2017 SPECIALTY DAY

MARCH 18, 2017 | SAN DIEGO, CALIFORNIA

Combined Session: Orthopaedic Trauma Association and American Shoulder and Elbow Surgeons

Controversial Upper Extremity Fractures: To Fix or Not?

4:20 pm – 5:00 pm

Moderators: David C. Ring, MD, PhD (ASES) and Gregory J. Della Rocca, MD, PhD, FACS (OTA)

4:20 pm – 4:30 pm	What I Have Learned the Most about Treating Patients with Clavicle Fractures *Michael D. McKee, MD (OTA)*
4:30 pm – 4:40 pm	What I have Learned the Most about Treating Patients with Humeral Shaft Fractures *John T. Gorczyca, MD (OTA)*
4:40 pm – 4:50 pm	What I have Learned the Most about Treating Patients with Distal Humerus Fractures *Graham J. W. King, MD, FRCS (ASES)*
4:50 pm – 5:00 pm	Discussion

OTA / ASES Combined Specialty Day 2017

What I Have Learned Most About Fixing Displaced Fractures of the Clavicle

Michael D. McKee
Professor, Division of Orthopaedic Surgery
Department of Surgery, St. Michael's Hospital and the
University of Toronto, Toronto, Canada

1. Introduction: Clavicle fractures are common injuries accounting for 2.6% of all fractures[1] and occur most commonly in young active individuals[2]. Middle third (or mid-shaft) fractures account for approximately 80% of all clavicle fractures[1,2], and have traditionally been treated non-operatively, even when significantly displaced. However, more recent studies have shown non-union rates of up to 21% in displaced midshaft clavicle fractures and unsatisfactory patient oriented outcomes in up to 31%. In addition, clavicular malunion has recently been described by multiple authors as a distinct clinical entity with characteristic clinical and radiographic features. It is clear that there is a role in selected individuals for primary operative fixation of displaced fractures of the shaft of the clavicle.

2. The incidence of nonunion following non-operative care of displaced mid-shaft fractures of the clavicle

A number of recent studies of completely displaced, mid-shaft fractures of the clavicle reveal nonunion rates between 15% and 20%[5,6]. These studies were recently summarized in a meta-analysis that found a nonunion rate of 15.1% following non-operative care of these fractures[7].

3. The incidence of symptomatic clavicular malunion following non-operative care

Malunion of the clavicle is a distinct clinical entity with characteristic orthopaedic (weakness, easy fatigueability, scapular winging), neurologic (thoracic outlet syndrome) and cosmetic (droopy, asymmetric shoulder, difficulty with backpacks, shoulder straps etc.) symptoms[9-12]. It is associated with increasing degrees of clavicular shortening. While radiographic malunion is

always seen following displaced clavicular shaft fractures, clinically symptomatic malunion has an incidence of 15-20%.

4. The rate of nonunion following surgical repair

There are multiple, modern studies that show plate fixation is an extremely effective technique for treatment of clavicular shaft fractures with a low complication and nonunion rate[14,15]. A meta-analysis described a nonunion rate with plate fixation of 2.2%, which represents an 86% risk reduction for nonunion compared to the same fracture treated non-operatively (nonunion rate 15.1%)[7]. Intramedullary fixation is another option with a high, albeit variable, success rate.

5. Strength deficits following non-operative care.

Hill et. al. were the first to use a patient-oriented outcome measure, and found 31% of patients described unsatisfactory outcome after non-operative care of displaced clavicle fractures[6]. This may be explained by significant residual strength deficits following the conservative treatment of these fractures. Using an objective strength testing protocol for both maximal effort and endurance (which had not been done previously) strength deficits ranging from 10% to 35% were found in patients a mean of 54 months after non-operative care of a displaced fracture of the clavicular shaft[16].

6. Evidence-based medicine

There are a number of randomized clinical trials that compare operative to non-operative treatment of displaced fractures of the clavicle. These studies provide clear facts that can be used when counseling patients regarding treatment options.

7. Substance Abuse

It is clear that patients with substance abuse have a much higher rate of complications with clavicle fracture fixation: the treating surgeon should be very careful in offering primary fixation to active substance abusers.

7. Summary

The choice to proceed with operative intervention for a displaced mid-shaft fracture of the clavicle will be a decision made between surgeon and patient. There is increasing evidence from Level 1 prospective and / or randomized trials that, for carefully selected patients, primary operative fixation of displaced clavicular fractures results in superior outcome.

