Young Adult Hip
Femoral Neck Fractures

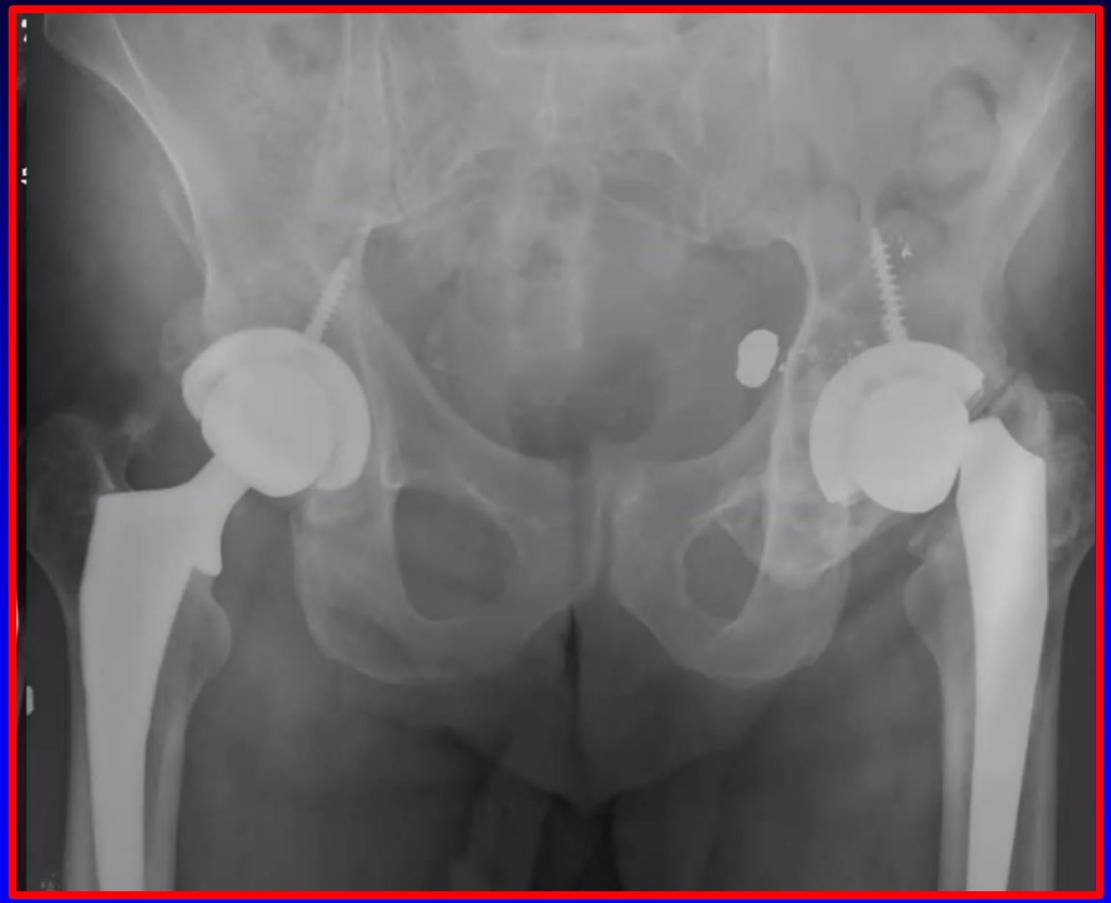
Paul Tornetta III

Boston Medical Center

Disclosures!

- **Publications:**
  - **Wolters Kluwer Royalties; AAOS; OKU Trauma, ICL Trauma, Tornetta; Op Techn in Ortho Surg, OTA Curriculum, AAOS ROCK**
  - **Journals:; JOT; Specialty editor, CORR, JAAOS, JBJS; Reviewer**
- **Research:**
  - **NIH, OTA, FOT, OREF, DOD**
- **Consultant / Designer**
  - **Smith and Nephew,**
- **Boards / Officer:**
  - **AAOS**

Different Than Elderly



Lots of Issues

- Type of fracture
  - Subcap vs basicervical
  - Anatomy of fx line
- Timing of fixation
- Patient and injury factors
- Surgeon controlled factors

Timing vs AVN ?

- Unclear!
  - Vascular injury
    - Disruption
    - Kinking (traction might help)
  - Undisplaced
    - Maybe some pressure issues (unlikely)
  - FAITH: SHS 9%; CS 5% (p=0.03)

The relationship between femoral neck fracture in adult and avascular necrosis and nonunion: A retrospective study

Saeed Koaban, Raheef Alatassi*, Salman Alharbi, Mansour Alshehri, Khalid Alghamdi

Time of fixation			0.011
Within 24 h	16 (28.1)	8 (66.7)	
After 24 h	41 (71.9)	4 (33.3)	

?

Until Recently Not Much

Haidukewych GJ, Rothwell WS, Jacofsky DJ, Torchia ME, Berry DJ. Operative treatment of femoral neck fractures in patients between the ages of fifteen and fifty years. JBJS. 2004 Aug 1;86(8):1711-6.

Lindequist & Tornkvist. Quality of reduction and cortical screw support in femoral neck fractures. An analysis of 72 fractures with a new computerized measuring method. J Orthop Trauma. 1995 Jun;9(3):215-21.

Booth KC, Donaldson TK, Dai QG. Femoral neck fracture fixation: a biomechanical study of two cannulated screw placement techniques. Orthopedics. 1998 Nov 1;21(11):1173-6.

Results of Internal Fixation of Pauwels Type-3 Vertical Femoral Neck Fractures

Liporace, Frank MD[1]; Gaines, Robert MD[2]; Collinge, Cory MD[3]; Haidukewych, George J MD[2]

- 76 Fractures
- AVN: 11%
- Nonunion
  - Screws: 19%
  - Fixed angle: 8%

Best Overall Data

Treatment Failure in Femoral Neck Fractures in Adults Less Than 50 Years of Age: Analysis of 492 Patients Repaired at 26 North American Trauma Centers

Cory A. Collinge, MD,[a] Andrea Finlay, PhD,[b] Andres Rodriguez-Buitrago, MD,[c] Michael J. Beltran, MD,[d] Phillip M. Mitchell, MD,[c] Hassan R. Mir, MD, MBA,[e] Michael J. Gardner, MD,[f] Michael T. Archdeacon, MD,[d] and Paul Tornetta III, MD[g] on behalf of the Young Femoral Neck Working Group

- **377 Displaced**
- **52% Complication rate!**

Patient & Injury

- Pauwels angle
- Displacement
- Comminution
- Age
- Male sex
- Metabolic bone
- Alcohol use

Most Important

- *Reduction*
- *OR 5.3!!!*

Managing Femoral Neck Fractures in Adults Less than 50 years of Age: Effects of Technical Errors on Outcomes in a Large, Multicenter Population

Cory Collinge[1]; Payton Harris[1], Andres Rodriguez-Buitrago[2], Michael J Beltran[3], Hassan Mir[4], Michael Gardner[5], Michael Archdeacon[6], Patton Robinette[7], David O'Neill[8], Paul Tornetta III[9], Andrew Sems[10], Kyle Jeray[11], John Ketz[12], Chad Coles[13], John Scolaro[14]; Brett Crist[15]; Patrick Bergin[16]; Jaimo Ahn[17]; Joseph Hsu[18]; Andrew Schmidt[19]; Nirmal Tejwani[20]; Walter Virkus[21]; Timothy Weber[22]; Brian Mullis[23]; Frank Liporace[24]; Frank Avilucea[25]; Daniel Horwitz[26]; Robert Hymes[27], Lisa Cannada[28], and other members of the Young Femoral Neck Working Group.

