



How to assess instability in distal radius fractures?



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The patients and the injuries

They are all different!!!

Remember

- ◊ Two different types of patients
 - ◊ Young vs. Old
- ◊ Two different types of trauma
 - ◊ High energy VS low energy

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Remember

- ◊ Two different types of patients
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- ◊ Two different types of trauma
- ◊ High energy VS low energy

The anatomy and the fractures

There are different needs

X-ray evaluation



X-ray evaluation



X-ray evaluation



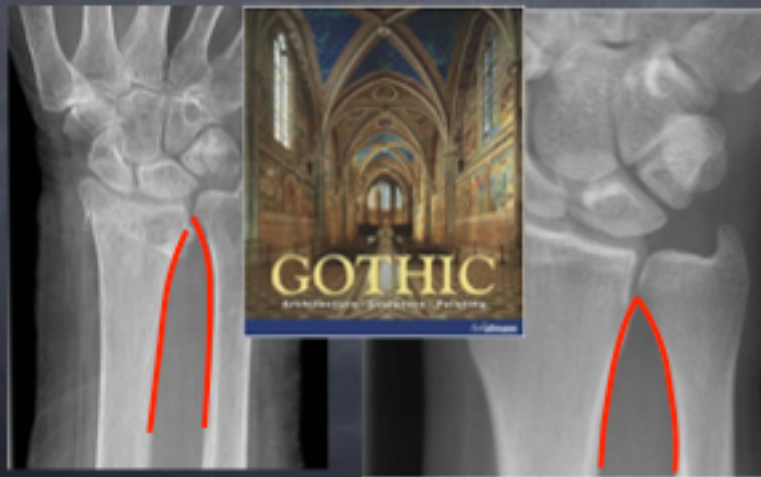
X-ray evaluation



X-ray evaluation



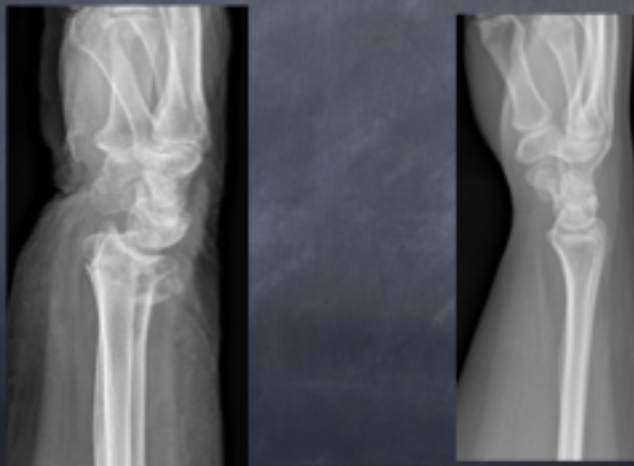
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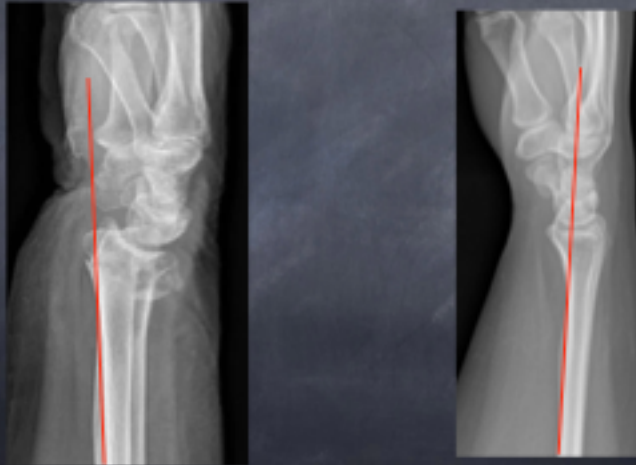
X-ray evaluation