8. References

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2. Rowe CR. An atlas of anatomy and treatment of midclavicular fractures. Clin Orthop Rel Res. 58:29-42, 1968.
3. Hill JM, McGuire MH, Crosby L "Closed treatment of displaced middle-third fractures of the clavicle gives poor results" *J Bone Joint Surgery(B),* 79B, No.4, 1997; pp 537-541.
4. Robinson CM, Court-Brown CM, McQueen MM, Wakefield AE. Estimating the risk of nonunion following non-operative treatment of a clavicle fracture. J Bone Joint Surg(A) 86A:7, 1359-1365, 2004.
5. Zlowodzki M, Zelle BA, Cole PA, Jeray K, McKee MD. Treatment of mid-shaft clavicle fractures: Systemic review of 2144 fractures. J Orthop Trauma. Vol 19:7, 2005, 504-508.
6. Basamania CJ, "Claviculoplasty" *J Shoulder Elbow Surg,* Vol. 8, No. 5, 1999; p 540. (Abstracts: Seventh International Conference on Surgery of the Shoulder, 1999).
7. Chan KY, Jupiter JB, Leffert RD, Marti R "Clavicle malunion" *J Shoulder Elbow Surg,* Vol. 8, No. 4, 1999; pp 287-290.
8. Kuhne JE, "Symptomatic malunions of the middle clavicle" *J Shoulder Elbow Surg,* Vol. 8, No. 5, 1999; p 539. (Abstracts: Seventh International Conference on Surgery of the Shoulder, 1999).
9. McKee MD, Wild LM, Schemitsch EH. Midshaft malunions of the clavicle. *J Bone Joint Surg*, 85A:5, 790-797, 2003.
10. McKee MD, Pedersen EM, Jones C, Stephen DJG, Kreder HJ, Scemitsch EH, Wild LM, Potter J. Deficits following non-operative treatment of displaced, mid-shaft clavicle fractures. J Bone Joint Surg(A), 2005.
11. Andersen K, Jensen PO, Lauritzen J. The treatment of clavicular fractures: Figure of eight bandage versus a simple sling. Acta Orthop Scand. 1987;58:71-74.
12. Potter J, Schemitsch EH, Jones C, Wild LM, McKee MD. Does delay matter? The restoration of objectively measured shoulder strength and patient-oriented outcome in immediate versus delayed reconstruction of displaced mid-shaft fractures of the clavicle. Accepted for publication, J Shoulder Elbow Surg.
13. McKee MD and the Canadian Orthopaedic Trauma Society. A multi-centre randomized controlled trial of non-operative versus operative treatment of displaced clavicle shaft fractures. J Bone Joint Surg(A), 2007, No.1, 1-11.

HANDOUT COMING SOON

DISTAL HUMERUS FRACTURES WHAT I HAVE LEARNED

AMERICAN SHOULDER AND ELBOW SURGEONS
ORTHOPAEDIC TRAUMA ASSOCIATION
SPECIALTY DAY
SAN DIEGO, MARCH 2017

Graham JW King MD, MSc, FRCSC

ROTH | McFARLANE
HAND & UPPER LIMB CENTRE
ST. JOSEPH'S HEALTH CARE LONDON

Western

I (and/or my co-authors) have something to disclose.

Detailed disclosure information is available via:

"My Academy" app;

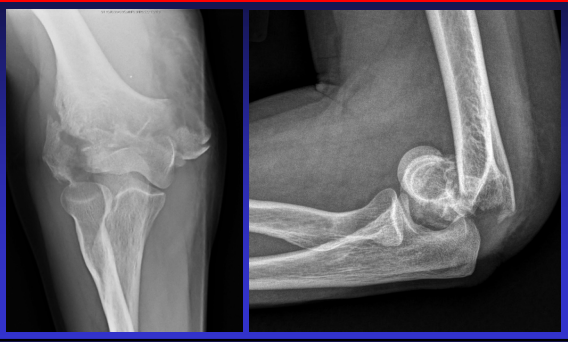
Printed Final Program; or

AAOS Orthopaedic Disclosure Program on the AAOS website at
http://www.aaos.org/disclosure

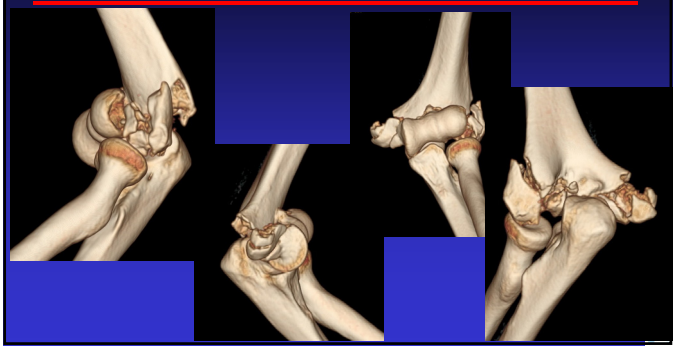
DISTAL HUMERUS FRACTURES WHAT I HAVE LEARNED

- Get adequate imaging – understand what you are getting into!