Technique Matters

"Technical error" defined as:

- Malreduction: Fair/poor
- Fixation:
  1. Fixed angle device: TAD >25mm
  2. Cannulated screw: >3mm from calcar cortex
  3. Cannulated screws: >10mm from joint
  4. Cannulated screws: <1cm separated

Errors Happen

Variables	All	Repairs *without* Technical Error(s)	Repairs *with* Technical Error(s)	P-value
Number of patients	492	247	245	NA
Mean Age, years (SD)	36.8 ±8.8	38.1± 8.7	36.2± 8.8	0.040
Gender (% female)	172 (35%)	64 (25.9%)	108 (44.0%)	0.002
Mean Body Mass Index	27.2 ±6.9	27.1±7.5	27.2± 6.6	0.980
Patients with medical problems associated with bone metabolism*	211	103 (48.8%)	108 (51.1%)	0.950
Mean Pauwels' angle	53.2 ±11.4	51.8± 14.0	54.1± 13.5	0.020
Displacement (Modified Garden) ● Non-displaced ● Displaced	 115 377	 70 (60.9%) 173 (45.9%)	 45 (39.1%) 204 (53.1%)	0.005
Pauwels' classification for displaced fractures (n=377) ● Type I (<30°) ● Type II (30°-50°) ● Type III (>50°)	 7 124 246	 4 (57.1%) 36 (27.8%) 38 (15.4%)	 3 (42.9%) 88 (71.0%) 208 (84.6%)	< .001
Fixation construct ● Multiple cannulated screws ● Fixed angled device	 287 205	 102 (35.5%) 145 (70.7%)	 185 (64.5%) 60 (29.2%)	<0.001

Relationship of technical errors with complications in all fracture, and non-displaced and displaced fractures

	All fractures (492)			Non-displaced Fractures (115)			Displaced Fractures (377)		
Treatment outcomes	*Repairs without TE(s)(247)*	*Repairs with TE(s) (245)*	P-value	*Repairs without TE(s) (70)*	*Repairs with TE(s) (45)*	P-value	*Repairs without TE(s) (177)*	*Repairs with TE(s) (200)*	*P-value*
Repairs with major complications and/or major reconstructive surgery	54 (21.9%)	135 (55.1%)	<0.001	8 (11.4%)	10 (22.2%)	0.099	46 (26.1%)	125 (62.2%)	<0.001
Nonunion and/or failed fixation	23 (9.3%)	88 (35.9%%)	<0.001	3 (4.3%)	4 (8.9%)	0.267	20 (11.3%)	84 (41.8%)	<0.001
Osteonecrosis (Stages 2b-4)	26 (10.5%%)	33 (13.5%%)	0.172	5 (7.1%)	4 (8.9%)	0.497	21 (11.9%)	29 (14.4%)	0.381
Malunion	4 (1.6%)	7 (2.8%)	0.238	0 (0)	1 (2.2%)	0.391	4 (2.3%)	6 (3.0%)	0.470
Required major reconstructive surgery	39 (15.8%)	100 (40.8%)	<0.001	6 (8.6%)	9 (20.0%)	0.048	33 (18.8%)	91 (45.3%)	<0.001

- **Complications**
- **Nonunion**
- **Major Surgery**

Errors Additive

	N	Success	Failure	P value
No Errors	177	73.4%	26.6%	<001
Error (s)	200	38%	62%	
1 Error	163	59.9%	40.1%	
2 Errors	32	20.5%	79.5%	
3 Errors	5	9.1%	90.1%	

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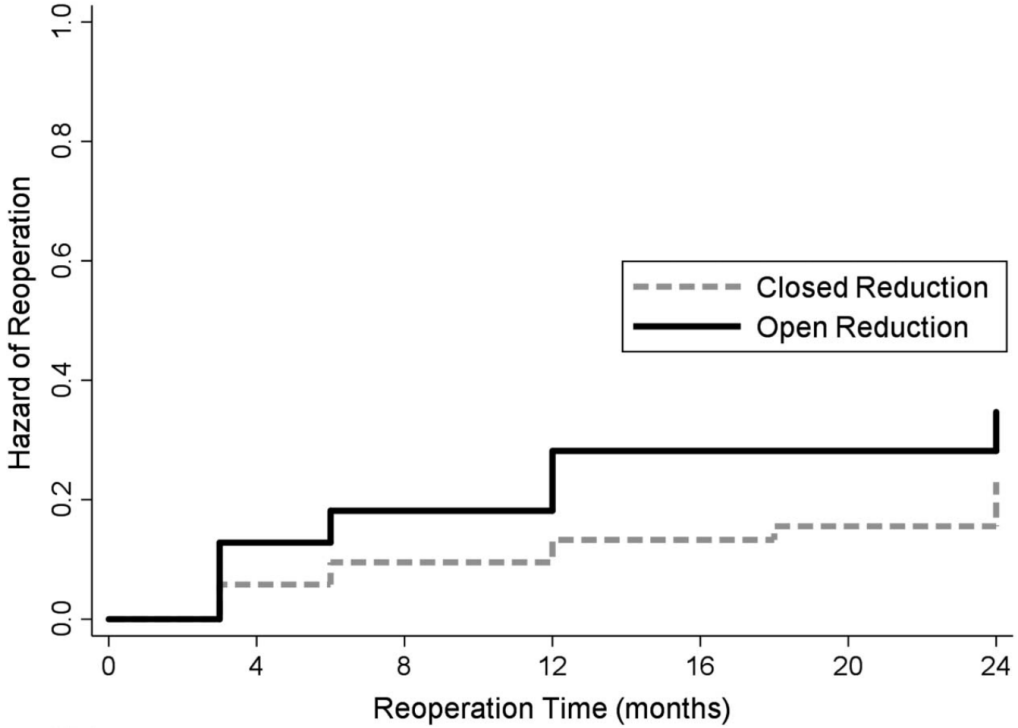
How to Do Better?

- Open reduction?
- Fixation type?

Open Reduction Is Associated With Greater Hazard of Early Reoperation After Internal Fixation of Displaced Femoral Neck Fractures in Adults 18–65 Years

Joseph T. Patterson, MD, Keisuke Ishii, MD,* Paul Tornetta III, MD,†*



Contents lists available at ScienceDirect

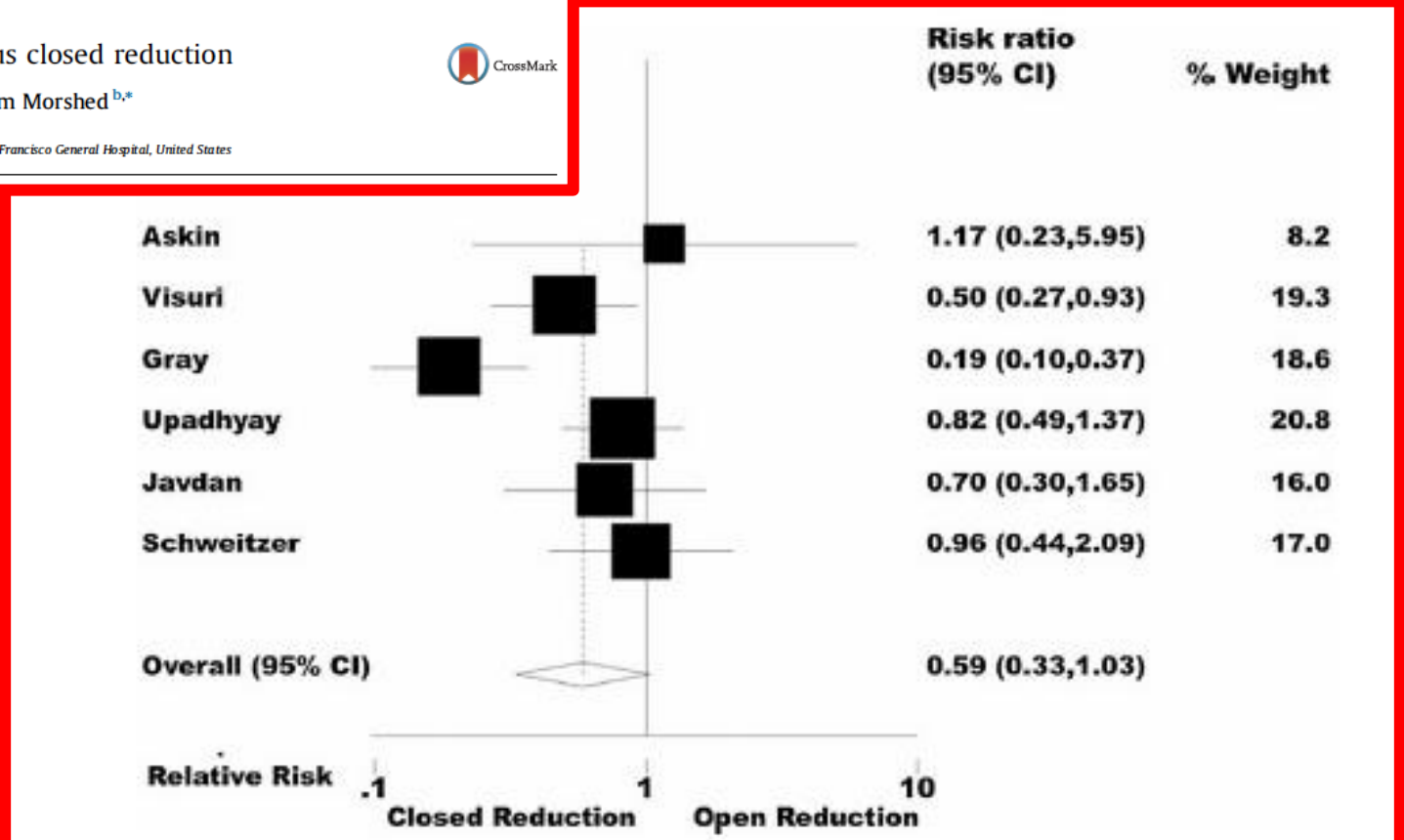
Injury

journal homepage: www.elsevier.com/locate/injury

Evidence based update: Open versus closed reduction

Pouriya Ghayoumi [a,1], Utku Kandemir [b,2], Saam Morshed [b,*]