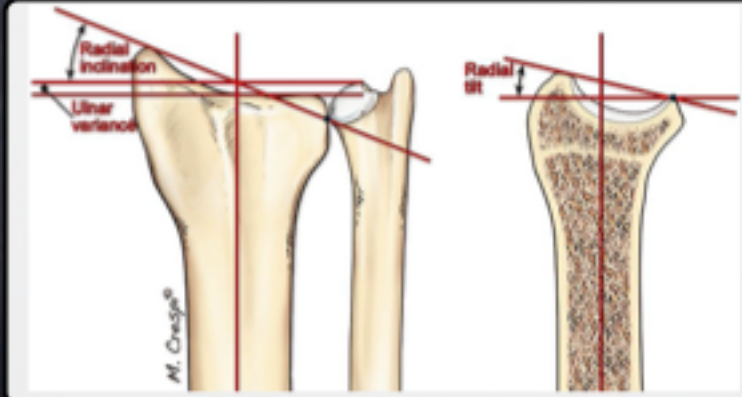
X-ray evaluation



X-ray evaluation



Radiological parameters



Solgaard et al 1986

Radiological parameters



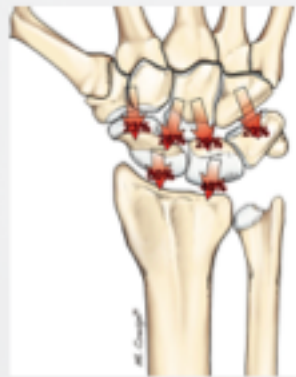
Solgaard et al 1986

Biomechanics



Palmer & Werner 1984

Biomechanics



Distribution of the axial load between radius and ulna in an intact wrist after simulated ulnar shortening and lengthening)

Site of Measurement	Axial Load (%)		
	-2.5 mm	0	+2.5 mm
Radius	95.7	81.6	59.1
Ulna	4.3	18.4	40.9

Palmer & Werner 1984

What is an unacceptable result?

- No one knows!
- BUT there is a relationship between anatomy and function

Member of common sense society (R)

What is an unacceptable result?

Welcome to the



UNIVERSITY OF
COMMON SENSE

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What is an unacceptable result?



Member of common sense society (R)

What do we find in the literature?



Cooney, 1989; Fernandez 1982; McQueen 1988; McQueen et al., 1992; McQueen et al., 1994; McQueen 1998; McQueen, 1999

What do we find in the literature?

There is a correlation between functional outcome and anatomical outcome

McQueen: « if more than 10 deg dorsal angulation, the patients more often have reduced function, reduced grip strength and more pain»



Cooney, 1989; Fernandez 1982; McQueen 1988; McQueen et al., 1992; McQueen et al., 1994; McQueen 1998; McQueen, 1999

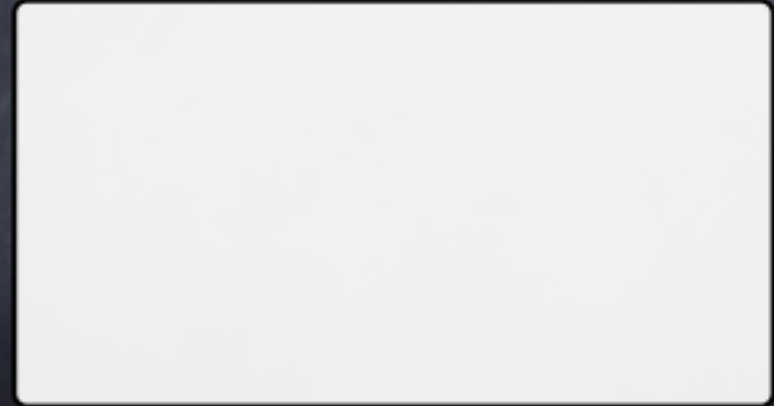
Fracture stability

The key to offer a good and correct treatment is to understand which fractures are unstable when treated with PoP