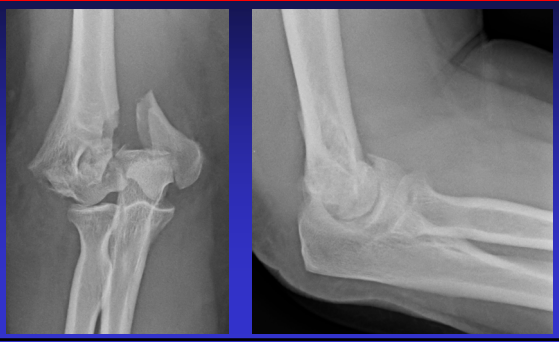
63 YO WOMAN



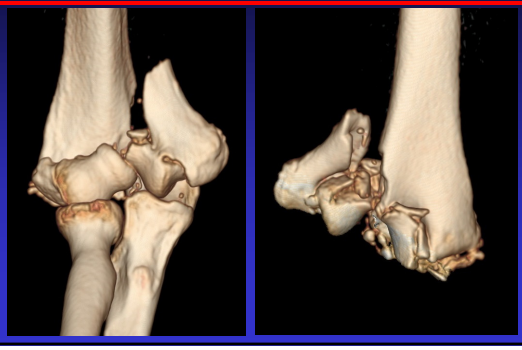
CT – FIXABLE OSTEOTOMY NOT NEEDED



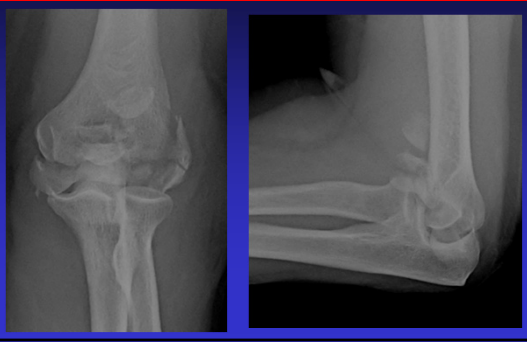
64 YO WOMAN FALL OF LADDER



CT – FIXABLE OSTEOTOMY NEEDED



74 YO WOMAN TRIPPED ON RUG

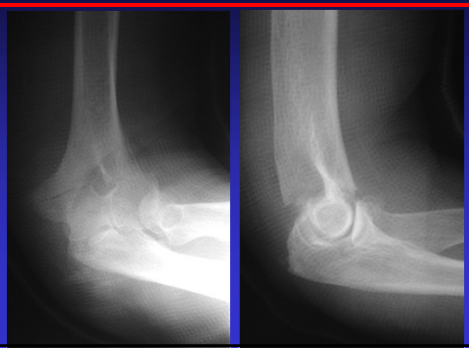


CT – NOT FIXABLE BAIL TO ARTHROPLASTY

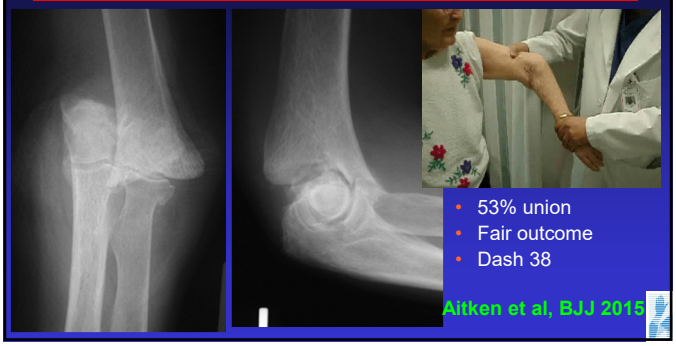
DISTAL HUMERUS FRACTURES WHAT I HAVE LEARNED

- Get adequate imaging – understand what you are getting into!
- Consider non-operative treatment in select patients

90 Y/O WOMAN Hx CVA, COPD, DEMENTIA



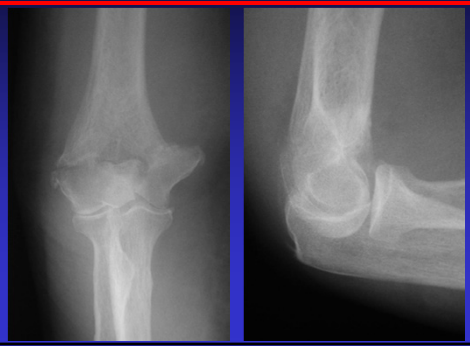
COLLAR & CUFF - NONUNION



- 53% union
- Fair outcome
- Dash 38

Aitken et al, BJJ 2015

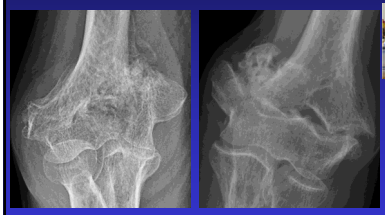
92 Y/O WOMAN
Hx CVA, MI, COUMADIN



CASTED 8 WEEKS - HEALED

UNION ABOUT 80% WITH CAST

- Union more likely if column contact – Desloges (81%)
- Similar to report by Robinson - (83%)