[a] University of California, San Francisco School of Medicine, United States
[b] University of California, San Francisco, Orthopaedic Trauma Institute at San Francisco General Hospital, United States

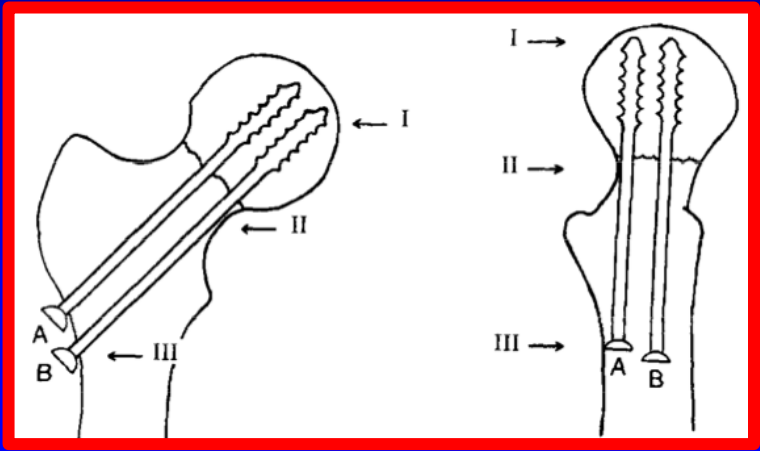


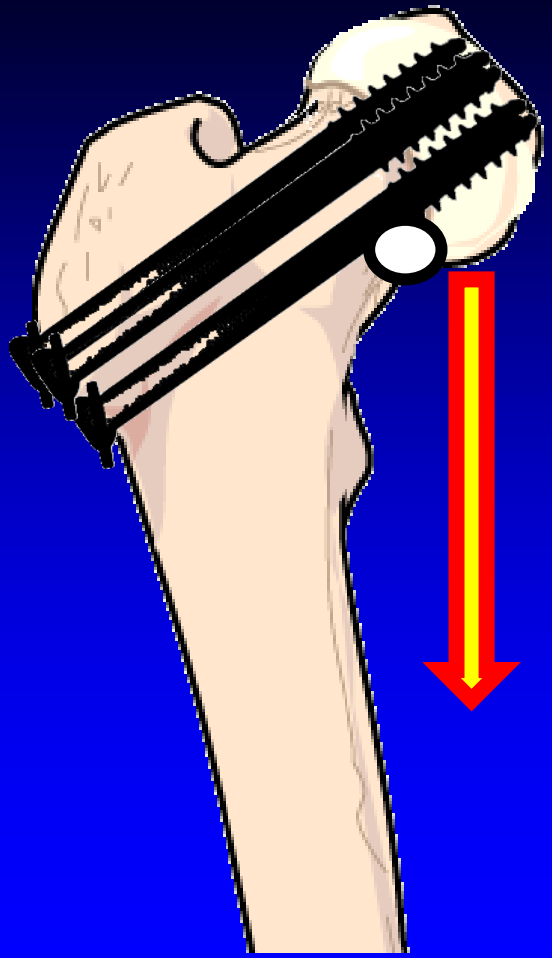
Fixation Device

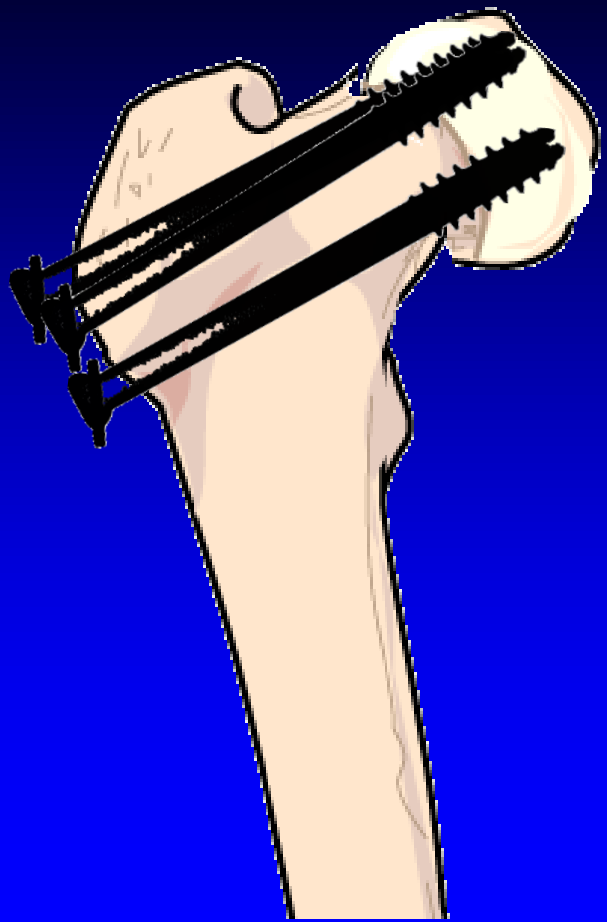
- If CS
  - Butress properly
  - Success < 5mm
- If SHS of FNS
  - TAD

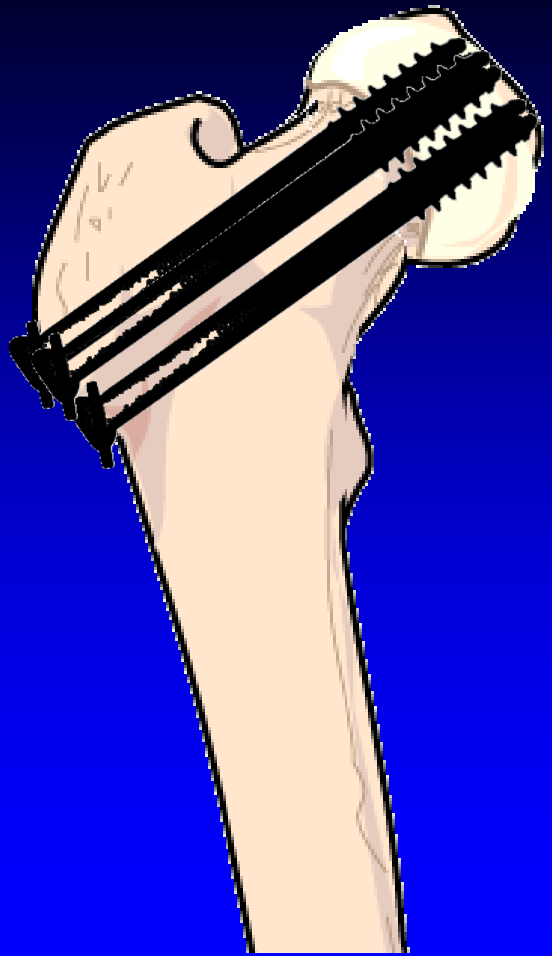
Percutaneous cannulated screw fixation of femoral neck fractures: the three point principle

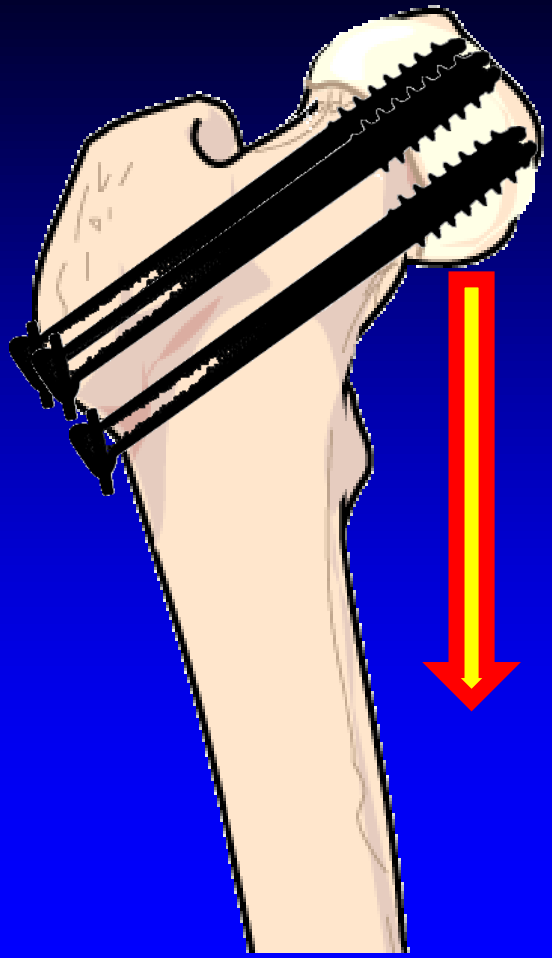
C. A. Bout, D. M. Cannegieter and J. W. Juttmann
Ziekenhuis Hilversum, Hilversum, The Netherlands

