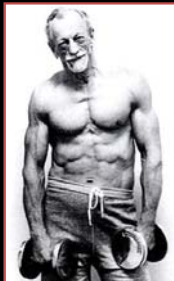
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### What is elderly?

- Not all elderly created equal
- ORIF, Unipolar, Bipolar, THA
- Lu Yao et al 1994
  - Displaced fractures: avg age 77
  - Nonunion 33%
  - Secondary surgery
    - >30% w/ ORIF
    - 6-18% HHA



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### • Bottom Line:

Short to midterm FU w/o clear difference in bipolar vs unipolar

Longer FU w/ better survivorship with bipolar

Consider potential patient mortality, costs, etc.

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### Cemented vs Non-cemented

- Many early studies eval'd Austin Moore, Thompson
- No analysis individually of Modern, Modular:
  - M-L Taper
  - Metaphyseal "Fill"
  - Diaphyseal Fit



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### THA vs HHA

- *THA w/ less pain than HHA*
  - Dorr 1986
  - Skinner 1989
  - Gebhard 1992
  - Squires 1999
- *Lower revision rate w/ THA*
  - Skinner 1989
  - Gebhard 1992
  - Squires 1999
- *No difference in M & M*




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### Acetabular Wear




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### Dislocation w/ THA for FNF

	n	# early dislocation	# late dislocation
Coates 1979	85	7	4
Cartledge 1981	48	7	1
Taine 1985	163	20	3
Sim 1986	112	12	2
Dorr 1986	39	7	1
Delamarter 1987	27	0	0
Pun 1987	46	4	1
Greenough 1988	37	3	3
Gebhard 1992	44	1	0
Lee 1998	126	13	2
<b>TOTAL</b>	<b>727</b>	<b>74 (10.2%)</b>	<b>17 (2.3%)</b>

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### Constrained Liner - Alternative



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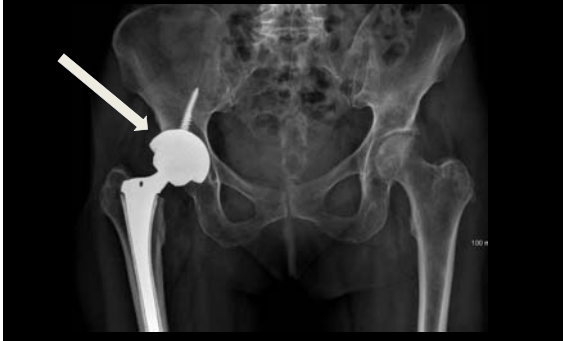
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### Constrained Liners - JP



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### Constrained Liners - JP



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## Dual Mobility

- Time proven in Europe
- Increased Stability with Jump Distance
- 2 articulations
  - Low wear
    - Volumetric analysis
  - 2 sites of potential wear
- Can't be closed reduced if dislocate
  - Dislocation usually intraprosthetic

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## Dual Mobility – Primary THA

**Table 1.** Main published results of dual mobility sockets in primary THA

Study	Number of hips	Mean followup (years)	Dislocation (%)	Intraprosthetic dislocation (%)	Radiographic loosening (%)	Survival (%) <sup>a</sup>
Original Bousquet design						
Boyer et al. [5]	240	22	0	4.1	8.3	73.9
Faizon et al. [9]	135	12	0	2	3	95.4
Lautridou et al. [17]	437	16.5	1.1	0.7	12	88.4
Philippot et al. [26]	106	10	0	1.9	1.9	94.6
Philippot et al. [28]	384	15.3	0	3.6	3.3	94.6
Philippot et al. [29]	438	17	0	5.2	3	89.2
Current dual mobility designs						
Guyen et al. [13]	167	3	0	0	0	
Locheux et al. [19]	200	6	0	0	0	100
Vieljeux et al. [31]	251	5.2	0	0	9	

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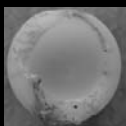
### Is a Cementless Dual Mobility Socket in Primary THA a Reasonable Option?

Moussa Hamadouche MD, PhD, Hervé Arnould MD, Bertrand Bouain MD

Clinical Orthopaedics and Related Research

2012

- 168 patients
- 2% dislocations
  - All dislocations were “long neck”
  - All dislocations were femoral head from insert