Desloges et al, JSES 2015
Robinson et al, J Orthop Trauma. 2003

OUTCOMES SIMILAR IN ELDERLY REGARDLESS OF TREATMENT

Measures	TEA	ORIF	NON-OP
Mean flexion arc	101	100	107
Extension	25	20	22
Flexion	126	120	128
MEPS	90	88	90

- Data from Systematic review and Meta-analysis
  - Twenty-seven studies with 563 patients, > 60 years old
  - mean follow-up after TEA was 46 months
  - Mean follow-up after ORIF was 43 months

Desloges et al, JSES 2015
Githens et al, J Ortho Trauma 2013

COMPLICATIONS LESS WITH NONOPERATIVE TREATMENT

- Non-operative:
  - One patient cast pressure sore
  - One patient had a TEA for poor outcome
  - No ulnar neuropathy or infection

- Operative:

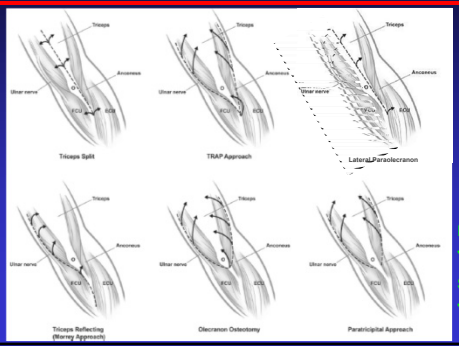
Complications	TEA	ORIF
Patients experiencing at least 1 complication	33.3% (CI 21.6-44.9%)	32.6% (CI 21.8-43.5%)
Total complications	37.6% (102)	34.2% (100)
Major	11% (30)	13.7% (40)
Minor	26.6% (72)	20.6% (60)

Desloges et al, JSES 2015 Githens et al. J Orthop Trauma. 2013

DISTAL HUMERUS FRACTURES WHAT I HAVE LEARNED

- Get adequate imaging – understand what you are getting into!
- Consider non-operative treatment in select patients
- Correct surgical approach to address pathology

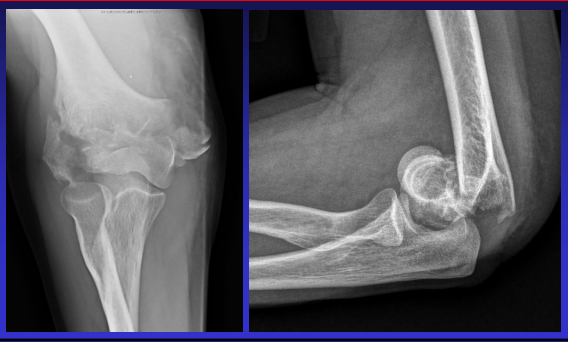
SURGICAL APPROACH KEY



Nauth et al, JBJS 2011

Studer et al. JHS 2013

63 YO WOMAN



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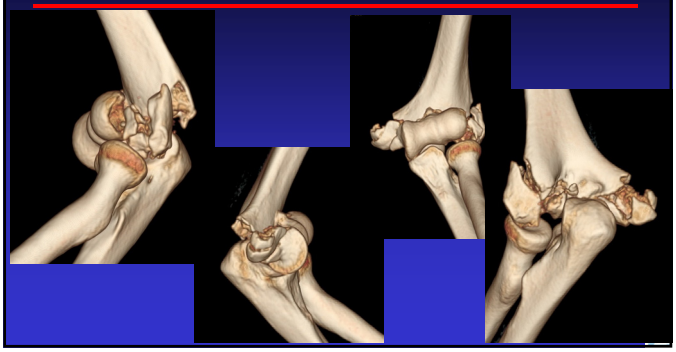
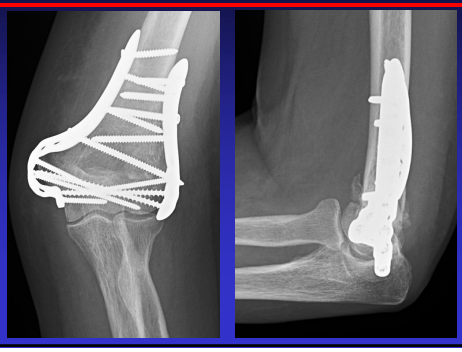
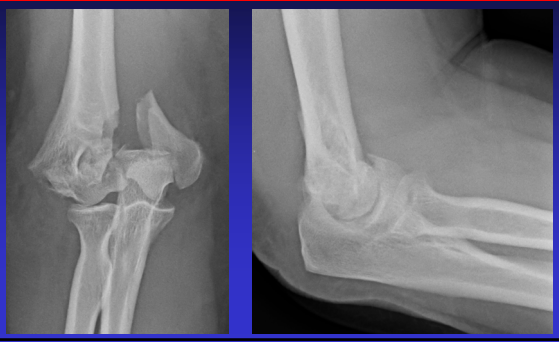