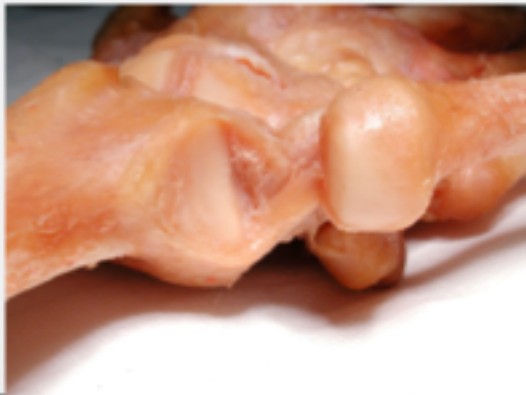
Distal radius fractures

Relevant patoanatomy - the common fragments



Radiusfrakturur

Relevant patoanatomy - the common fragments



Radiusfrakturur

Relevant patoanatomy - the common fragments



Radiusfrakturur

Relevant patoanatomy - the common fragments



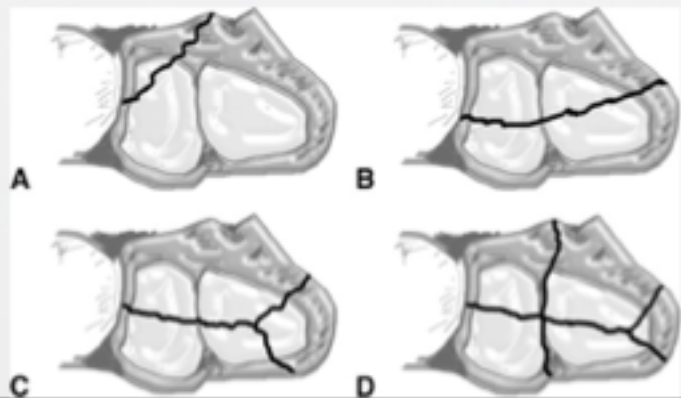
Radiusfraktur

Relevant patoanatomy - the common fragments



Melone (1984)

Relevant patoanatomy - the common fragments



Melone (1984)

"Terrorist corner"



Radius fractures

How to predict instability

THE JOURNAL OF BONE & JOINT SURGERY
J B & J S

*This is an enhanced PDF from The Journal of Bone and Joint Surgery
The PDF of the article you requested follows this cover page.*

Prediction of Instability in Distal Radial Fractures

P.J. Mackenzie, M.M. McQueen and R. Elton
J Bone Joint Surg Am. 2006;88:1944-1951. doi:10.2106/JBJS.D.02520

Unstable distal radius fractures

How to predict instability

THE JOURNAL OF BONE & JOINT SURGERY
J B & J S

All Fractures

For the prediction of carpal malalignment ($R^2 = 0.12$): $X = (0.03 \times \text{age}) - 0.56$ (if independent) $- 0.97$ (if comminution type = none) $- 0.46$ (if comminution type = dorsal and volar) $+ 0.34$ (if AO/OTA subgroup = 2) $+ (0.0017 \times \text{dorsal angle at presentation}) - 2.14$.

P_i

The probability of instability or carpal malalignment can be expressed as a percentage with use of the following conversion equation:

$\frac{P_i}{100}$

$$\text{Probability (\%)} = (e^X \times 100) / (1 + e^X)$$

Unstable distal radius fractures

Which fractures are unstable?

The more important factors to predict loss of reduction:

Unstable distal radius fractures

Which fractures are unstable?

The more important factors to predict loss of reduction:

Old age



Unstable distal radius fractures

Which fractures are unstable?

The more important factors to predict loss of reduction:

Old age
All types of comminution



Unstable distal radius fractures

Which fractures are unstable?

The more important factors to predict loss of reduction:

Old age
All types of comminution
Loss of radial length



Unstable distal radius fractures

Which fractures are unstable?

The more important factors to predict loss of reduction:

Old age
All types of comminution
Loss of radial length
High Energy



Unstable distal radius fractures

Which fractures are unstable?

The more important factors to predict loss of reduction:

Old age
All types of comminution
Loss of radial length
High Energy
Loss of radial tilt (dorsal/volarly)



Unstable distal radius fractures

Fracture stability

The key to offer a good and correct treatment is to understand which fractures are unstable when treated with PoP



Distal radius fractures

Which fractures are unstable?

$\geq 10^\circ$ Dorsal angulation

Radial shortening ≥ 2 mm

Intra-articular step ≥ 2 mm

Dorsal and/or volar comminution



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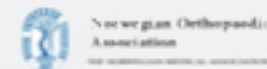
Dorsal and/or volar comminution



Mackenney et al. 2006

When should surgery be considered?

Guidelines for treatment of DRF in adults



wristfractures.no

Distal radius fractures

When should surgery be considered?