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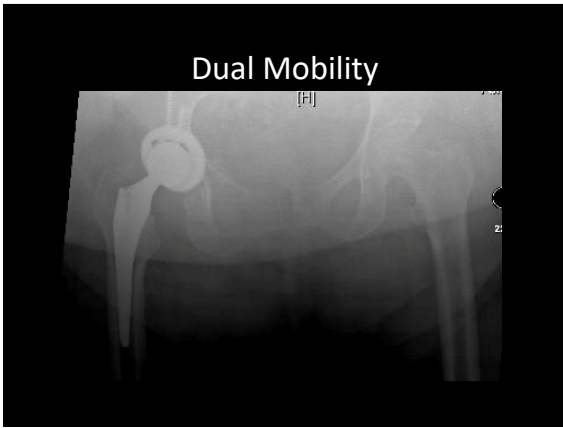
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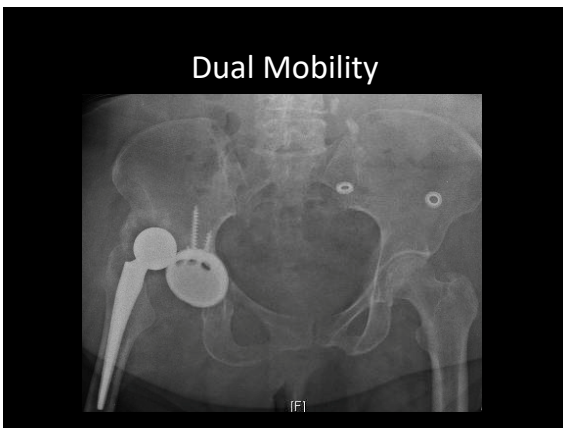
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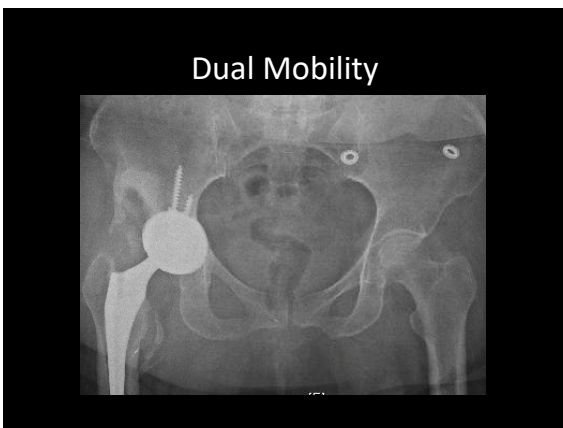
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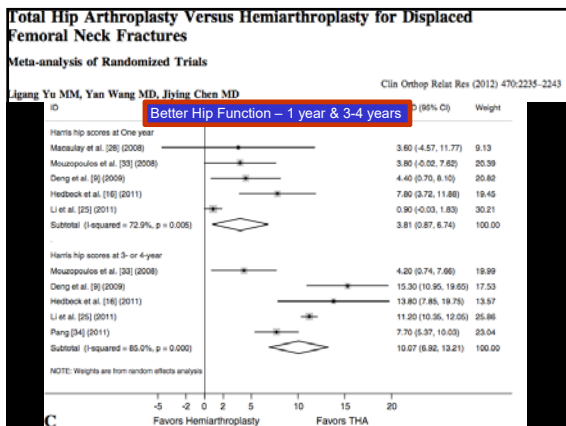
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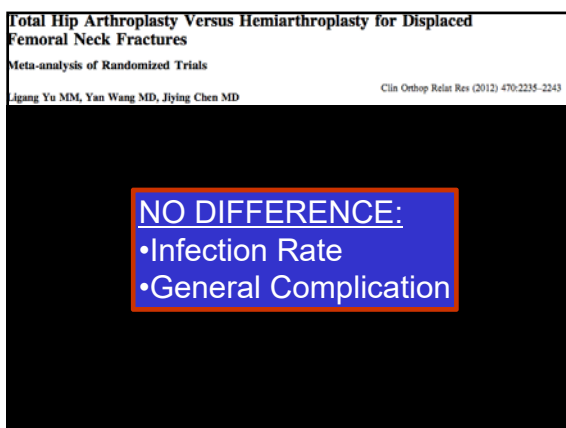
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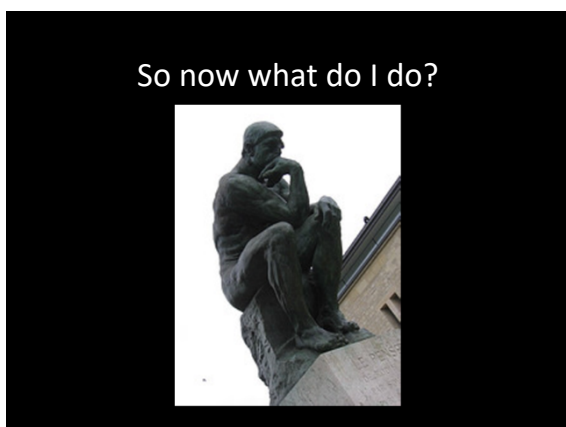
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### Over 65 years old w/ displaced FNF?

- Ambulation status
  - Community
  - Community w/ AD
  - Household
  - Household w/ AD
- Health status



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### My answer for DISPLACED FNF...

- CRPP for NON-DISPLACED or if patient is going to die with anything more and this is for pain relief / immobilization
- THA if community ambulator w/o assistive device and >65 y.o.
- HHA (Bipolar b/c same \$ at my hospital)
  - Try Non-cemented w/ M-L taper stem
  - If fit is questionable - cement

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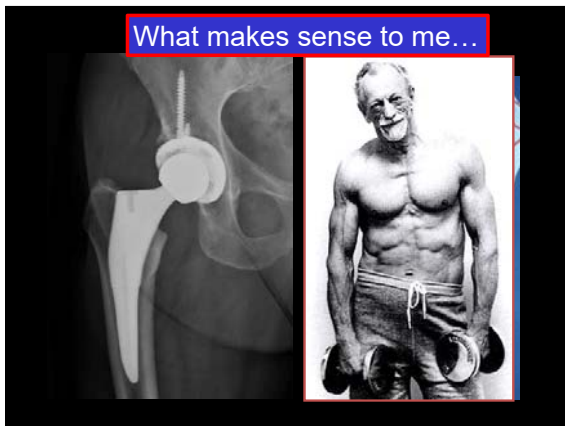
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What if you're SUPPOSEDLY Non-Displaced?

- 10-15% failure???
- Recently indicated up to 25%
- If actually displaced
- 40% + failure

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### Fix vs Replace – 76 year old F



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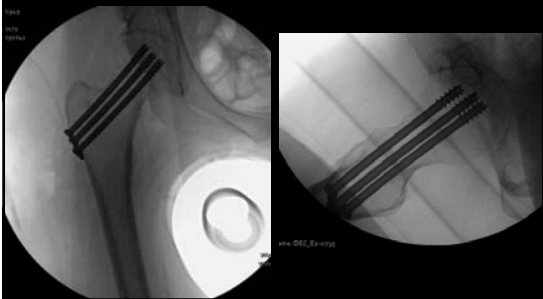
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### Fix



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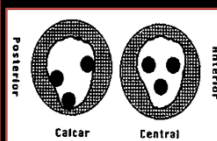
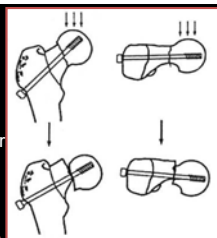
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### Screw Fixation

- Peripheral Screw Placement
- Within 3mm of calcar and posterior cortex  
– (Lundquist et al. Acta Orthop Scand)
- Avoid Central screw placement



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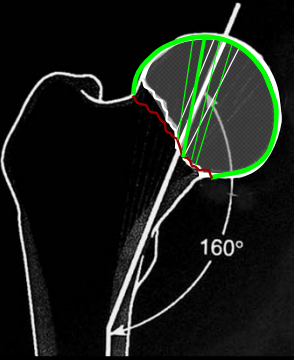
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Femoral Neck Fxs: Keys to a Good Repair



**Reduction Criteria**

**AP**

1-2 mm displacement

160- 175° Garden alignment index

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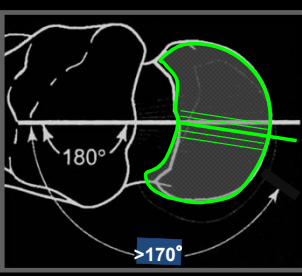
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Femoral Neck Fxs: Keys to a Good Repair