PARATRICIPITAL APPROACH TYPE A AND SIMPLE TYPE C1

PARALLEL PLATES GOOD FUNCTIONAL OUTCOME



64 YO WOMAN FALL OF LADDER



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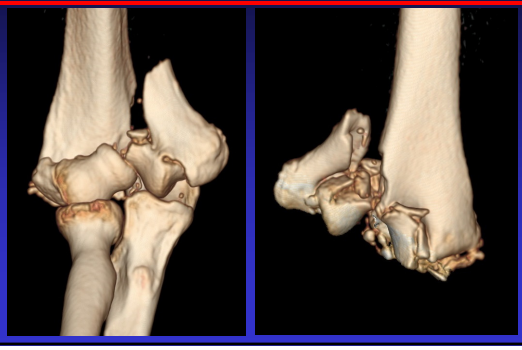


OLECRANON OSTEOTOMY COMMINUTED TYPE C

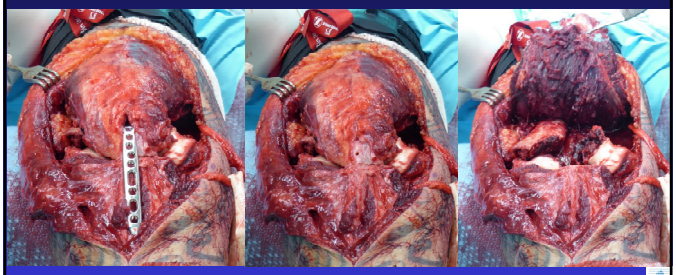
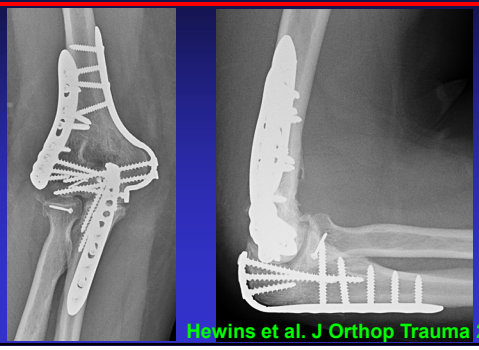


PLATE FIXATION OF OSTEOTOMY PREFERRED

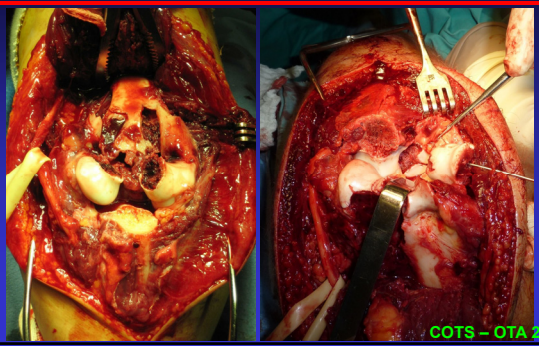


Hewins et al. J Orthop Trauma 2007

DISTAL HUMERUS FRACTURES WHAT I HAVE LEARNED

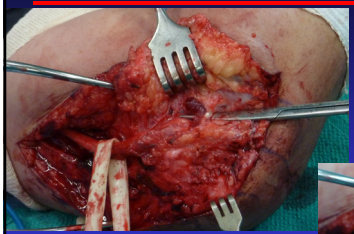
- Get adequate imaging – understand what you are getting into!
- Consider non-operative treatment in select patients
- Correct surgical approach to address pathology
- Transpose ulnar nerve

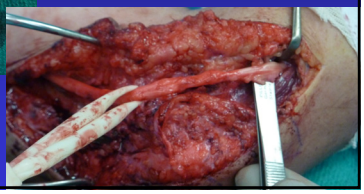
ULNAR NERVE - NO DIFFERENCE IN OUTCOME TRANSPOSITION OR IN-SITU RELEASE?



COTS – OTA 2016

NERVE SCARRING TO PLATE PROBLEMATIC WITH REVISION SURGERY – I MOVE IT!





