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Innovative Fixation of Proximal Humerus Fractures

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Vanderbilt Orthopedic Trauma

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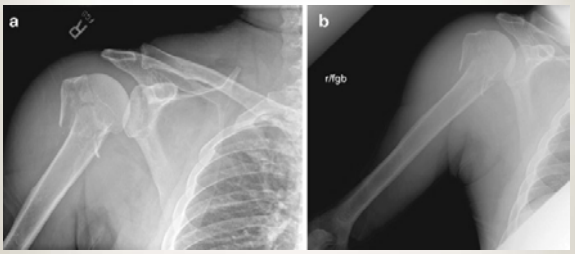
67 yo F s/p MVC, isolated ortho injury



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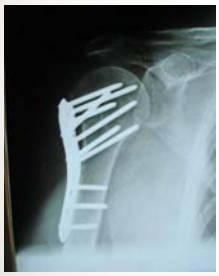
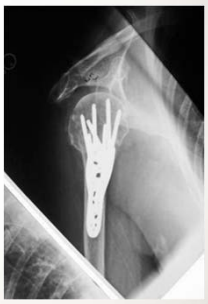
postop





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Results –Locking Plates

- Good Constant Scores
- High Complication Rates

Author/Technique	Impingement (n)	Screw Perforation Joint Space (n)	Fragment Dislocation (n)	Other (n)	Total (n)
Südkamp et al,[37] open and MI	4	21	11	6 infection 3 nerve lesion 6 AVN 4 nonunion 2 screw loosening 2 plate pullout 3 plate breakage	82 (34%)
Brunner et al, open and MI	4	35	20	2 infection 1 hematoma 4 frozen shoulder 3 rotator cuff lesion 4 nerve lesion 1 screw loosening 2 screw backing out 1 plate breakage 4 screw + plate pullout 13 AVN 1 abdominal wall hematoma 1 cervical pain syndrome	91 out of 135 Fractures (67%)
Sesberg BES et al,[42] open	—	6	4	6 AVN 3 infections	19 (38%)
Lafferstorm et al,[17] MI Egol et al, open	1 —	1 8	— 1	9 nonanatomic reduction 1 infection 1 heterotopic ossification 1 distal screw breakage	11 (52%) 12 (34%)
Agudelo et al,[11] open and MI	3	—	20 "loss of fixation"	2 delayed union 1 nonunion 7 AVN 3 frozen shoulder 5 rotator cuff rupture 7 deep infection 1 wound dehiscence	49 (32%)
Koukakis et al, open	1	—	—	1 infection 1 AVN 1 plate pullout	4 (22%)
Fankhauser et al, open	3	1	3	1 infection 1 partial AVN 1 plate breakage	10 (38%)

** "Total number of complications" takes into account associated events, eg, fragment dislocation with screw perforation.
MI, minimally invasive; AVN, avascular necrosis.

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Complications

- Brorson S. Rasmussen JV. Frich LH. Olsen BS. Hrobjartsson A. Benefits and harms of locking plate osteosynthesis in intraarticular (OTA Type C) fractures of the proximal humerus: a systematic review. Injury. 43(7):999-1005, 2012 Jul.

- avascular necrosis - 4-33%
- screw perforations - 5-20%
- loss of fixation - 3-16%
- infections - 4-19%
- Reoperation ranged - 6 to 44%.

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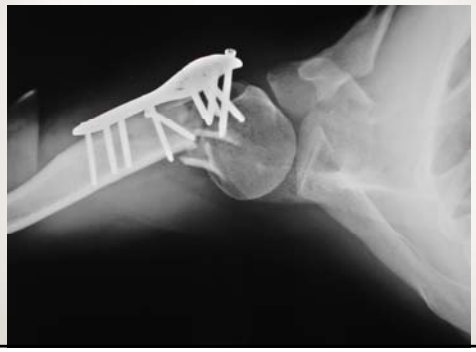
Loss of Fixation



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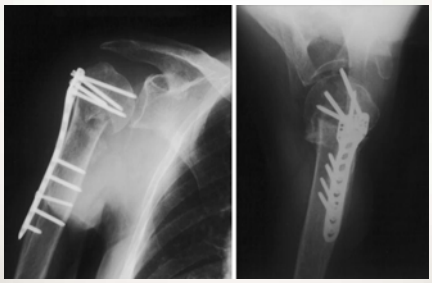
Screw Penetration



Original Investigation

Surgical vs Nonsurgical Treatment of Adults With Displaced Fractures of the Proximal Humerus

The PROFHER Randomized Clinical Trial

Amar Rangan, FRCS(Tr&Orth); Helen Handoll, DPhil; Stephen Brealey, PhD; Laura Jefferson, PhD; Ada Keding, MSc; Belen Corbacho Martin, MSc; Lorna Goodchild, MSc; Ling Hsiang Chuang, PhD; Catherine Hewitt, PhD; David Torgerson, PhD; for the PROFHER Trial Collaborators

- PROFHER JAMA 2015
- 250 pts in RCT (16-80 yo)
- No diffs in:
  - Oxford score
  - SF-12

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PROFHER

- Problems:
  - Multiple centers (66)
  - 50% eligible enrolled
  - Age

Age group, No. (%)		
<65 y	51 (40.8)	57 (45.6)
≥65 y	74 (59.2)	68 (54.4)

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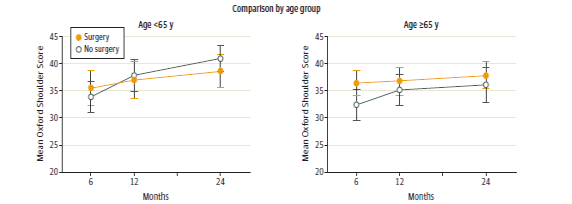

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Cochrane 2012

Interventions for treating proximal humeral fractures in adults.