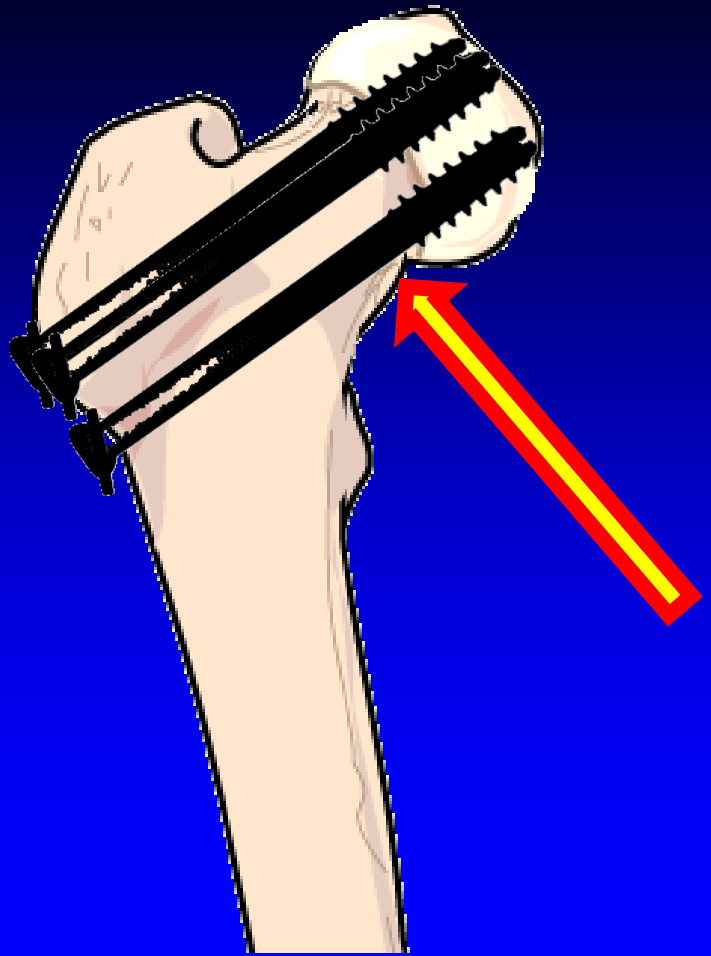


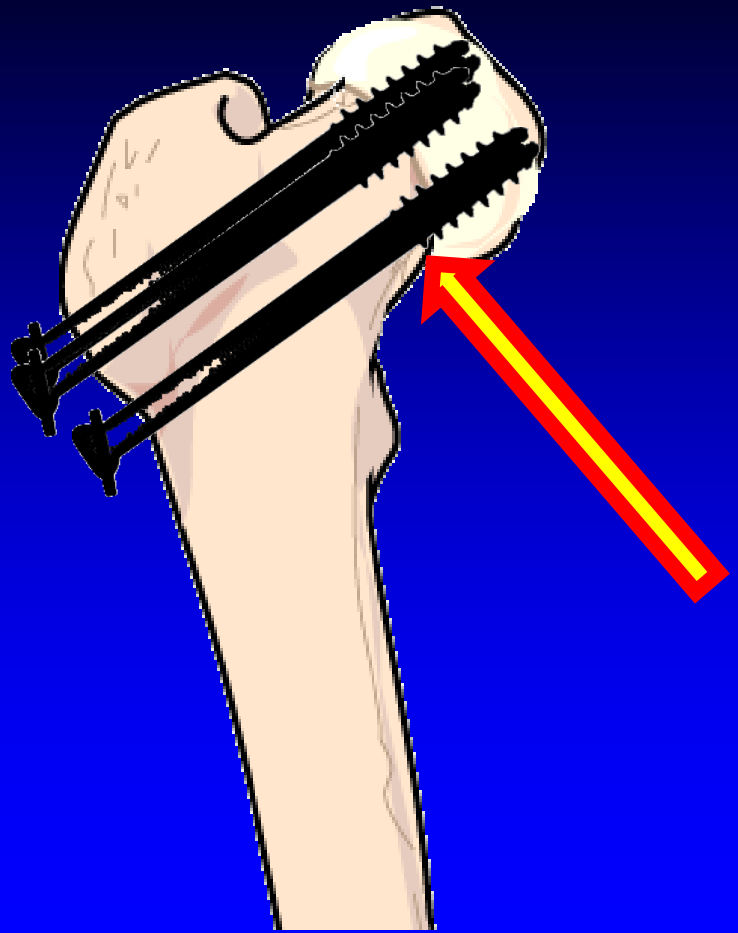






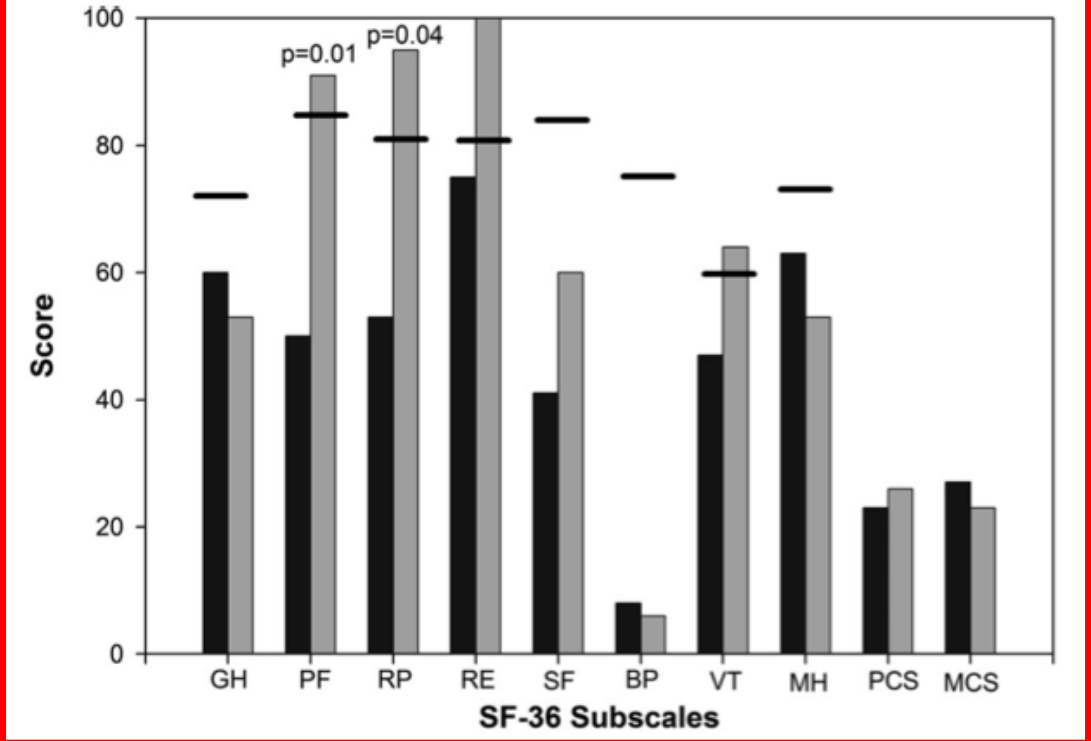






Femoral Neck Shortening After Fracture Fixation With Multiple Cancellous Screws: Incidence and Effect on Function

Michael Zlowodzki, MD, Olufemi Ayieni, MD, Brad A. Petrisor, MD, and Mohit Bhandari, MD, MSc,