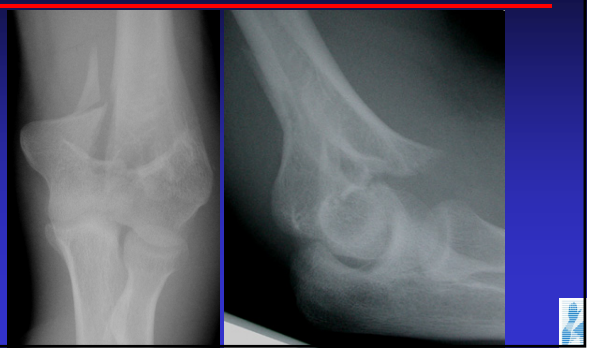
DISTAL HUMERUS FRACTURES WHAT I HAVE LEARNED

- Get adequate imaging – understand what you are getting into!
- Consider non-operative treatment in select patients
- Correct surgical approach to address pathology
- Transpose ulnar nerve
- Flexible approach to ORIF – ensure adequate fixation

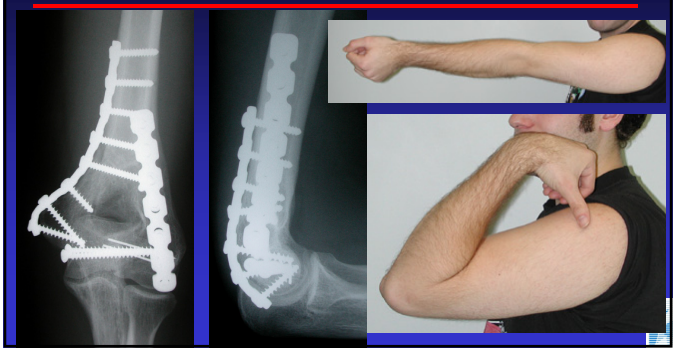
PRINCIPLES OF ORIF

- Restore articular congruity
- Maximize fixation in distal fragments
  - At least three screws medially and laterally
  - Screws as long as possible
- Compress supracondylar component of fracture
- Robust plates if shaft extension