Handoll HH, Ollivere BJ, Rollins KE.

Health and Social Care Institute, Teesside University, Middlesbrough, UK. h.handoll@tees.ac.uk

- 6 Trials with 270 Pts Compared Op vs Nonop
  - From 3 Trials (153 Pts)
    - Pt-Reported 1-yr Function showed No Difference
    - EuroQol showed No Difference up to 12 months. However, Results at two years (101 participants) were **significantly in Favor of the Surgical Group.**
    - No significant difference in mortality
    - Significantly More Surgical Pts had Additional or Secondary Surgery (An Extra Operation in 1/9 Surgically Treated Pts)

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Proximal Humerus Fractures

- **Evidence-Based Working Group - Bhandari, Tornetta, Schemitsch, Swiontkowski, Dirschl, Ellis, Sanders, Kreder, Hanson, Audige, Mckee, Matthys, and Obremskey**
- **CONCLUSION -** insufficient evidence from RCTs to determine the optimal intervention in patients with displaced four part fractures of the proximal humerus…..
- …treatment will likely be based upon surgeon experience and preference

JOT JOURNAL OF ORTHOPAEDIC TRAUMA

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Innovative options

- Adjuvants
  - Calcar Screws
  - Ca Phosphate
  - Allograft
- Small fixation
  - Plates
  - Suture
- MIS

Effect of Calcar Screw Use in Surgical Neck Fractures of the Proximal Humerus With Unstable Medial Support: A Biomechanical Study

Lu Bai, MD, Zhongguo Fu, MD,† Shuai An, MD,† Peixun Zhang, MD,† Dianying Zhang, MD,† and Baoguo Jiang, MD†*

- JOT 2014
- Calcar screws added stability in normal alignment even if medial support gone
- No benefit if in Varus

- Use medial calcar screws!!
- Thou Shalt NOT Varus!!

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ORIF – Calcium Phosphate

Fracture site augmentation with calcium phosphate cement reduces screw penetration after open reduction–internal fixation of proximal humeral fractures

Kenneth A. Egol, MD*, Michelle T. Sugi, MD, Crispin C. Ong, MD, Nicole Montero, MD, Roy Davidovitch, MD, Joseph D. Zuckerman, MD

J Shoulder Elbow Surg (2012) 21, 741-748

- 92 Patients ORIF - Nonrandomized: No Graft (36), Cancellous Allograft Chips (29), or Calcium Phosphate (27)
- 11 Cases of Postoperative Joint Penetration - 7 No Graft, 3 Chips, 1 CaPO4 (p=0.02, 0.009)
- Less postop settling at 1 year with CaPO4

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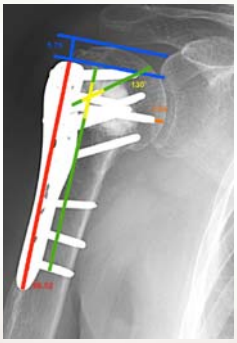
Ca Phosphate



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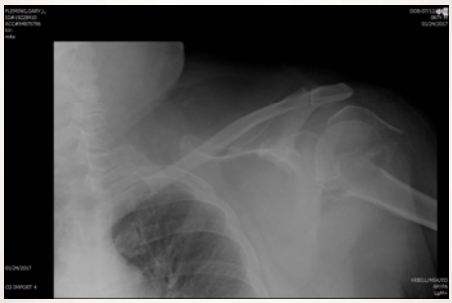
67 yo M s/p Fall



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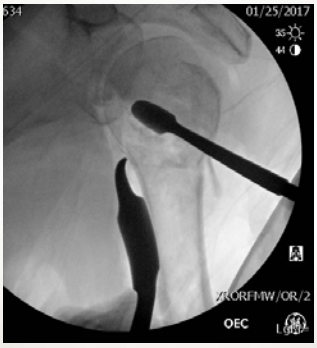
Intra op



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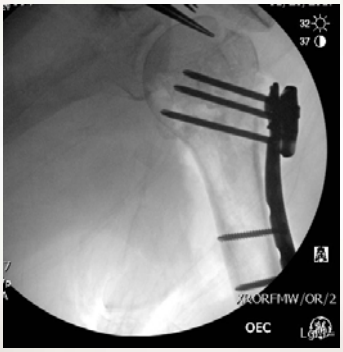
Intra op



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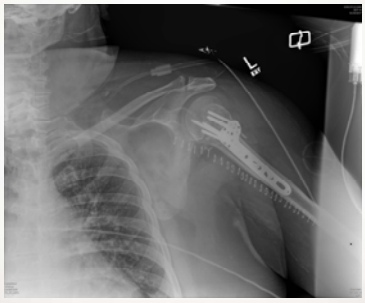
Post op- Allograft supplement



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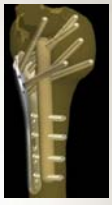
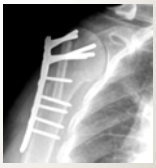
ORIF – Fibular Strut

- Badman, B., **Mighell, M.** Fixed-Angle Locked Plating of Two, Three, and Four Part Proximal Humerus Fractures. J Am Acad Orthop Surg, May 2008; 16(5): 294-302.