$\geq 10^\circ$ Dorsal angulation

Radial shortening ≥ 2 mm

Intra-articular step ≥ 2 mm

Dorsal and/or volar comminution

Incongruence in DRUJ

High energy trauma



www.wristfractures.no ; Hebe Dísiría Kverrma, Leiv Magne Hove, Adalsteinn Odinson, Kátrine Þjórnebek Frénsdal, Ingrid Herboe, Yngver Krukhaug

Conservative vs pinning

Issue	Distal 1/3 distal radius	Radial Head	Proximal Radius	Proximal Ulna	Proximal Distal Radius	Proximal Distal Ulna
Functional grading for or post independent on length of bone system	Medial Distal 1/3 of bone Distal 1/3 of bone Distal 1/3 of bone	800-2.21 200-2.19 1.98	275 200-190	150 200-190	200-190 200-190 200-190	100-2.19 100-2.19 100-2.19
Functional grading for or post after 12 months follow up	Medial Distal 1/3 of bone Distal 1/3 of bone Distal 1/3 of bone	800-2.21 200-2.19 1.98	400 200-190	140 200-190	200-190 200-190 200-190	100-2.19 100-2.19 100-2.19
No distraction healing surgical condition	Medial Distal 1/3 of bone Distal 1/3 of bone Distal 1/3 of bone	800-2.21 200-2.19 1.98	140 200-190	15 200-190	100-190 200-190 200-190	100-2.19 100-2.19 100-2.19
Capitulum fracture (radial head)	Distal 1/3 of bone Distal 1/3 of bone Distal 1/3 of bone	800-2.21 200-2.19 1.98	50 200-190	20 200-190	20-190 200-190 200-190	100-2.19 100-2.19 100-2.19
Complex regional pain syndrome	Distal 1/3 of bone Distal 1/3 of bone Distal 1/3 of bone	800-2.21 200-2.19 1.98	100 200-190	140 200-190	20-190 200-190 200-190	100-2.19 100-2.19 100-2.19

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Recommendation

Operative vs conservative treatment of unstable DRF

Strong recommendation Options

Benefits clearly outweigh the drawbacks/harms.

We recommend operative treatment of patients with unstable distal radius fractures in adult patients.

Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.

Distal radius fractures

Which surgical method?



Distal radius fractures

Ex Fix vs Volar locking plates

Unit	Time to Effortlessness	Residual Effect	External Fixation	Volar Locking Plates	Forearm and Wrist Locking Plates	Analgesic Intake (Opioids, Gabapentin)
COXSI after 3 months follow-up Meta-analysis and observational performed by the guideline group/The Norwegian Knowledge Centre	Medial Wide confidence intervals, no starting few participants		mean 27.1	mean 11.8	MD 15.3 Score (95% CI 13.3 Score - 17.3 Score)	188 (3 RCT)
COXSI after 6 months follow-up Meta-analysis and observational performed by the guideline group/The Norwegian Knowledge Centre	Medial Risk of bias studies with few participants		mean 19.2	mean 11.3	MD 7.9 Score (95% CI 6.9 Score - 8.9 Score)	170 (3 RCT)
COXSI after 1 year follow-up Meta-analysis and observational performed by the guideline group/The Norwegian Knowledge Centre	Medial Small studies		mean 19.9	mean 12.4	MD 7.5 Score (95% CI 6.5 Score - 7.5 Score)	171 (3 RCT)
Pain (VAS) at activity after 4 months follow-up Meta-analysis and observational performed by the guideline group/The Norwegian Knowledge Centre	Low 1 small study		mean 21	mean 10	MD 9 Score (95% CI 8 Score - 10 Score)	104 (1 RCT)

Ex Fix vs Volar locking plates

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Ex Fix vs Volar locking plates

Label	Time To Effectiveness	Result Effect	External Fixation	Volar Locking Plates	Forearm Distal Volar Locking Plates	Amput Inclusions (Shoulder, Openings)
GDEN after 3 months follow-up Micro-analysis and clinical performed by the guideline group (The Norwegian Bone Trauma Centre)	Medial		Mean 27.1 (95% CI 23.9-30.3)	Mean 11.8 (95% CI 9.0-14.6)	MD 15.3 Nerve (95% CI 12.0-18.6)	189 (3 RCT)
GDEN after 6 months follow-up Micro-analysis and clinical performed by the guideline group (The Norwegian Bone Trauma Centre)	Medial		Mean 19.2 (95% CI 16.4-22.0)	Mean 11.2 (95% CI 8.0-14.4)	MD 7.8 Nerve (95% CI 4.0-11.6)	170 (3 RCT)
GDEN after 1 year follow-up Micro-analysis and clinical performed by the guideline group (The Norwegian Bone Trauma Centre)	Medial		Mean 16.8 (95% CI 14.0-19.6)	Mean 12.4 (95% CI 9.6-15.2)	MD 4.4 Nerve (95% CI 1.6-7.2)	171 (3 RCT)
Pain (VAS) at activity after 6 months follow-up Micro-analysis and clinical performed by the guideline group (The Norwegian Bone Trauma Centre)	Lateral		Mean 21 (95% CI 18-24)	Mean 15 (95% CI 12-18)	MD 6 Nerve (95% CI 3-9)	106 (1 RCT)