**Reduction Criteria**

**Lateral**

1-2 mm displacement

+/-10° anatomic version

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Not all "Valgus Impacted" are created equal. 😞



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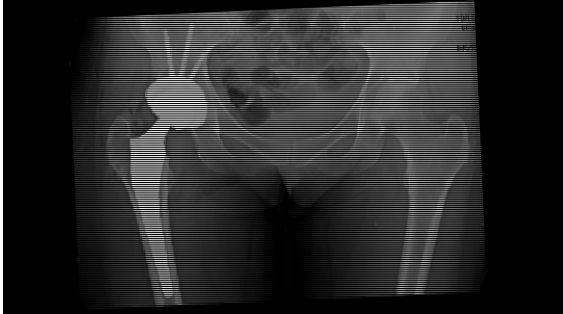
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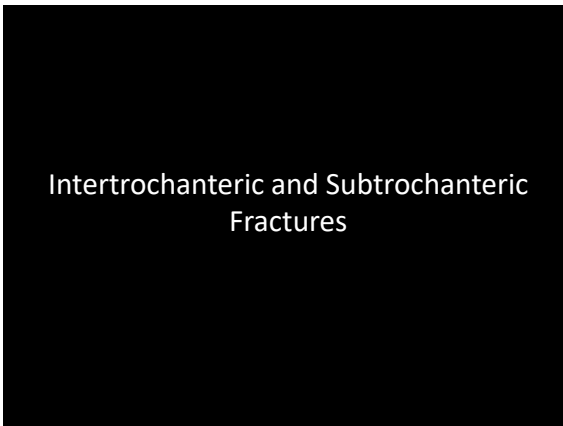
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Intertrochanteric and Subtrochanteric Fractures



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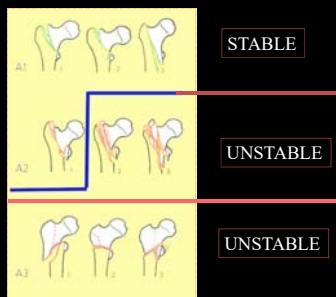
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Stability Matters



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### Let's Focus on Peri-trochanter

- IF CATASTROPHIC FAILURE does NOT occur these fractures WILL HEAL...

**IF FAIL TO AVOID PROBLEMS:**

- LOSS of OFFSET
- AMBULATORY STATUS
- FUNCTION
- MORTALITY RISK



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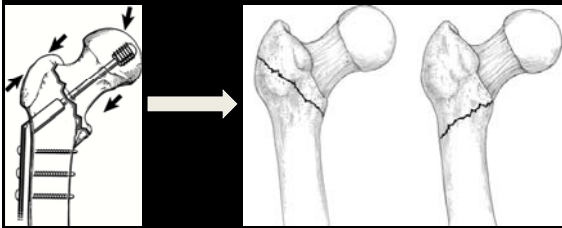
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### Fracture Pattern & Common Theme of Instability - Geometry



**As the LATERAL fracture line moves DISTALLY → INSTABILITY**

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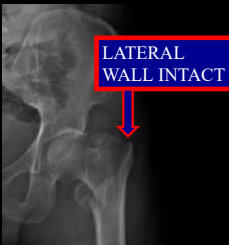
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### Does instability matter?

- What is instability?
  - PM cortical loss
  - 3-4 part fracture

**No DISTAL extension**

**Intact LATERAL CORTEX**



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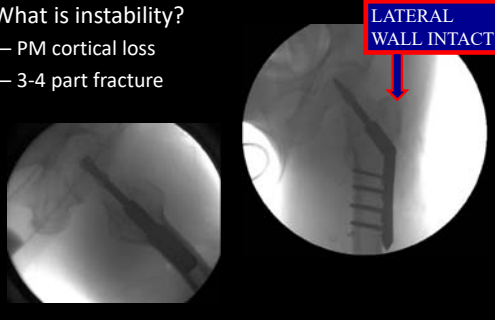
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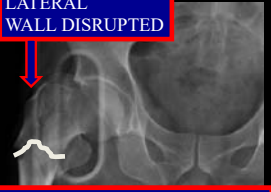
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### Does instability matter?

- What is instability?
  - PM cortical loss
  - 3-4 part fracture

**TRUE INSTABILITY**

- 1) Reverse obliquity
  - 2-5%: reduction is paramount (Haidukewych, et al: JBJS 2001)
- 2) Subtrochanteric extension
- 3) Lack of Lateral Wall Integrity



**LATERAL WALL DISRUPTION**  
Converts potentially STABLE fx to  
**REVERSE OBLIQUITY**

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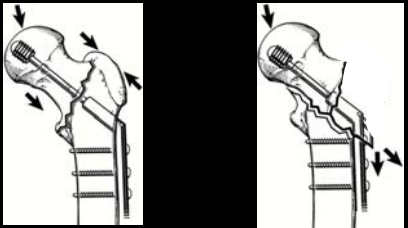
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### REVERSE OBLIQUITY FRACTURES OF THE INTERTROCHANTERIC REGION OF THE FEMUR

JBJS-Am 2001

By GEORGE I. HAIDUKEWYCH, MD, T. ANDREW ISRAEL, MD, AND DANIEL I. BERRY, MD



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JBJS-Am 2001

BY GEORGE I. HAIDUKOWYCH, MD, T. ANDREW ISRAEL, MD, AND DANIEL L. BERRY, MD

- Reverse Obliquity
  - Fracture in Lateral Cortex
  - Loss of Lateral Buttress
  - Loss of Resistance to Medial Shaft Displacement




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### The Result with TIME


Loss of Offset

Im G-I, Shin Y-W, Song YJ, MD: Potentially unstable intertrochanteric fractures. JOT 2005

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### Predictors of Lateral Wall Issue

Parameters	Group I	Group II	P Value
Age (yrs, mean ± SD)	81 ± 4.3	72 ± 15	0.01*
Gender	M: 3, F: 7	M: 21, F: 36	0.70
		I: 10	0.33
		II: 8	
		III: 19	
		IV: 10	
		V: 6	
		VI: 4	
Poor quality of reduction	2/9	3/57	0.53
Intraoperative comminution of lateral cortex	6/9	1/57	0.0001*
Postoperative comminution of lateral cortex	3/9	0/57	0.002

\*P < 0.05

Im G-I, Shin Y-W, Song YJ, MD: Potentially unstable intertrochanteric fractures. JOT 2005