N = 80	Allograft= 45	No Allograft= 35
Age Over 70	19	6
Age Under 70	26	29

- 1 (1.25%) hardware complication
  - Screw penetration
- 4 (5%) AVN
  - 2 required revision to arthroplasty
- 7 (8.75%) post-traumatic contractures
  - All required capsular releases





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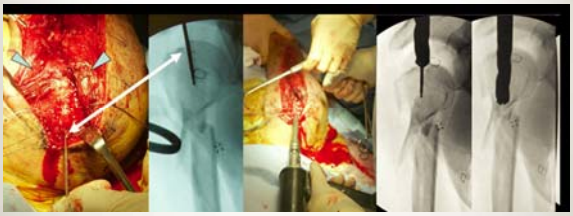
ORIF – Fibular Strut

Intramedullary Allograft Fibula as a Reduction and Fixation Tool for Treatment of Complex Proximal Humerus Fractures With Diaphyseal Extension



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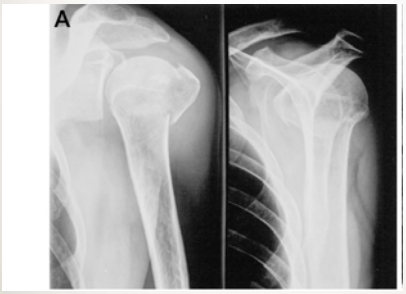
Proximal Humerus Fracutres



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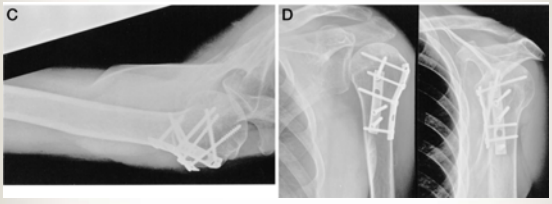
Proximal Humerus Fracutres



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Proximal Humerus Fracutres

Wanner GA, J. of Trauma 54(3):536-44, 2003

- Plates – small
- 71 patients with orif
- 12 % complications needed revision

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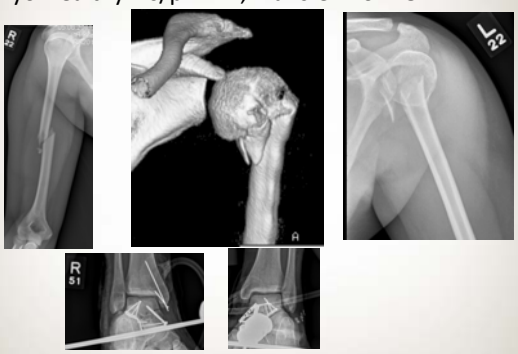
Case 2

- 22yo Healthy F s/p MVA, Transfer from OLH



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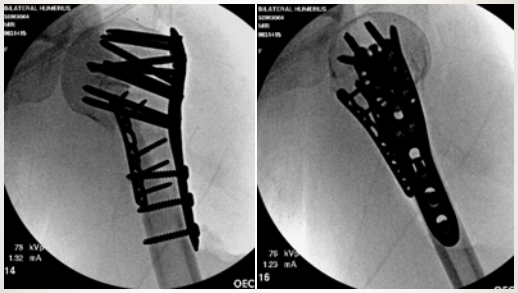
Case 2

- ORIF – Mini-Frag Plate



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Case 2

- 1 Year

- No Pain
- FE 170
- Abd 160
- ER 85
- IR T12
- Performs ADL's

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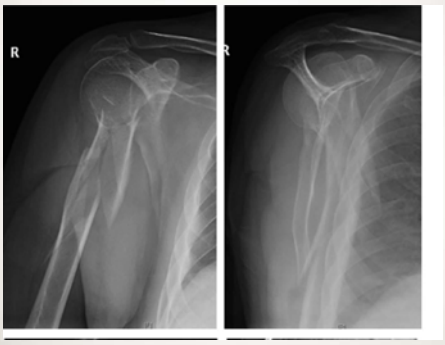
46 yo M RHD s/p multitrauma



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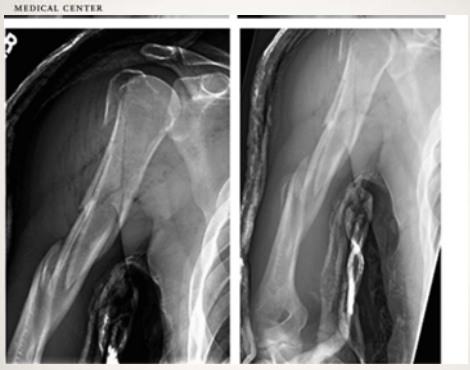

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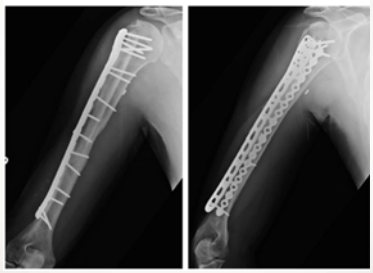
Intramedullary Allograft Fibula as a Reduction and Fixation Tool for Treatment of Complex Proximal Humerus Fractures With Diaphyseal Extension



No Contribution of Tension-Reducing Rotator Cuff Sutures on Locking Plate Fixation in a 2-Part Proximal Humerus Fracture Model

Philip M. Sinatra, MD, Michael L. Jernick, BS,† Gary Bledsoe, PhD,‡ and Scott G. Kaar, MD**

- JOT 2013
- In 2 part fxs
- Sutures do NOT add strength to failure

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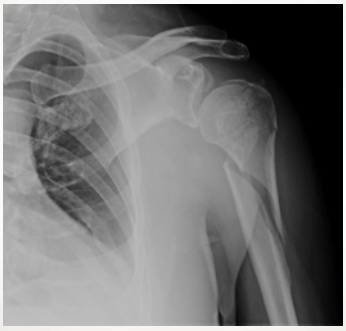
Case 3