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Pinning vs Volar Locking Plates

Label	Time To Effectiveness	Result Effect	Percutaneous Pinning	Volar Locking Plates	Forearm Distal Volar Locking Plates	Amput Inclusions (Shoulder, Openings)
Total complications after 6 months - 1 year LAI Pin participants, See events (compensation)		RR 0.24 (95% CI 0.08-0.70)	262 per 1000	63 per 1000	198 Nerve per 1000 (95% CI 168-228)	236 (4 RCT)
Distal complications after 6 months - 1 year Vending for See participants, See events (compensation)		RR 0.19 (95% CI 0.04-0.84)	108 per 1000	21 per 1000	87 Nerve per 1000 (95% CI 58-116)	140 (3 RCT)
Mid complications after 1 year LAI Pin participants, See events (compensation)		RR 0.58 (95% CI 0.24-1.39)	124 per 1000	72 per 1000	52 Nerve per 1000 (95% CI 32-72)	176 (3 RCT)
Continuous Outcomes						
GDEN after 3 months Medial Distal studies	GDEN 0-100	Mean 28.7 (95% CI 25.9-31.5)	Mean 18.9 (95% CI 16.1-21.7)	MD 9.8 Nerve (95% CI 6.0-13.6)	236 (4 RCT)	
GDEN after 6 months LAI Distal studies	GDEN 0-100	Mean 22 (95% CI 19.2-24.8)	Mean 16 (95% CI 13.2-18.8)	MD 6 Nerve (95% CI 3.2-8.8)	199 (3 RCT)	
GDEN after 12 months LAI Only 1 study for participants	GDEN 0-100	Mean 18.3 (95% CI 15.5-21.1)	Mean 13.2 (95% CI 10.4-16.0)	MD 5.1 Nerve (95% CI 2.3-7.9)	76 (3 RCT)	

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Volar locking plates vs Ex-Fix/ Pinning & PoP

Weak recommendation

Option

Consider choosing volar locking plates rather than percutaneous pinning for adult patients irrespective of age who meet the indication for operation.

Restraint should be exhibited with respect to using surgery for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.

Distal radius fractures

The DRAFFT-study



W RIST AND HAND

Cost effectiveness of treatment with percutaneous Kirschner wires versus volar locking plate for adult patients with a dorsally displaced fracture of the distal radius

ANALYSIS FROM THE DRAFFT TRIAL

We present an economic evaluation using data from the British Society for Bone and Joint Surgery (BSBJ) to compare the relative cost effectiveness of percutaneous Kirschner wires (K-wire fixation) and volar locking plate fixation for patients with dorsally displaced fractures of the distal radius.

The cost effectiveness analysis (cost per quality-adjusted life year (QALY) was derived from a health economic, two-arm, parallel group, randomised, controlled trial which took place in 16 trauma centres in the United Kingdom. Data from 48 patients were available for analysis, which included quality of life, health economic parameters including costs of surgery, hospital, and medication resources used over a 12-month period after surgery, and clinical perspectives, which included the cost of time off work and the need for additional private care.

There was only a small difference in QALYs gained for patients treated with locking plate fixation over those treated with K-wire, at a mean additional cost of 1714 (95% confidence interval 588 to 2840) per patient. Locking plate fixation presented an incremental cost effectiveness ratio (ICER) of 188 (95% CI 120 to 256) within the first 12 months of treatment. Sensitivity analysis with substitution in favour for K-wire of locking plate fixation compared with K-wire. These were greater than 100 000.

Compared with locking plate fixation, K-wire fixation is a cost-saving intervention, with similar health benefits.