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**Integrity of the Lateral Femoral Wall in Intertrochanteric Hip Fractures: An Important Predictor of a Reoperation**  
JBJS-Am 2007  
 By Henrik Palm, MD, Steffen Jacobsen, MD, Stig Sonne-Holm, MD, DMSc, and Peter Gebuhr, MD, on behalf of the Hip Fracture Study Group

**Lateral Wall Intact**      **Lateral Wall Disrupted**      **FAILURE !!!**

**Can be created IATROGENICALLY!!!**

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	N	Median*
Age (yr)	83	(77-90)
Female gender	153	(71)
Prefracture NMS of 0-5†	116	(54)
ASA score of 3 or 4‡	116	(53)
Postoperative tip-apex distance (mm)	22	(17-27)
Postoperative fracture reduction (mm)	6	(0-13)
Postoperative fractured minor trochanter	89	(42)
Postoperative fractured greater trochanter	132	(62)
Postoperative fractured lateral femoral wall	46	(21)

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	Fractured Lateral Femoral Wall*	Intact Lateral Femoral Wall*	P Value†
No. of patients	46 (100)	168 (100)	
Age (yr)	82 (71-91)	83 (77-89)	0.676
Female gender	35 (76)	118 (70)	0.436
Prefracture NMS of 0-5†	25 (54)	91 (54)	0.983
ASA score of 3 or 4‡	23 (50)	100 (60)	0.247
AJCC classification			<0.001
31.A2	1 (2)	83 (50)	
31.A2.1	2 (4)	17 (10)	
31.A2.2 or A2.3	31 (68)	68 (40)	
31.A3	12 (26)	6 (4)	
Reoperation within 6 mo	10 (22)	5 (3)	<0.001

**> 7x Re-operation Rate !!!**

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### Sliding Hip Screw Insertion

Central position  
Within 1 cm of subchondral bone  
T.A.D. < 25 mm (AP + Lateral)



Tip-Apex-Distance  
DOESN'T  
COUNTER  
INSTABILITY  
Based on  
GEOMETRY

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THE BONE & JOINT JOURNAL

■ TRAUMA

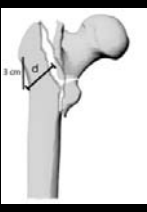
### Lateral femoral wall thickness

A RELIABLE PREDICTOR OF POST-OPERATIVE LATERAL WALL FRACTURE IN INTERTROCHANTERIC FRACTURES

*Bone Joint J 2013;95-8:1134-8.*

C.E. Hsu,  
C.M. Shih,  
C.C. Wang,  
K.C. Huang

- 208 patients
- T.A.D. ~18mm
- Failures / Re-operation Rates
- $d < 20.5\text{mm} \rightarrow$  No SHS



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### What we are trying to avoid: INSTABILITY & DEFORMITY

- Jacobs (1980)
  - 15.7 mm sliding in unstable IT's treated with DHS
- Rha (1993)
  - Excessive sliding major cause of fixation failure
- Steinberg (1988)
  - incidence of fixation failure was increased when sliding length > 15mm
- Baixauli (1999)
  - pts with sliding >15mm had more pain



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### Does Any Plating Make Sense ???



68 yo m s/p unstable peri-troch 4 yrs prior in Nepal  
Originally had a DHS and in Dec 2005 had a DCS



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### Planning



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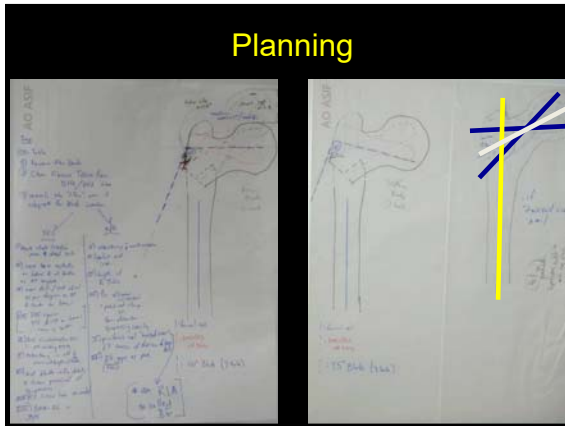
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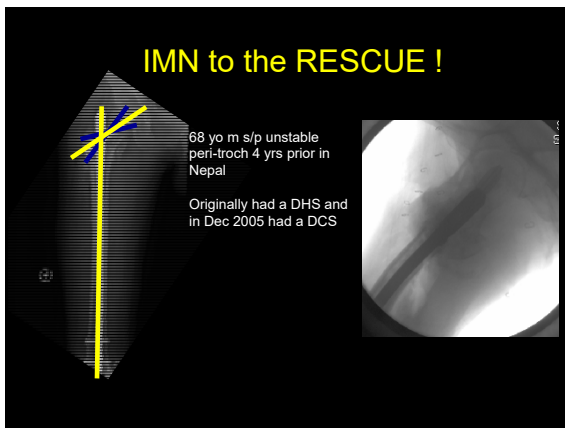
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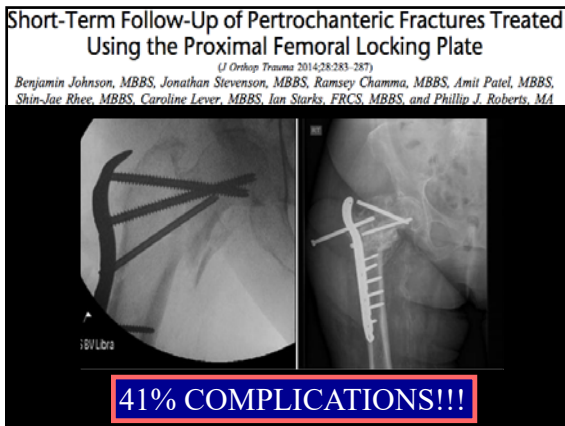
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Reverse Obliquity Fracture  
(Kuzyk PR, Schemitsch EH, et al: JOT 2009)



**DHS** — Infinite ability to slide

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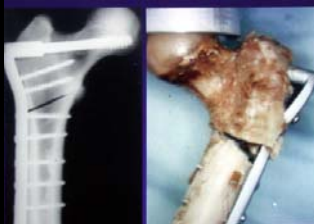
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Reverse Obliquity Fracture  
(Kuzyk PR, Schemitsch EH, et al: JOT 2009)