- 58yo M with IDDM



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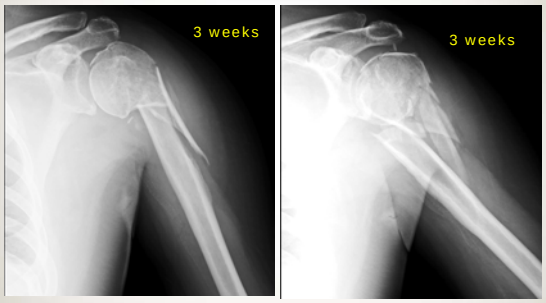
Case 3

- Treated Non-op



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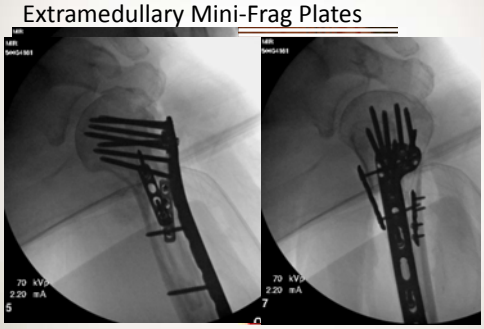
Case 3

- ORIF – Fibular Strut, Intramedullary and Extramedullary Mini-Frag Plates



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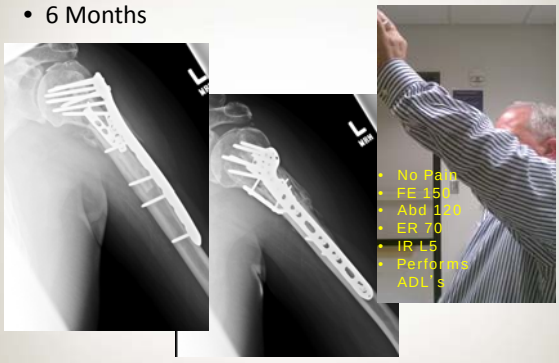
Case 3

- 6 Months



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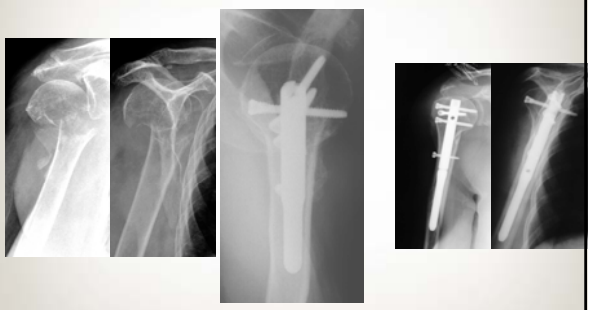
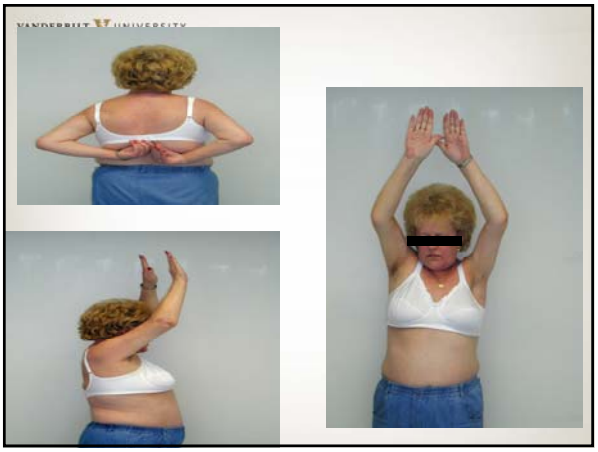
MIS





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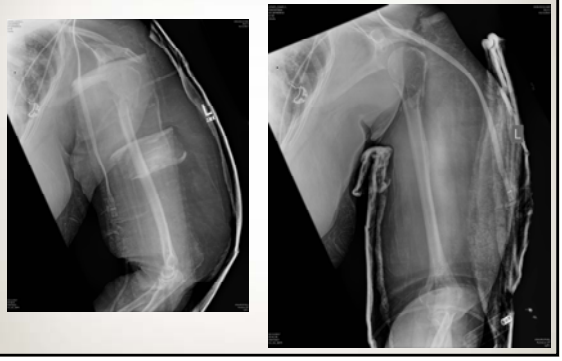
51 yo F with T7 Paraplegia



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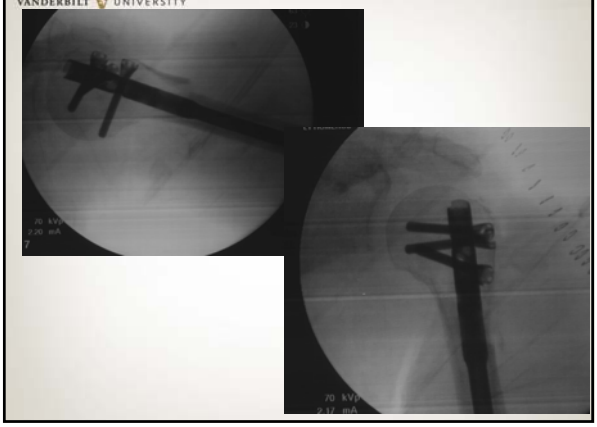

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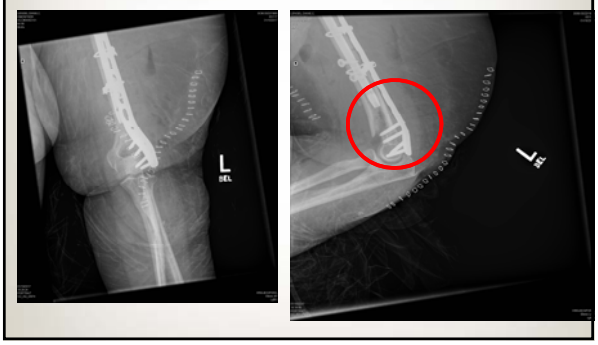