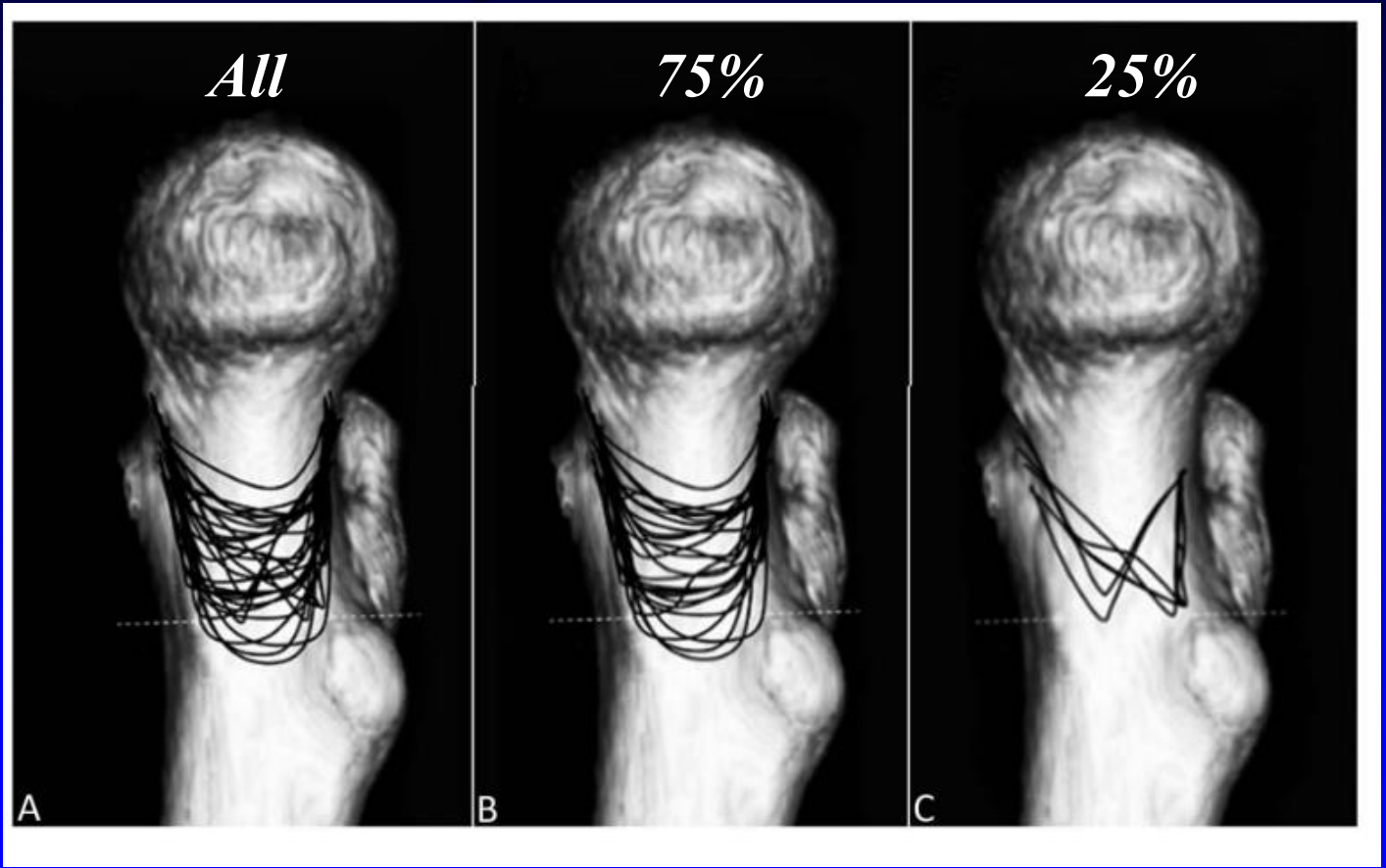


Anatomy of the Fracture

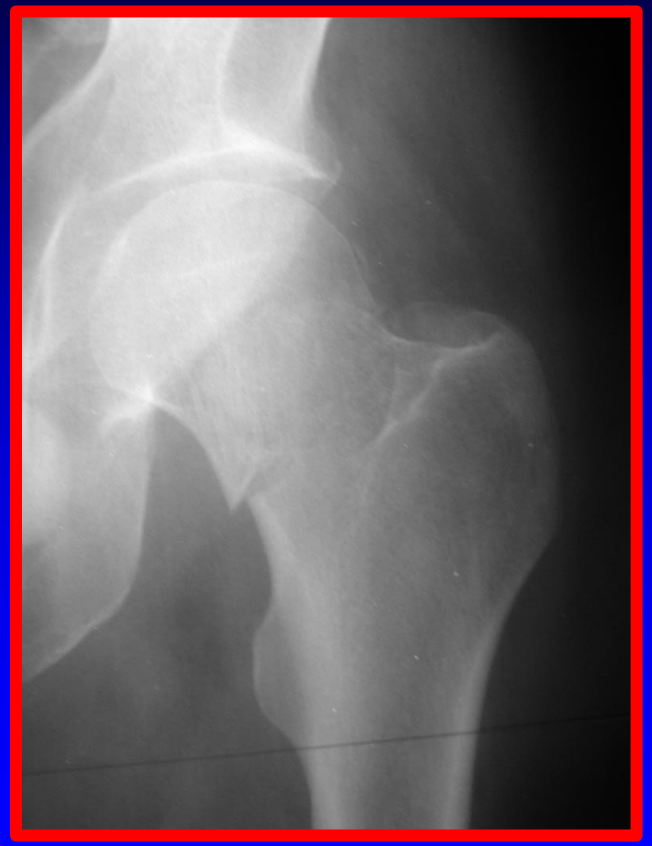
Mapping of Vertical Femoral Neck Fractures in Young Patients Using Advanced 2 and 3-Dimensional Computed Tomography

Shumaila Sarfani, MD,[a] Michael J. Beltran, MD,[b] Michael Benvenuti, MD,[a] and Cory A. Collinge, MD[c]