**DCS**: Some Slide, Some Rotational Instability

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Reverse Obliquity Fracture  
(Kuzyk PR, Schemitsch EH, et al: JOT 2009)



**IMN**: Prevents Excessive Slide and Newer  
**IMN** Potential to Prevent Rotation !!!

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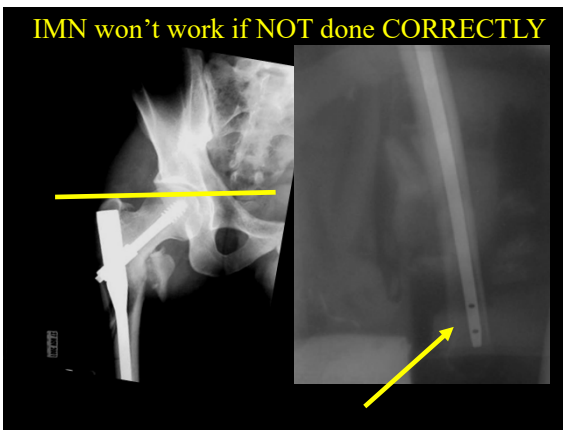
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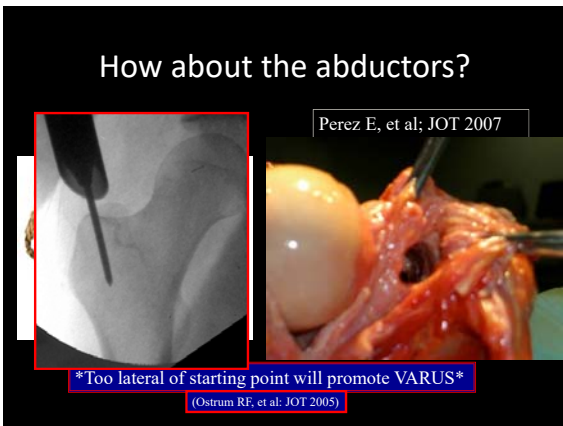
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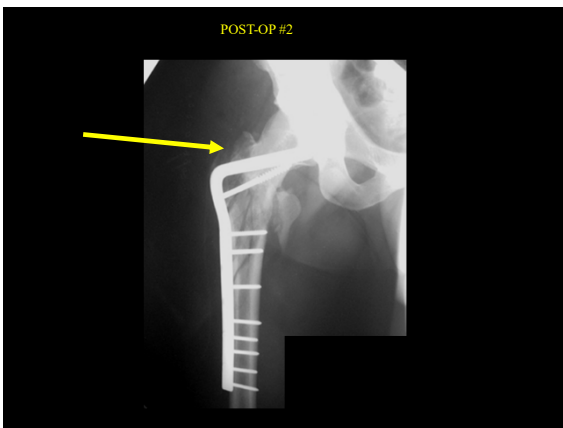
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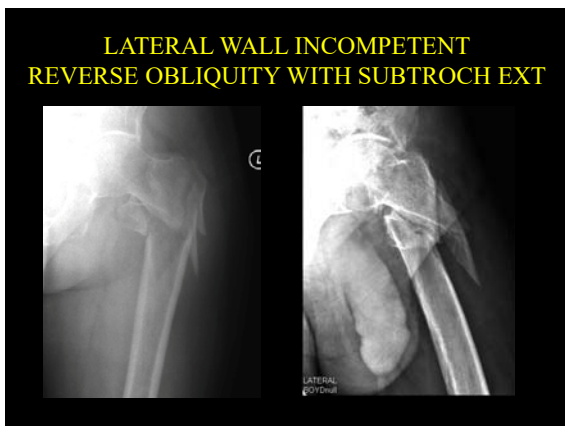
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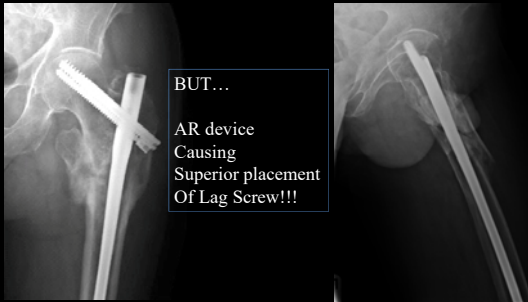
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### OFF-SET MAINTAINED – SUCCESS!!!



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### What is best TAD for lag screw with IMN?

**CONCLUSIONS:**

- The inferior lag screw position produced the highest axial and torsional stiffness.
- Anterior and posterior lag screw positions produced the lowest stiffnesses and load-to-failure.
- Inferior lag screw on the AP x-ray and central placement on the lateral x-ray is recommended.



[J Orthop Trauma. 2012 Jul;26\(7\):414-21](#)  
[Femoral head lag screw position for cephalomedullary nails: a biomechanical analysis.](#)  
[Kuzyk PR, Zdero R, Shah S, Olsen M, Waddell JP, Schemitsch EH](#)

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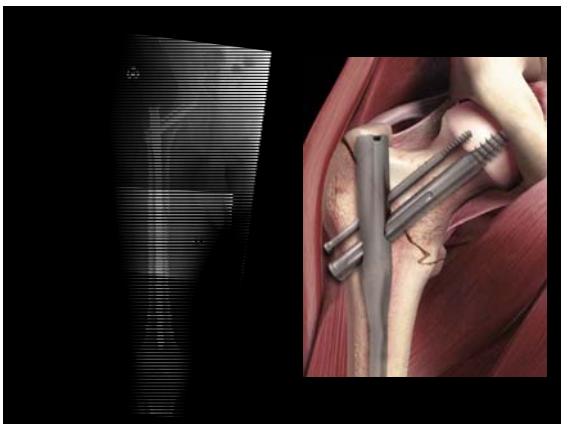
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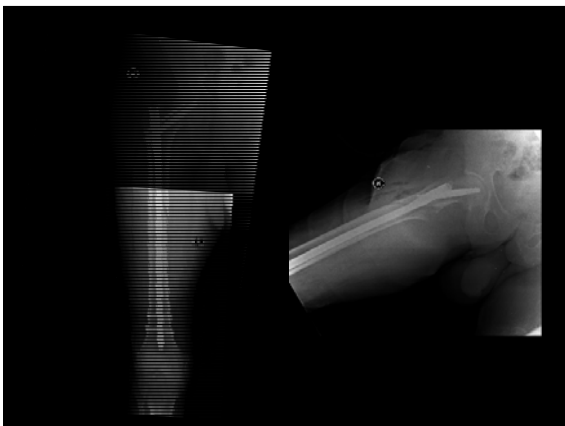
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What's the price we pay?