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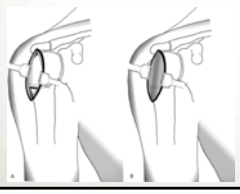
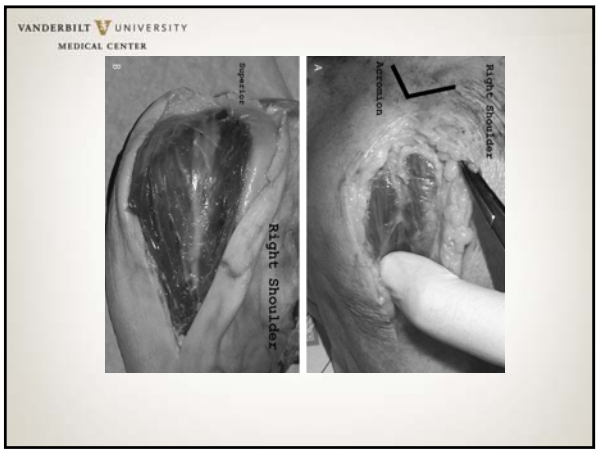
Gardner MJ. Et al. *CORR (434):123-9, 2005*

- The extended anterolateral acromial approach allows minimally invasive access to the proximal humerus
- 20 cadavers
  - Axillary nerve 3.5 cm from greater tuberosity
- 16 patient w/o complications




VANDERBILT UNIVERSITY
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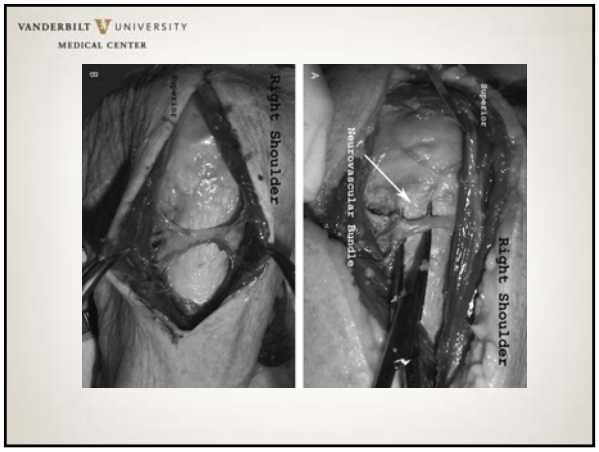
B
Superior
Right Shoulder
A
Acromion
Right Shoulder


VANDERBILT UNIVERSITY
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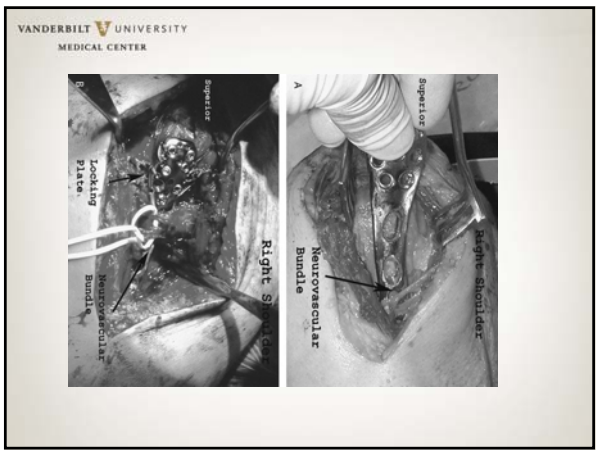
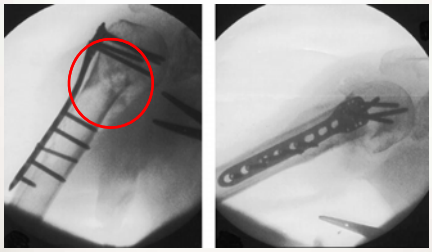
B
Superior
Right Shoulder
A
Superior
Neurovascular Bundle
Right Shoulder


VANDERBILT UNIVERSITY
MEDICAL CENTER
B
Superior
Locking Plate
Neurovascular Bundle
Right Shoulder
A
Superior
Neurovascular Bundle
Right Shoulder