Achten et al; Joint J 2015;97-B:1082-9.

INCLUSION CRITERIA (STANDARDISATION?)

Aged 18 or over

Dorsally displaced fracture of the distal radius within 3 cm of the radio-carpal joint

The treating surgeon **believed** that the patient would benefit from surgical fixation of the fracture, and the fracture can be reduced by closed reduction

Achten et al; Joint J 2015;97-B:1082-9.

DRAFFT TRIAL OUTCOME

No difference in functional outcome

K-wire fixation, however, is cheaper and quicker to perform.

Achten et al; Joint J 2015;97-B:1082-9.

BUT

Contrary to the existing literature, and against the rapidly increasing use of locking plate fixation

Achten et al; Joint J 2015;97-B:1082-9.

DRAFFT TRIAL IN SMALL PRINT

Dorsally displaced distal radius fractures **only**

Exclusion of all significant **intra-articular fractures** that require an open reduction....

K wire technique and plating technique not standardised.....

Dash score

Achten et al; Joint J 2015;97-B:1082-9.

WHAT HAVE WE LEARNT FROM FROM DRAFFT???

K wires may achieve a similar outcome when:

The fracture is dorsally displaced **ONLY!**

Can be reduced with **closed** technique

Is within the 2 week timeframe

K wire technique does not matter ???

Achten et al; Joint J 2015;97-B:1082-9.

To do a good job you
need a proper approach

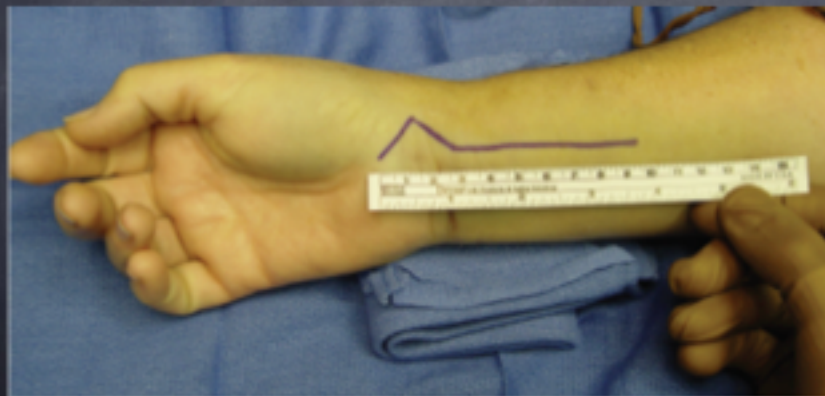
To do a good job you
need a proper approach



The volar approach is the work horse

Henry's extended
approach

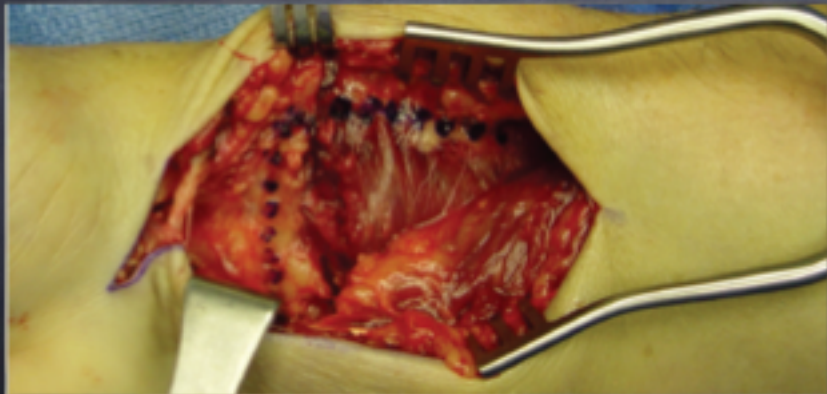
Henry's extended
approach



Henry's extended
approach



Henry's extended approach



Henry's extended approach



Woman 63 years



To do a good job you
need a proper approach

To do a good job you
need a proper approach



The dorsal approach

Dorsal plating of distal radius.
Is it still indicated?

Dorsal plating of distal radius.
Is it still indicated?

Yes, it is still indicated, sometimes...