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IT fx treatment

- *Most important to understand radiographic picture*
- IMN if:
  - Reverse Obliquity
  - Subtrochanteric extension
  - Lateral Wall blow-out
  - Thin Lateral Wall
  - If unsure of stability

ANY QUESTION OF CURRENT OR POTENTIAL INSTABILITY!!!

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CASES

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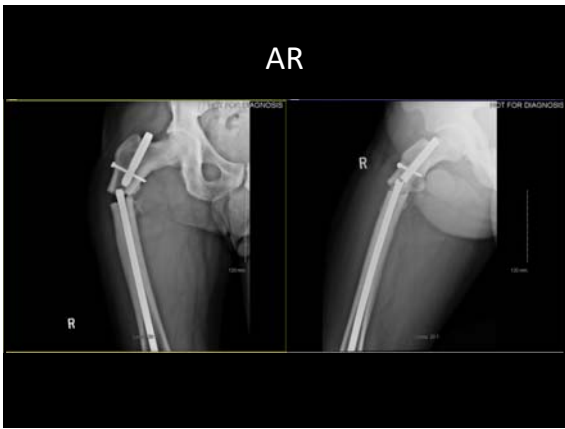
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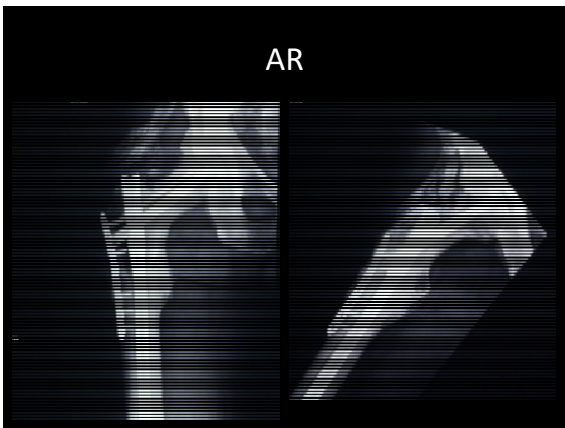
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### Clamp-Assisted Reduction of High Subtrochanteric Fractures of the Femur

JBJS-Am 2009

By Alan Afari, MD, Frank Liporace, MD, Eric Lindvall, DO, Anthony Infante Jr., DO, Henry C. Sagi, MD, and George J. Haidukewych, MD



43 / 44 united  
<5 deg deformity  
86% anatomic  
6 pts w/2-5 deg varus

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### Clamp-Assisted Reduction of High Subtrochanteric Fractures of the Femur

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By Alan Afari, MD, Frank Liporace, MD, Eric Lindvall, DO, Anthony Infante Jr., DO, Henry C. Sagi, MD, and George J. Haidukewych, MD



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### Tricks to help reduction

- Blocking screws
- Concavity of ENTRY Fragment

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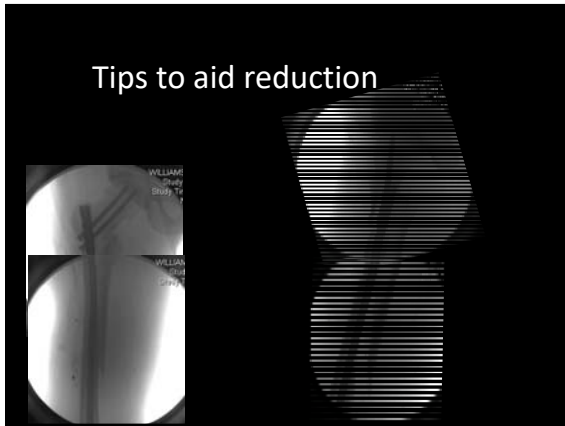
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**Peri-troch**

- Osteoporotic Bone (whole femur is subpar)
- Basiceervital fracture
- Single cephalomedullary device
- No anti-rotation

- Problems
  - Not an Intertroch Fx
  - Needed Rotational stability
  - Screw placement poor
- Potential solutions
  - SHS
  - Nail w/ ability to have AR screw