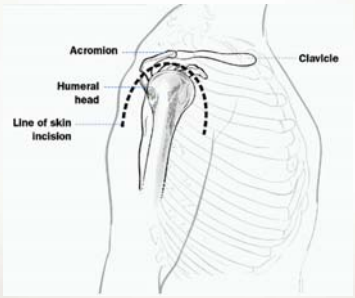
VANDERBILT UNIVERSITY MEDICAL CENTER



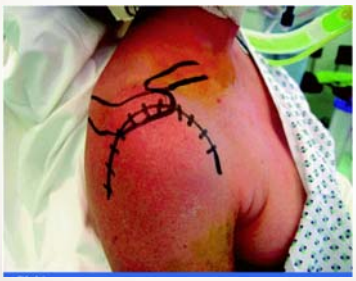
Thou shalt use Calcar Screws

VANDERBILT UNIVERSITY MEDICAL CENTER

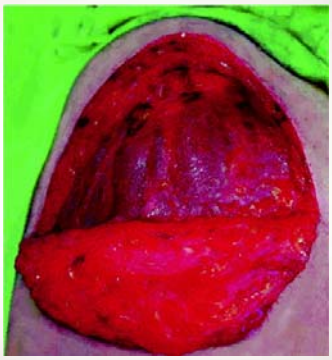
Shoulder Strap incision



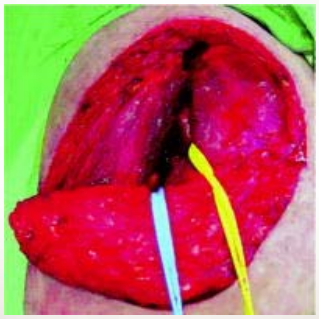
VANDERBILT UNIVERSITY MEDICAL CENTER



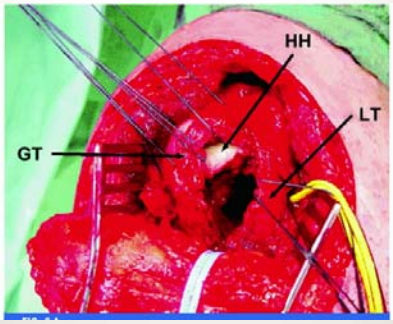
VANDERBILT UNIVERSITY MEDICAL CENTER



VANDERBILT UNIVERSITY MEDICAL CENTER



VANDERBILT UNIVERSITY MEDICAL CENTER



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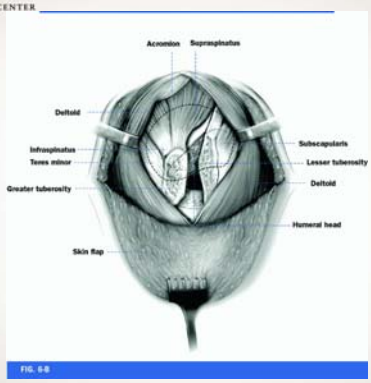
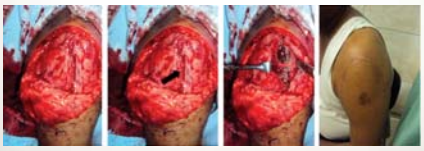


Complex Proximal Humerus Fractures Treated With Locked Plating Utilizing an Extended Deltoid Split Approach With a Shoulder Strap Incision

Ashok S. Gavaskar, MS, Naveen Chowdary, MS,† and Samson Abraham, MS**

- JOT 2013 – Shoulder Strap
- 50 pts – no axillary nerve injury



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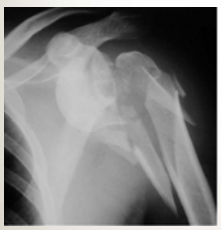
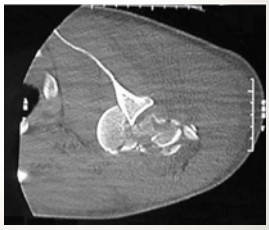
Proximal Humerus Fxs - Scope

- Dawson FA. Arthroscopy 19(6):662-6, 2003
- Four-part fracture dislocation of the proximal **humerus**: an arthroscopic approach.





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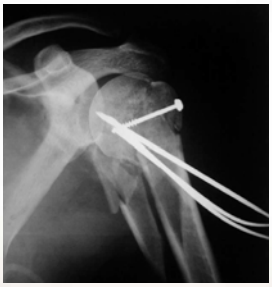
Scope Assisted



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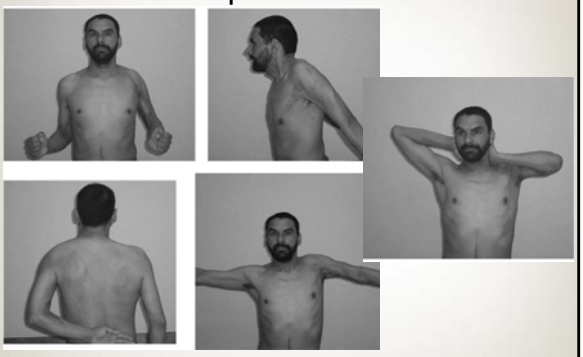
Scope Assisted



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MIS

- All limit exposure
- BUT
- All violate RC and Deltoid motion plane
- Motion may be more important than exposure

- Life is Motion; Motion is life

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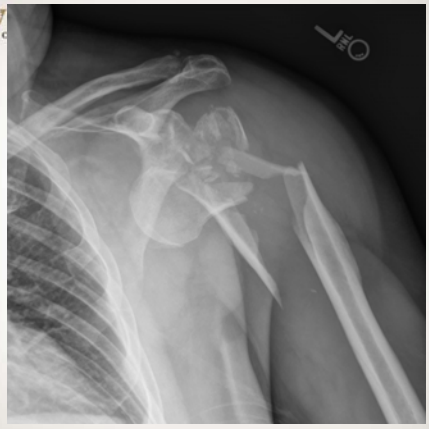
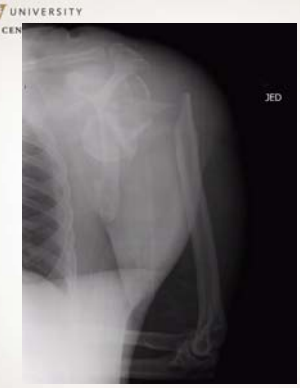
Case 1

- 48 yo male obese, s/p fall
  - NIDDM
  - RHD
- PE
  - LARGE male
  - Axillary nerve sensory diminished
  - Isolated LUE injury





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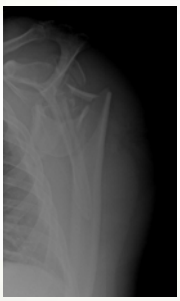

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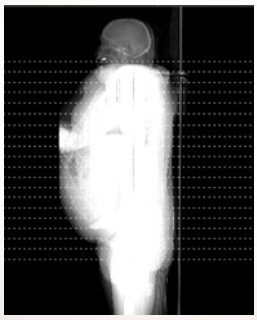
I think you need this included.