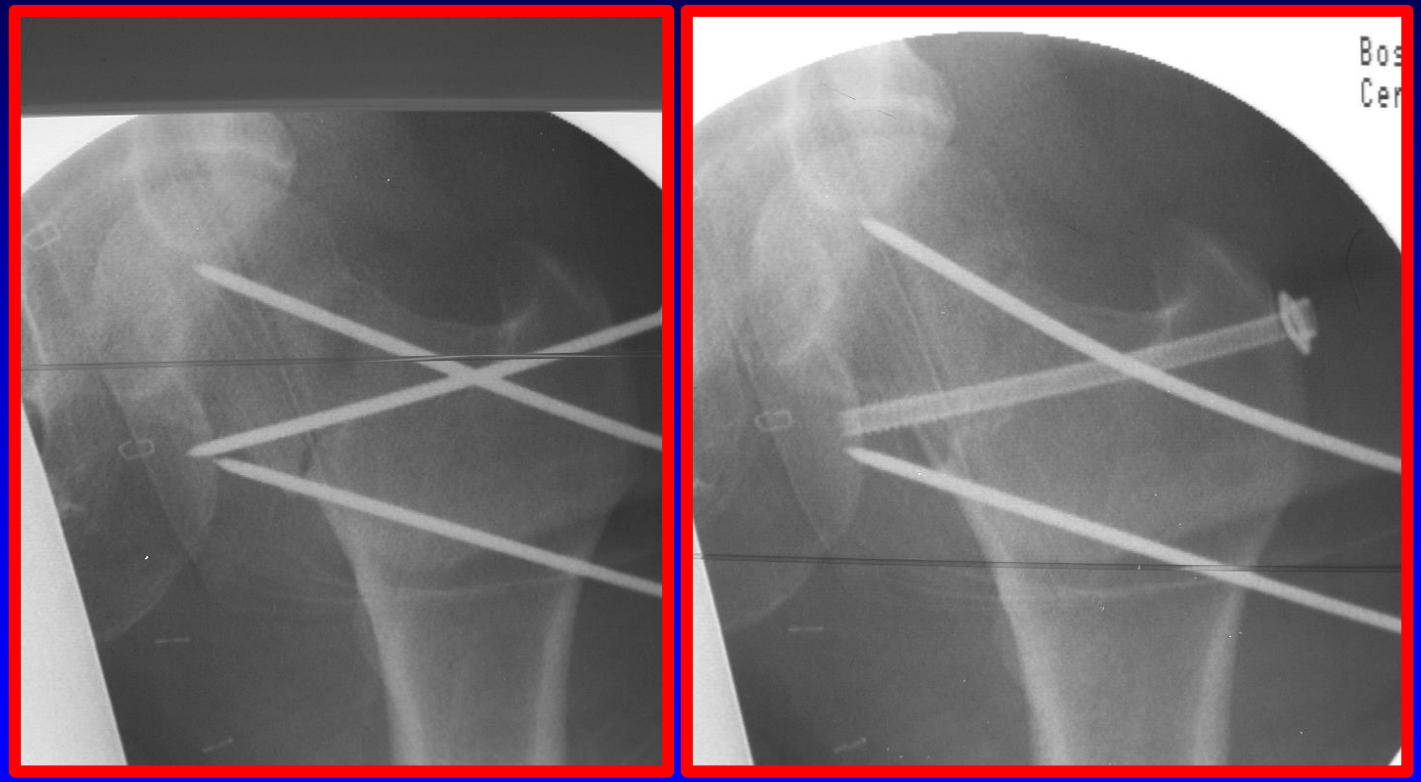
Anatomy of the Fracture



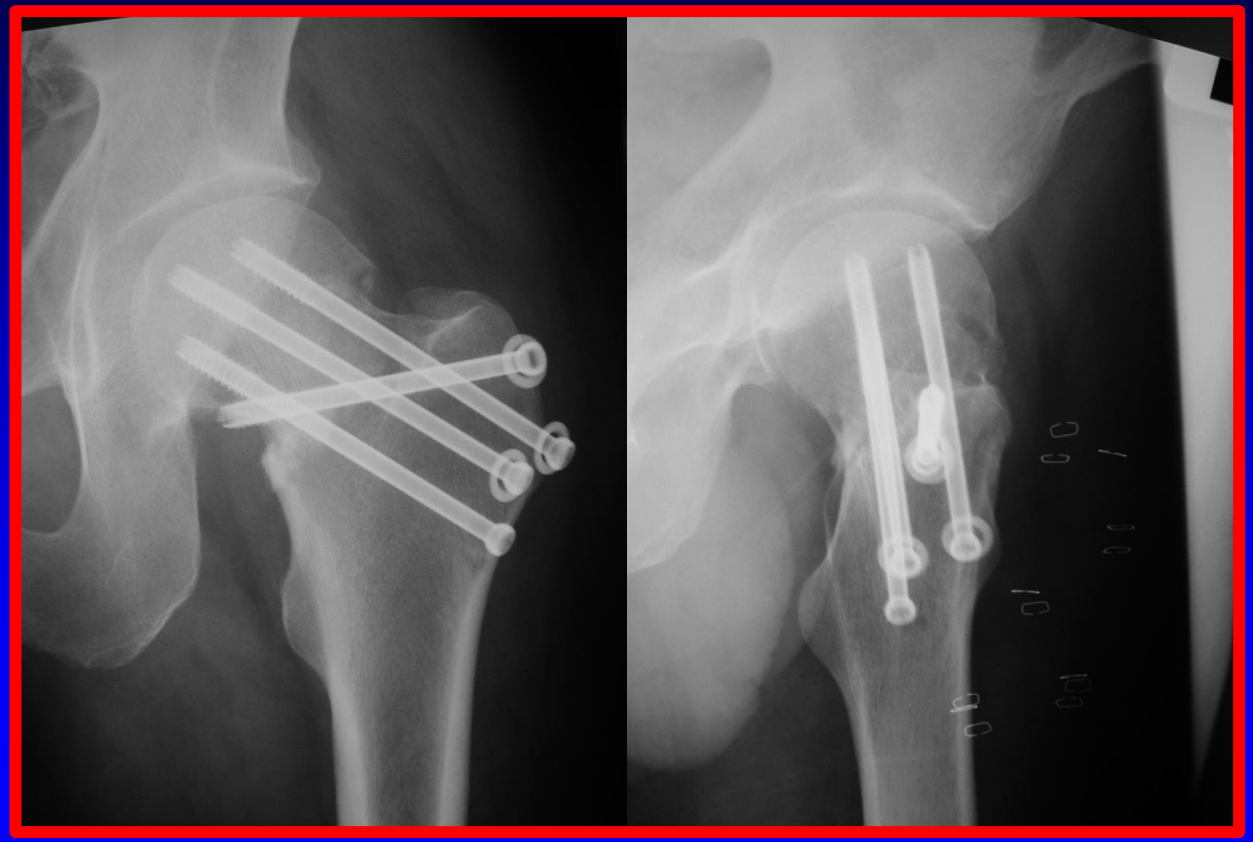
Prevent Shear



Weber Screw



Healed



Factors Associated With Early Failure of The Femoral Neck System (FNS) in Patients With Femoral Neck Fractures

Jialei Chen (chenjialei2016@wchscu.cn)
Sichuan University West China Hospital https://orcid.org/0000-0001-6029-765X

- 62 Patients
- 16% Failure rate
- All <65 yo
- Shortening, cutouts, nonunions

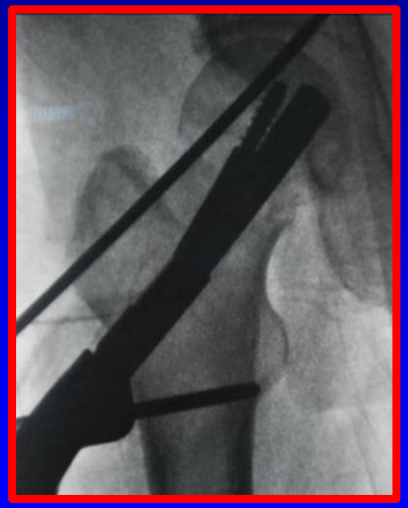
Neck of femur fractures treated with the femoral neck system: outcomes of one hundred and two patients and literature review

Amit Davidson[1,3] · Shlomo Blum[3] · Elad Harats[3] · Erick Kachko[4] · Ahmad Essa[4] · Ram Efraty[4] · Amos Peyser[3] · Peter V

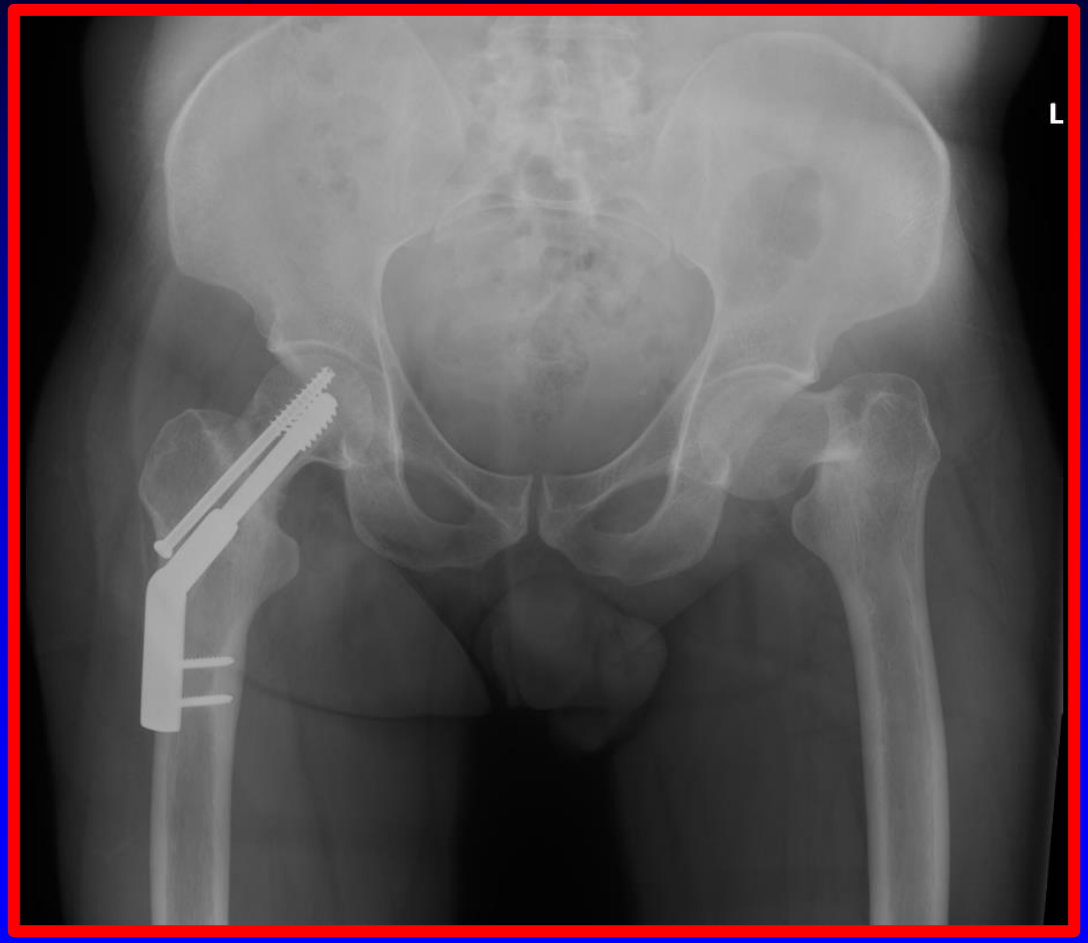
Femoral neck system versus cannulated screws for fixation of femoral neck fracture in young adults: a systematic review and meta-analysis

Yao Lu[1*], Zhilong Huang[2*], Yibo Xu[1*], Qiang Huang[1], Cheng Ren[1], Ming Li[1], Zhong Li[1], Liang Sun[1], Hanzhong Xue[1], Kun Zhang[1], Qian Wang[1], Teng Ma[1]

- Not impressive
- Less shortening
- Still all about the technical surgery



We Tried It..