AP BURNGHull C3048 W4036

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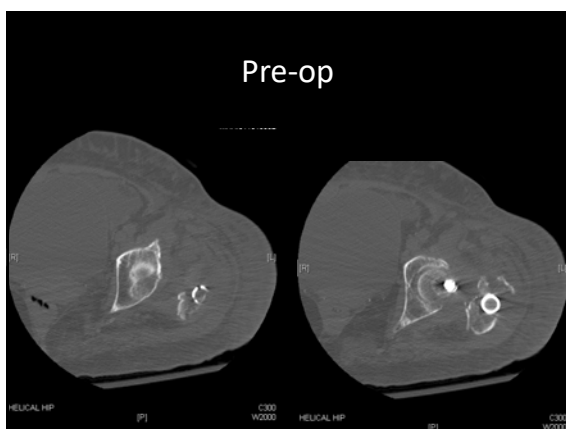
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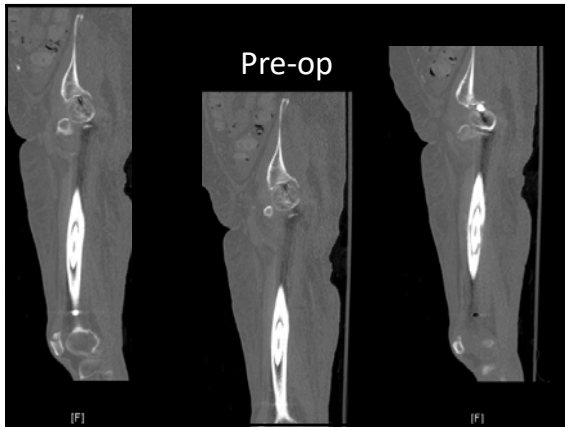
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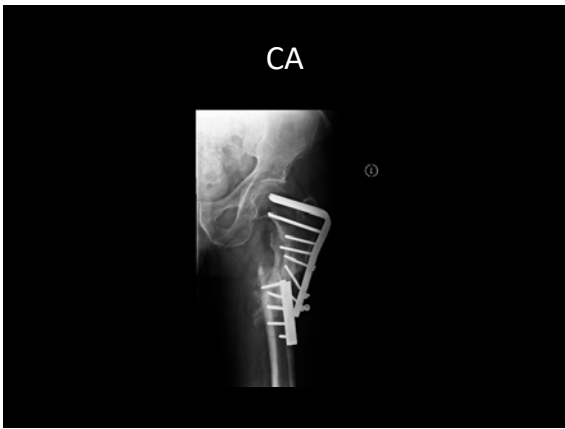
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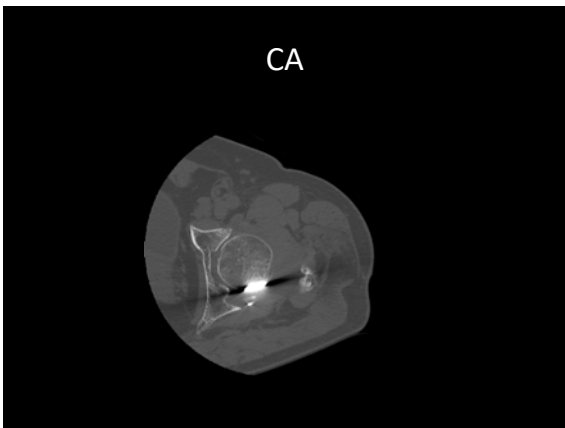
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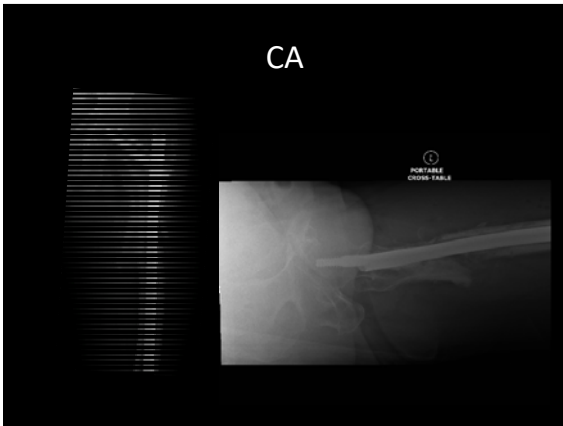
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Immediate post-op  
(outside hospital)



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2 weeks post-op on transfer



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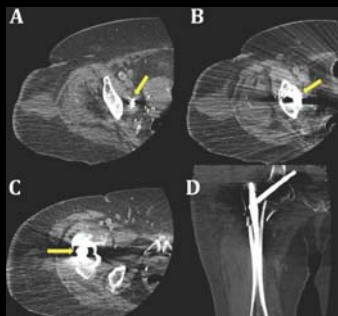
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2 weeks post-op on transfer



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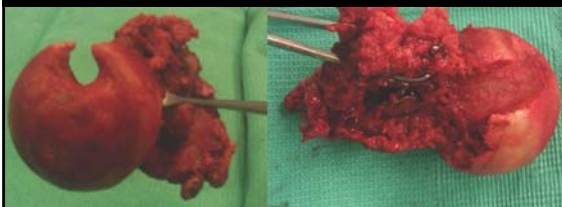
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**Forward Progression of the Helical Blade into the Pelvis Following Repair with the Trochanter Fixation Nail**

Liporace et al: Journal of Orthopaedic Trauma



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**Final Revision**



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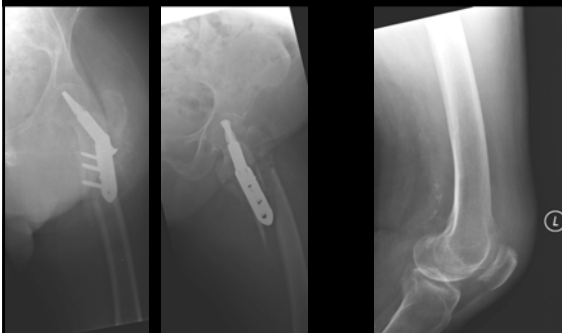
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**Failed ORIF – 3 wks post ORIF**