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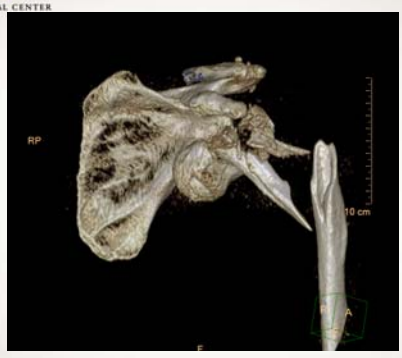
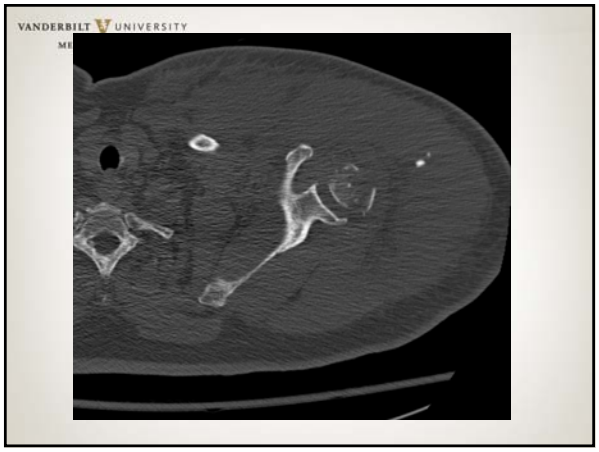
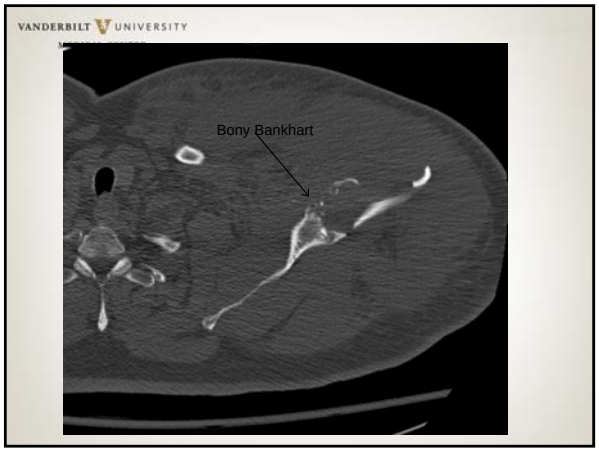
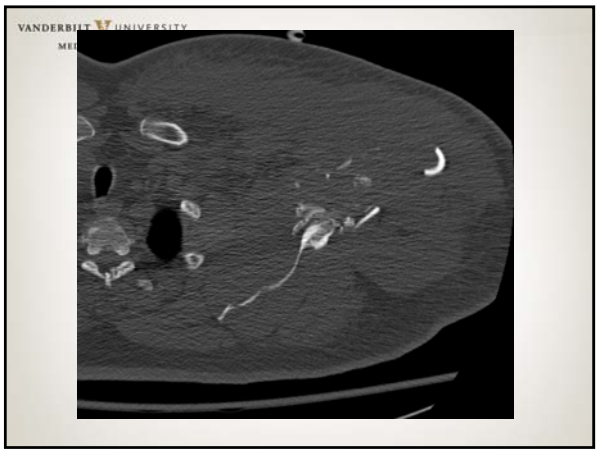
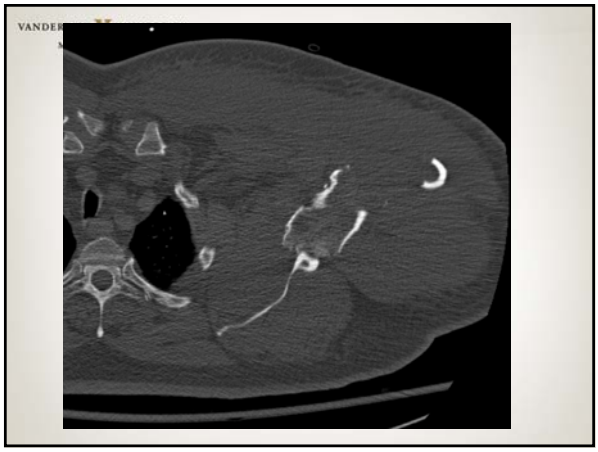