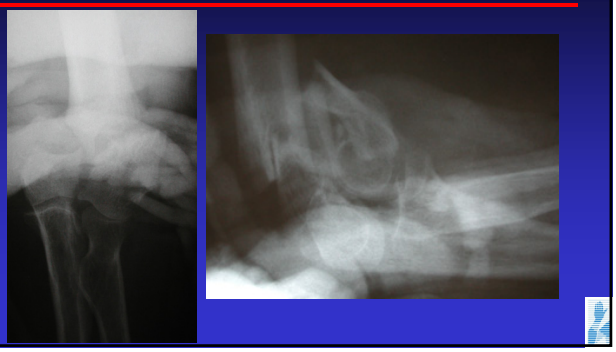
21 YO SNOWBOARDING



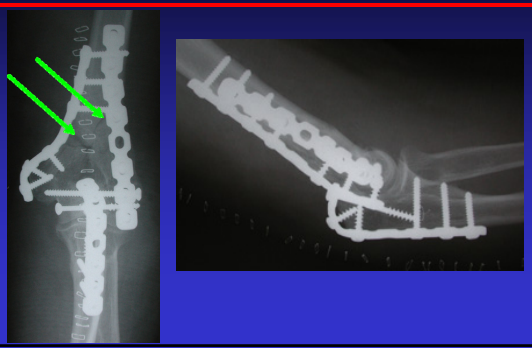
SPECIAL PLATES NOT NEEDED FOR SIMPLE FRACTURES WITH GOOD BONE



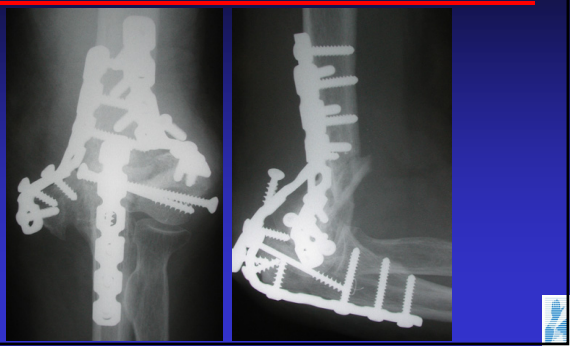
77 Y/O WOMAN



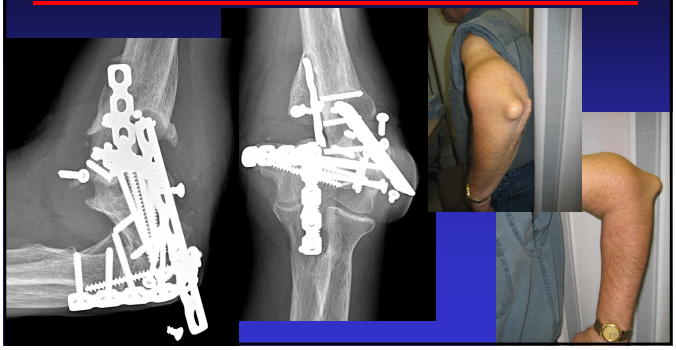
POST-OP ORIF PROXIMAL SUPRACONDYLAR



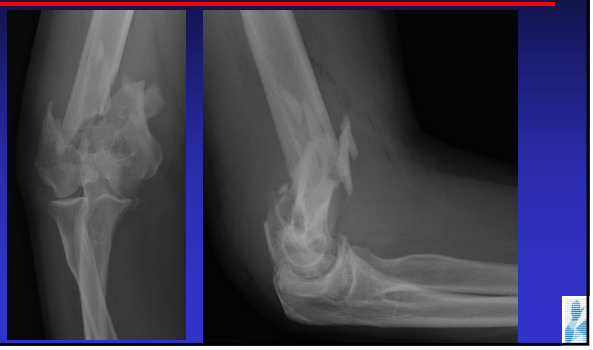
PLATES TOO WEAK – NEED THICKER PLATES FOR # ABOVE OLEC FOSSA



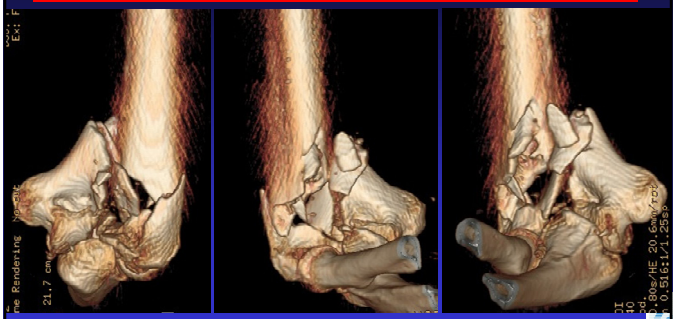
60 YEAR OLD MAN NOT MUCH DONE RIGHT!



75 YEAR OLD FARMER FALL OFF TRACTOR – OPEN



HUMERUS SMASHED BUT HE'S A FARMER – AVOID TEA!



PRECONTOURED PLATES SPEED SURGERY SMALL PLATE HOLDS REDUCTION ADD MORE PLATES IF NEEDED ? LOCKING ?

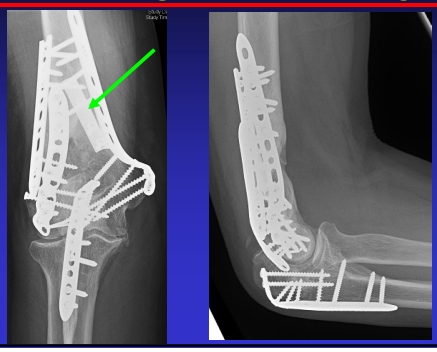


PLATE POSITION

- Parallel plates
  - Osteoporosis
  - Risk radial nerve and LCL injury
  - Lateral plate bothersome

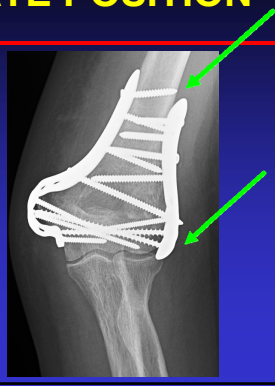


PLATE POSITION

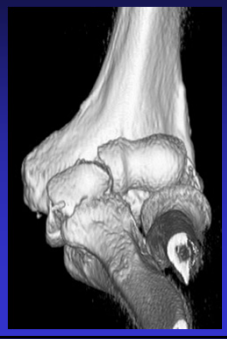
- Parallel plates
  - Older patient
  - Risk radial nerve and LCL injury
  - Lateral plate bothersome
- Orthogonal plates
  - Younger patient
  - Coronal shear component

DISTAL HUMERUS FRACTURES WHAT I HAVE LEARNED

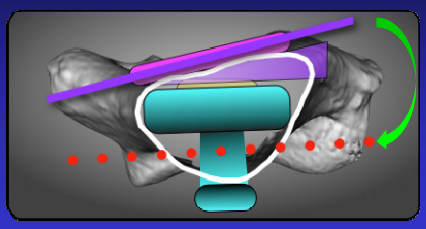
- Get adequate imaging – understand what you are getting into!
- Consider non-operative treatment in select patients
- Correct surgical approach to address pathology
- Transpose ulnar nerve
- Flexible approach to ORIF – ensure adequate fixation
- Consider arthroplasty in older lower demand patients