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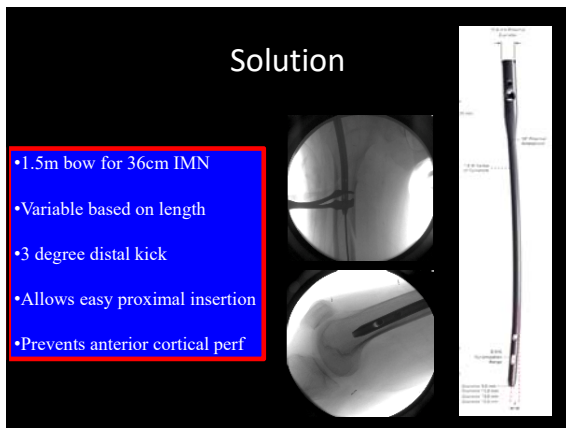
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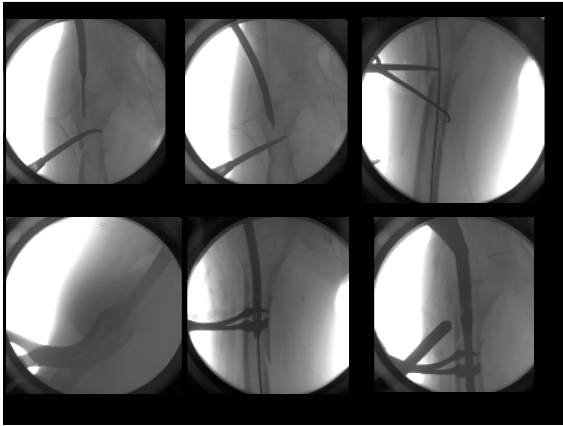
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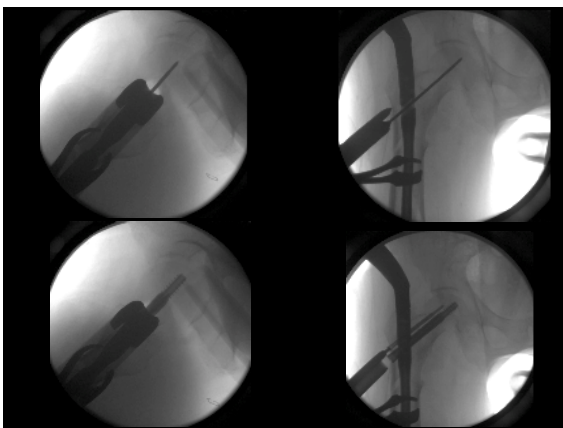
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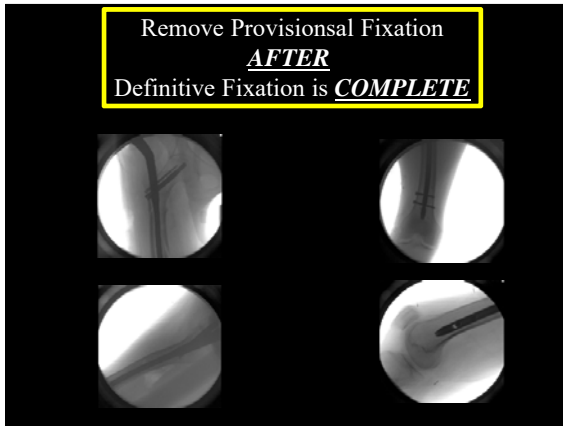
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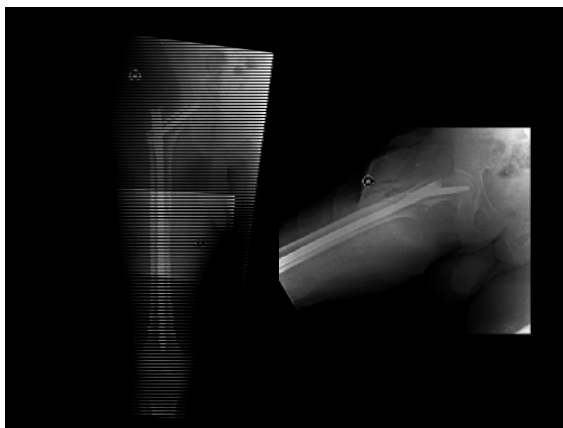
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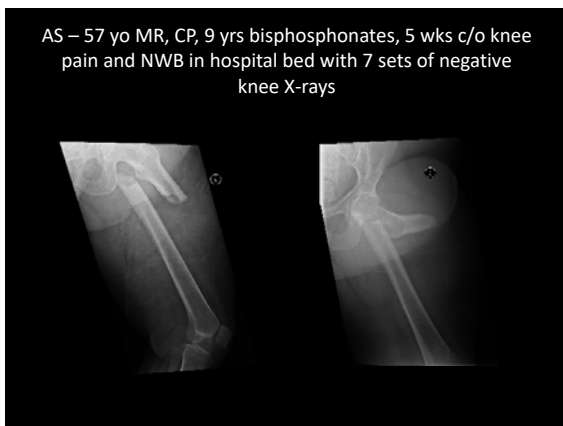
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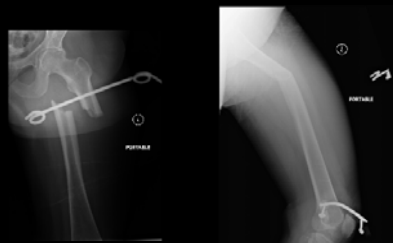
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AS – 57 yo MR, CP, 9 yrs bisphosphonates, 5 wks c/o knee pain and NWB in hospital bed with 7 sets of negative knee X-rays



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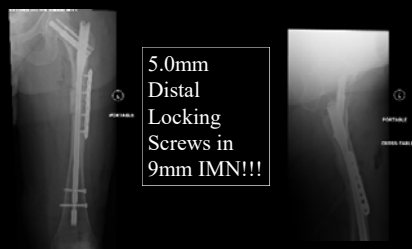
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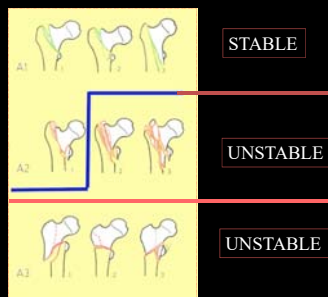
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**SUMMARY: It's all about STABILITY**



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What's the price we pay?

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**EXHIBIT SELECTION**  
**Cost-Effective Trauma Implant Selection**  
AAOS Exhibit Selection **JBJS 2014**  
Kenneth A. Egol, MD, Christina E. Capriccioso, BSE, Sanjay R. Konda, MD, Nirmal C. Tejwani, MD,  
Frank A. Liporace, MD, Joseph D. Zuckerman, MD, and Roy I. Dovidovitch, MD



Long Intramedullary Nail \$4,133  
Short Intramedullary Nail \$2,986  
Sliding Hip Screw \$1,152.50

\*Reference: Stryker and Synthes pricing provided via email correspondence

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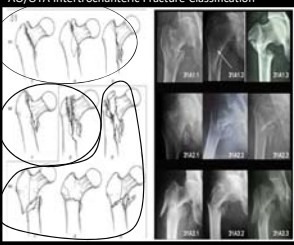
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**AO/OTA Intertrochanteric Fracture Classification**



SHS  
Short Nail  
Long Nail

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### Classification Based Treatment Algorithm for Hip Fxs

Overall, the classification based protocol resulted in **real cost savings: \$70,000**

This savings seen by only changing implant choice for IT hip fractures during a 6 month period

No other treatment measures were changed

**BUT >>>**

- Re-admission direct costs for Hip fx can exceed \$35K / pt
- Loss of offset → Loss of ambulatory status & complications
- FAILURE = MORBIDITY + / - MORTALITY

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### Take Home: It's How You Read the Xray

- Defining the "TYPE" of fracture
- Realizing the CHALLENGES
- Knowing the CORRECT PLAN to execute

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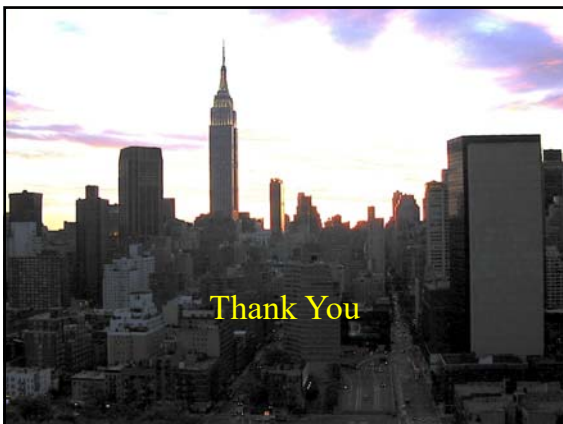
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