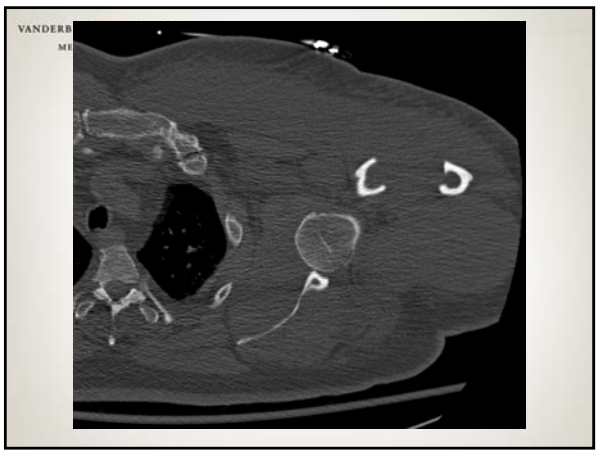

VANDERBILT UNIVERSITY
MEDICAL CENTER
RP
10 cm
F
P
L
HP

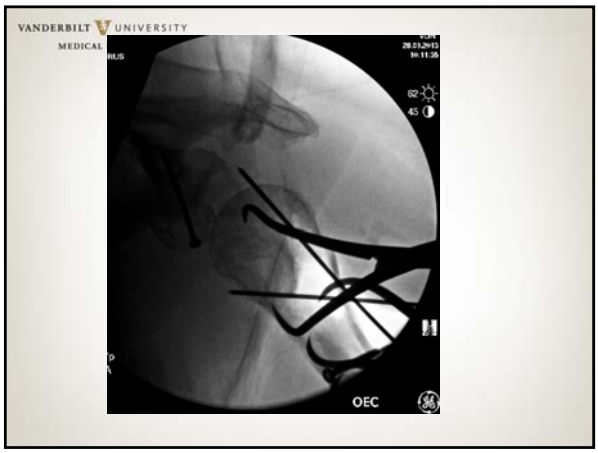

VANDERBILT UNIVERSITY

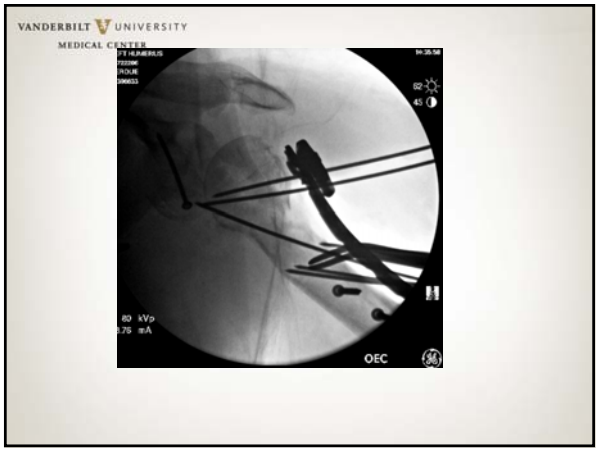

VANDERBILT UNIVERSITY
Bony Bankhart

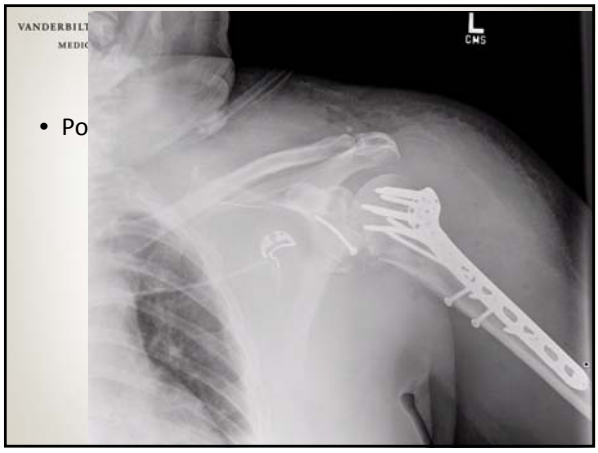







VANDERBILT UNIVERSITY
MEDICAL
OEC


VANDERBILT UNIVERSITY
MEDICAL CENTER
OEC


VANDERBILT
L
CMS

- Po

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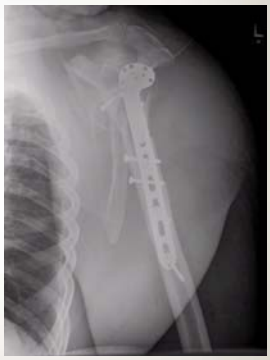
Post-op day 1



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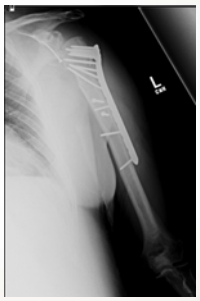
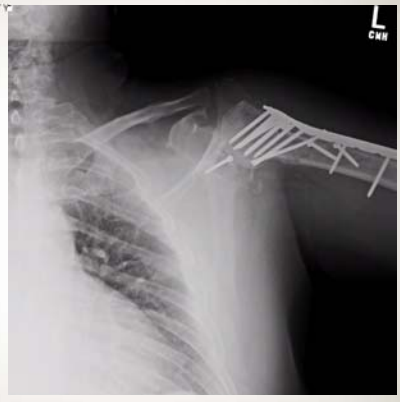
- 3 months



VANDERBILT UNIVERSITY MEDICAL CENTER

- 3 months



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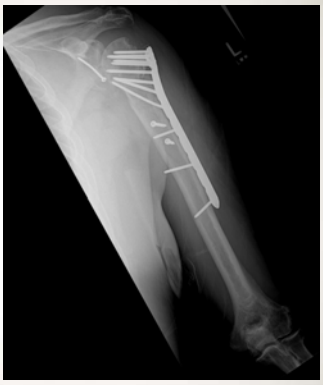
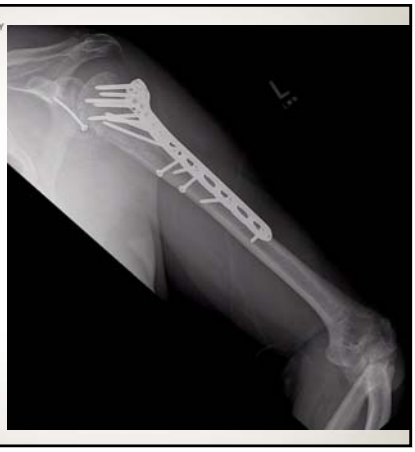
- 6 months



VANDERBILT UNIVERSITY MEDICAL CENTER

- 6 months



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Innovative options

- Adjuvants
  - Calcar Screws
  - Ca Phosphate
  - Allograft
- Small fixation
  - Plates
  - Suture
- MIS

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Any Surgery

- Attain and Maintain anatomy
- BUT
- All violate RC and Deltoid motion plane
- Motion may be more important than technique
- Life is Motion; Motion is life