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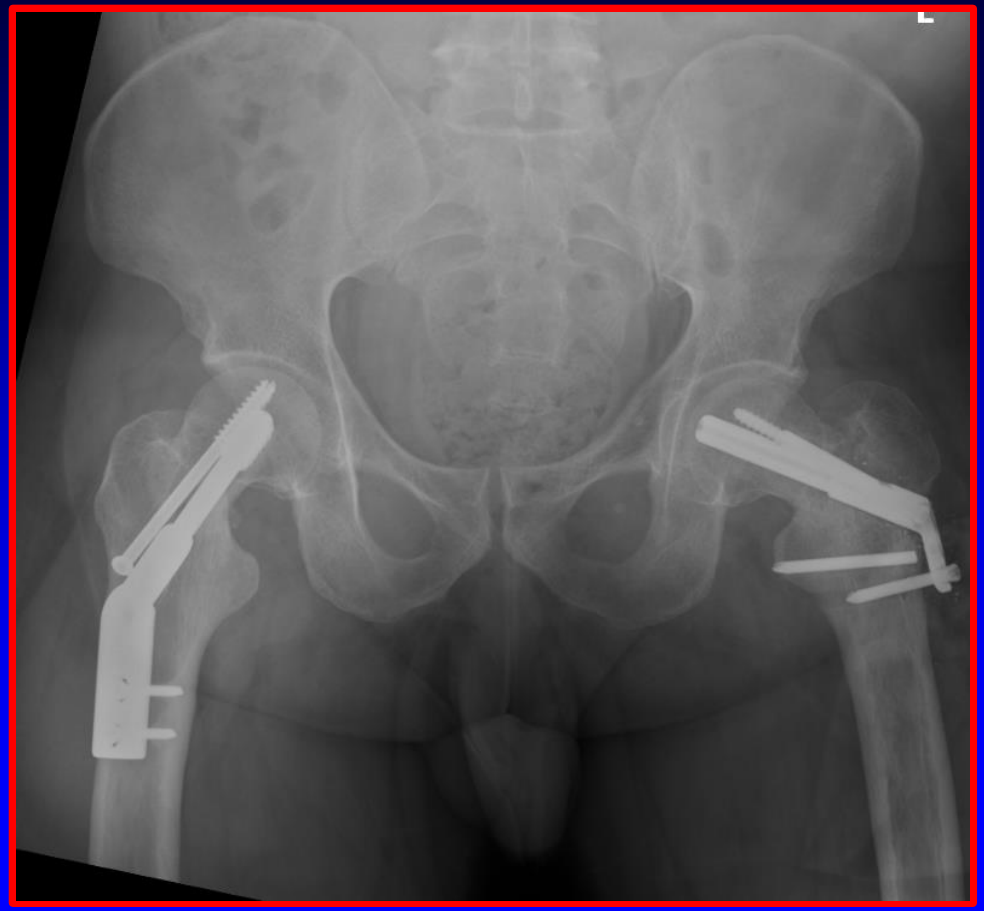

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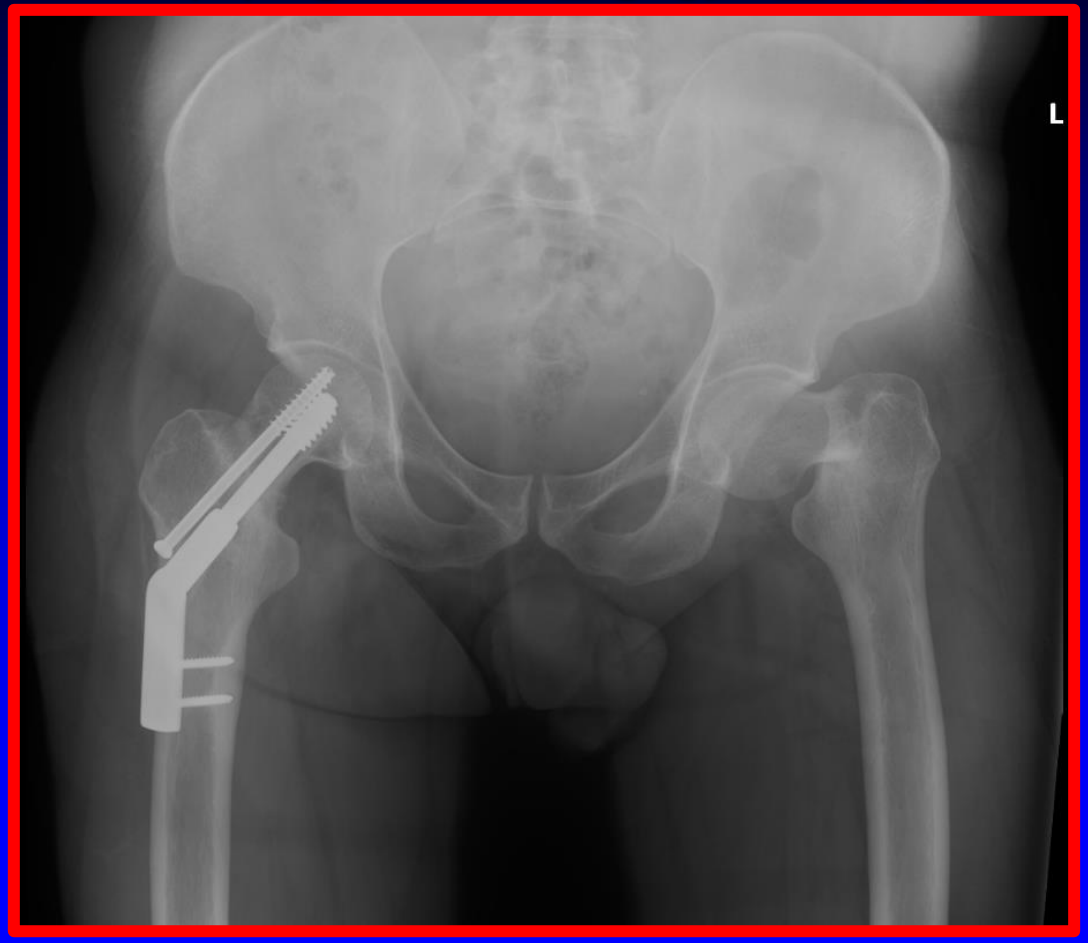
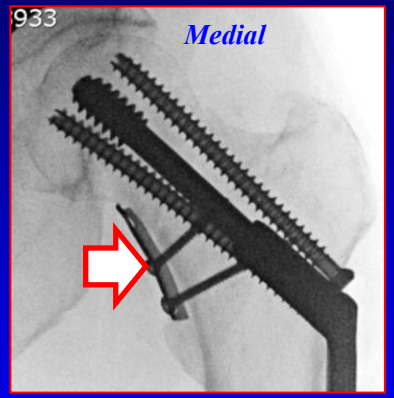
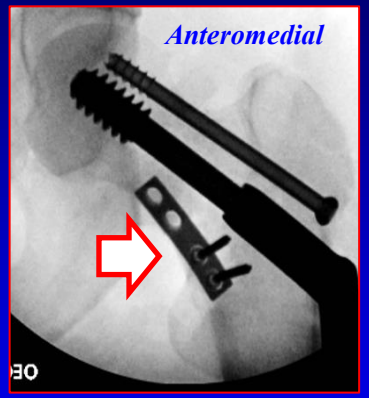


Buttress Plating

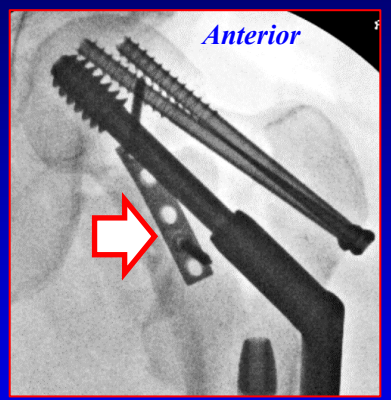
"MNPA" plate location affects failure.