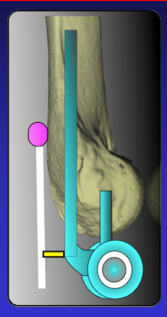
82 YO WOMAN CAPITELLUM-TROCHLEA

CT



14 °INTERNAL ROTATION HC RELATIVE TO POSTERIOR FLAT SPOT





Sabo et al, JBJS 2012

FOUR YEARS POST LINKED TEA

TEA FOR DISTAL HUMERUS FRACTURES

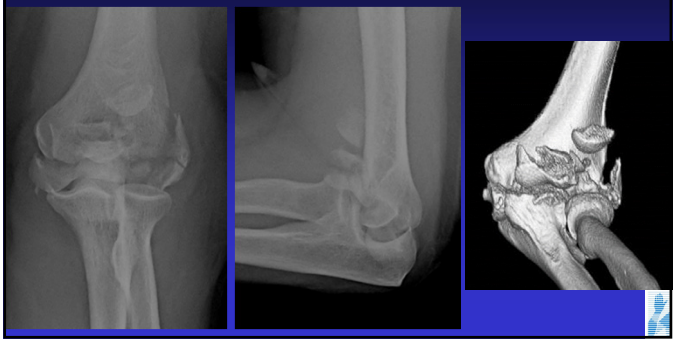
- More rapid return of function than ORIF
- Short-term outcome better than ORIF in elderly
- Complications less common but more severe than ORIF
- Loosening and wear concern at longer follow-up

Kamineni and Morrey, JBJS 2004; Lee et al, J Trauma 2006; Egol at al, Am J Orthop, 2011; Burkhart et al, Orthop Traumatol, 2010; Ali et al, JSES, 2010; Mansat et al OTSR, 2013; Obert et al, OTSR, 2013, Antuna et al, Acta Orthop Bel, 2012, McKee et al, JSES 2009.

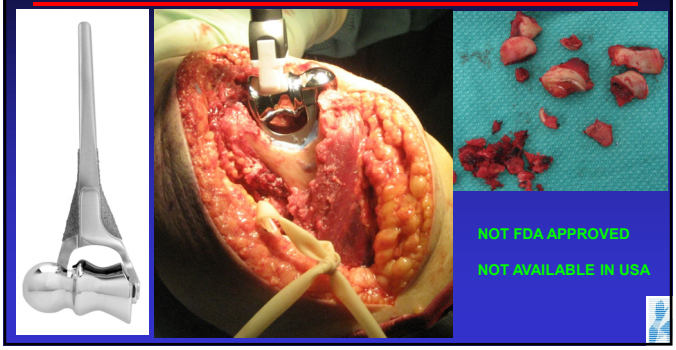
TEA FOR FRACTURE PEARLS

- Good patient selection
- Discard fractured condyles
- Efficient surgery to reduce infection
- 'Gentle' surgery to avoid fractures
- Immobilize elbow until skin heals

74 YO ACTIVE WOMAN TOO YOUNG FOR TEA?



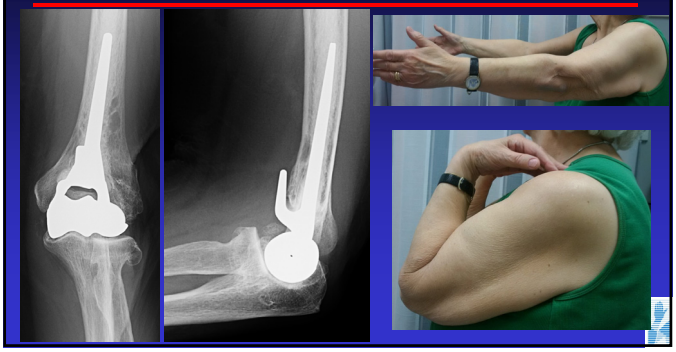
PARATRICIPITAL APPROACH HEMIARTHROPLASTY & LCL REPAIR



NOT FDA APPROVED

NOT AVAILABLE IN USA

TEN YEARS POSTOP NO PAIN MILD SUBSIDENCE & OA



HEMIARTHROPLASTY FOR DISTAL HUMERUS FRACTURES

- Insertion of humeral component straight forward
- Must reconstruct columns and/or collateral ligaments
- Elbow stability concern at short-term follow-up
- Ulnar wear concern at longer follow-up

Schultzel et al, JSES 2017; Phadnis et al, ShElb 2016; Desai et al, JSES 2016; Nestorson et al, BJJ, 2015; Hohman et al, JSES 2014, Smith et al, JSES, 2013; Burkhart et al, J Trauma, 2011; Street et al, JBJS, 1974

DISTAL HUMERUS FRACTURES WHAT I HAVE LEARNED

- Get adequate imaging – understand what you are getting into!
- Consider non-operative treatment in select patients
- Correct surgical approach to address pathology
- Transpose ulnar nerve
- Flexible approach to ORIF – ensure adequate fixation
- Consider arthroplasty in older lower demand patients

DISTAL HUMERUS FRACTURES WHAT I HAVE LEARNED

AMERICAN SHOULDER AND ELBOW SURGEONS
ORTHOPAEDIC TRAUMA ASSOCIATION
SPECIALTY DAY
SAN DIEGO, MARCH 2017

Graham JW King MD, MSc, FRCSC

ROTH | McFARLANE
HAND & UPPER LIMB CENTRE
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