2/22
4%



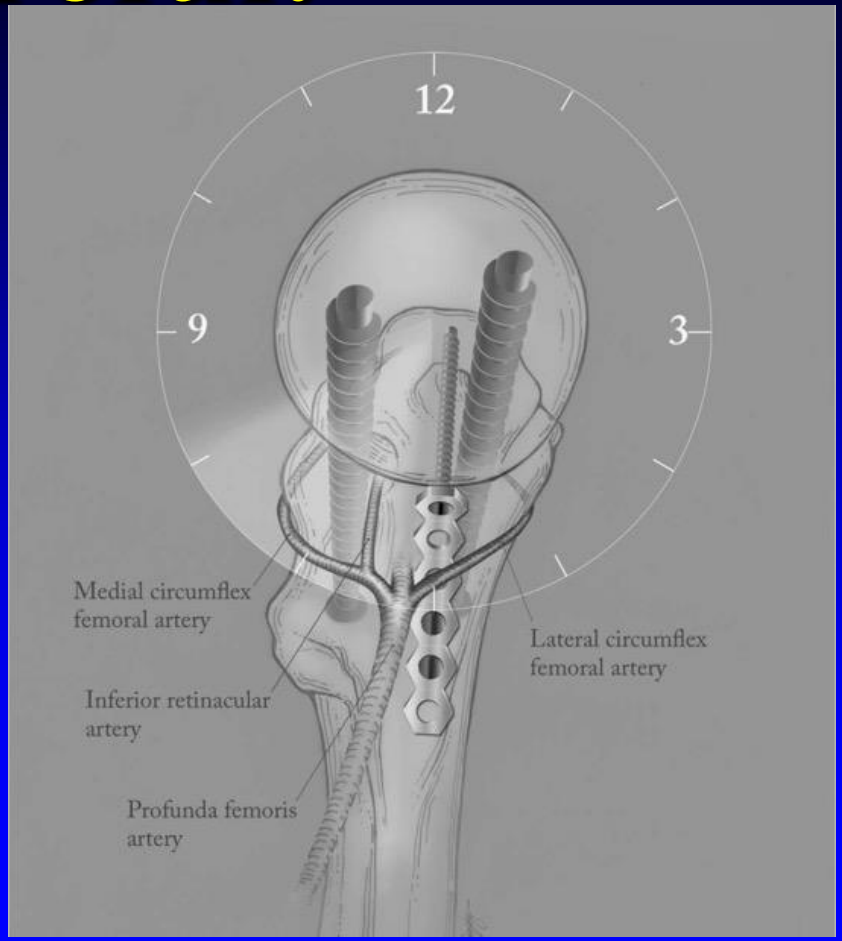
7/21
33%



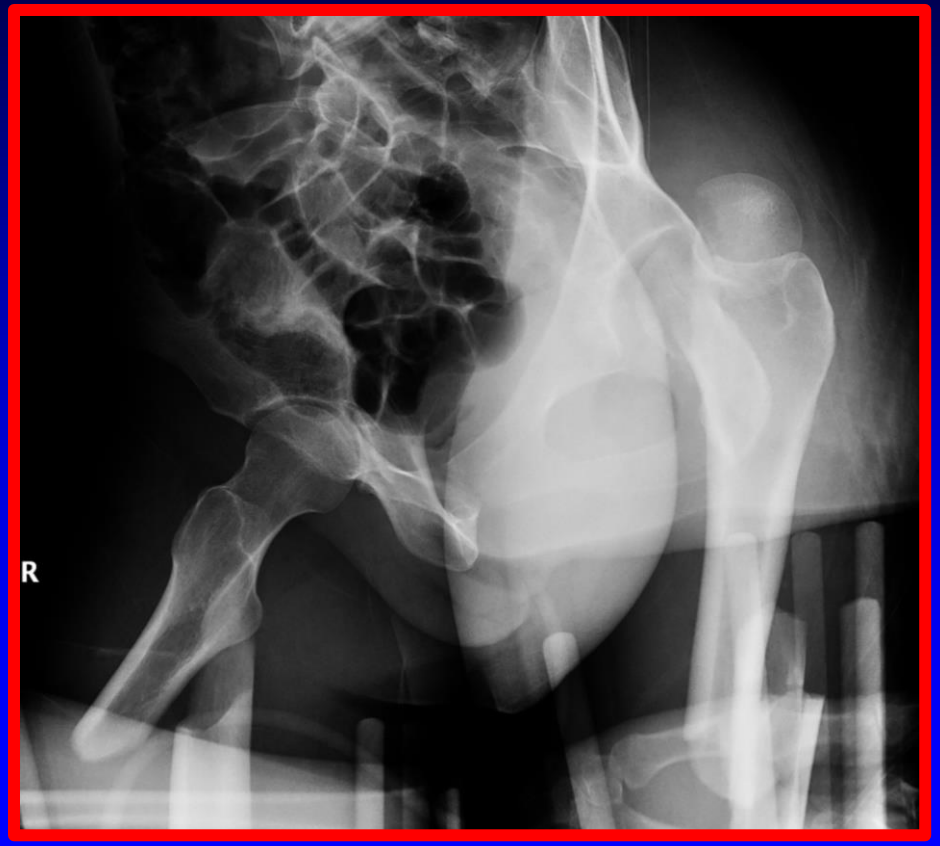
6/8
75%

P=0.003

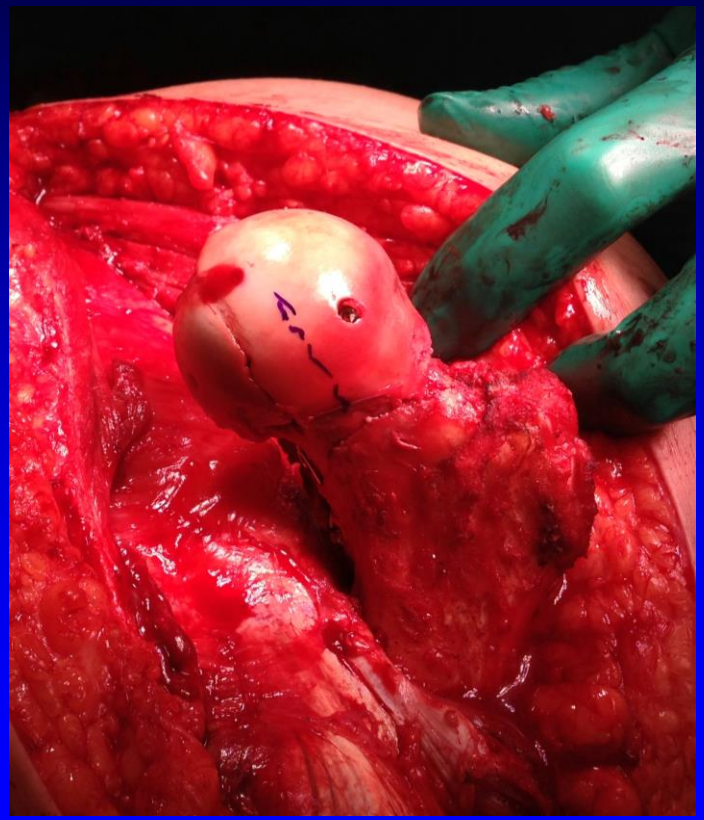
Be Careful!

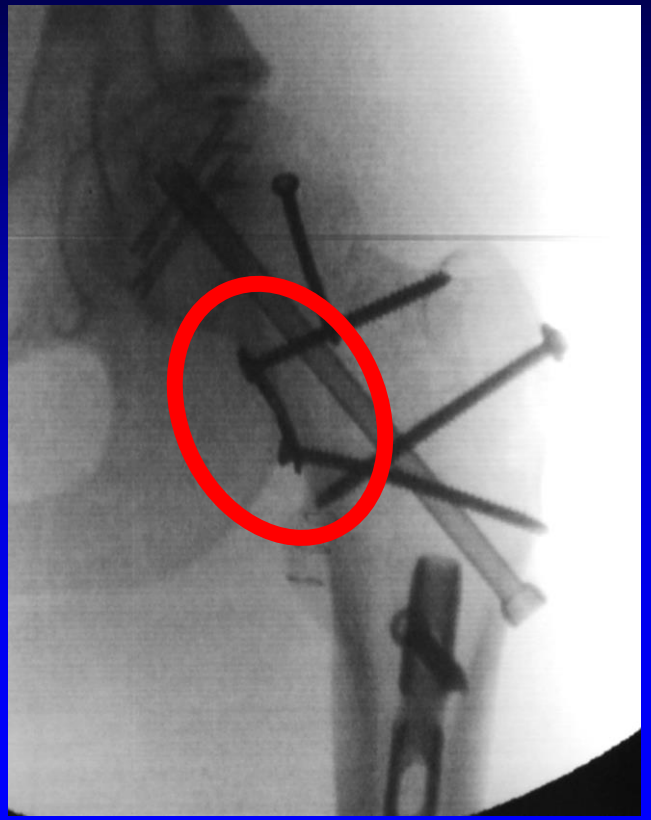

12
9
3
Medial circumflex femoral artery
Inferior retinacular artery
Profunda femoris artery
Lateral circumflex femoral artery

Worse Injury



Surgical Dislocation





Summary

- Timing
  - When YOU are at your best (traction)
- Technique trumps all
  - Reduction is the #1 key (open if needed)
  - Fixed angle helps
    - SHS, CS (calcar), medial antiglide plates
  - Do what you do best, but get the reduction!

Thank You