Unstable distal radius fractures

Unstable distal radius fractures

**Dorsal plating of distal radius.
Is it still indicated?**

Unstable distal radius fractures

**Dorsal plating of distal radius.
Is it still indicated?**

Unstable distal radius fractures

**Dorsal plating of distal radius.
Is it still indicated?**

And it is best option in some cases

Unstable distal radius fractures

**Dorsal plating of distal radius.
Is it still indicated?**

And it is best option in some cases

Unstable distal radius fractures

**Dorsal plating of distal radius.
Is it still indicated?**

And it is best option in some cases

Dorsal Barton fractures

Unstable distal radius fractures

**Dorsal plating of distal radius.
Is it still indicated?**

And it is best option in some cases

Dorsal Barton fractures
Dorso-ulnar corner fractures

Unstable distal radius fractures

**Dorsal plating of distal radius.
Is it still indicated?**

And it is best option in some cases

Dorsal Barton fractures
Dorso-ulnar corner fractures
Impacted articular fracture

Unstable distal radius fractures

**Dorsal plating of distal radius.
Is it still indicated?**

And it is best option in some cases

Dorsal Barton fractures
Dorso-ulnar corner fractures
Impacted articular fracture
Comminuted articular fractures

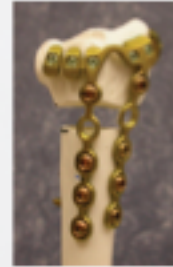
Unstable distal radius fractures

Dorsal plating "Old News"?



Unstable distal radius fractures

Dorsal plating "Old News"?



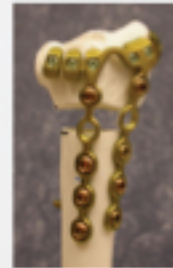
Unstable distal radius fractures

Dorsal plating "Old News"?



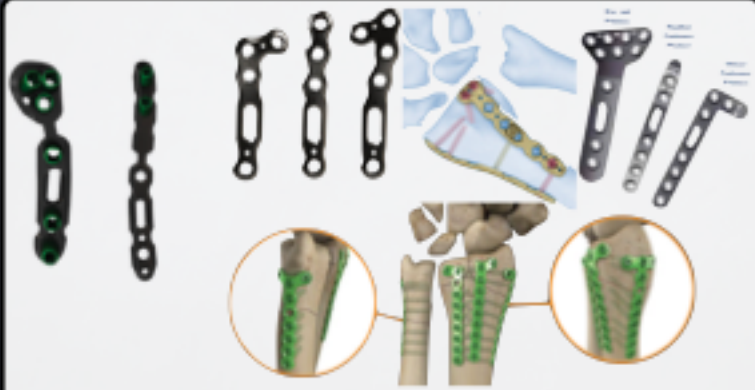
Unstable distal radius fractures

Dorsal plating "Old News"?



Unstable distal radius fractures

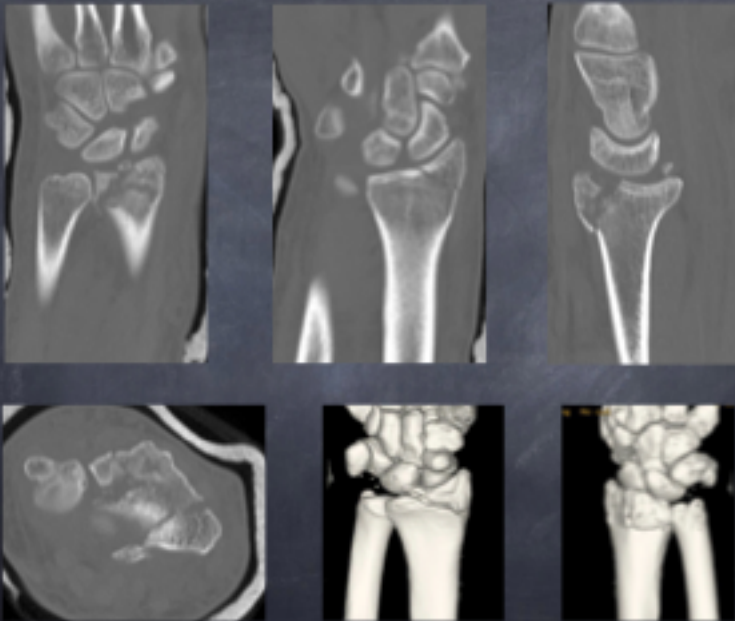
Dorsal plating "Old News"?

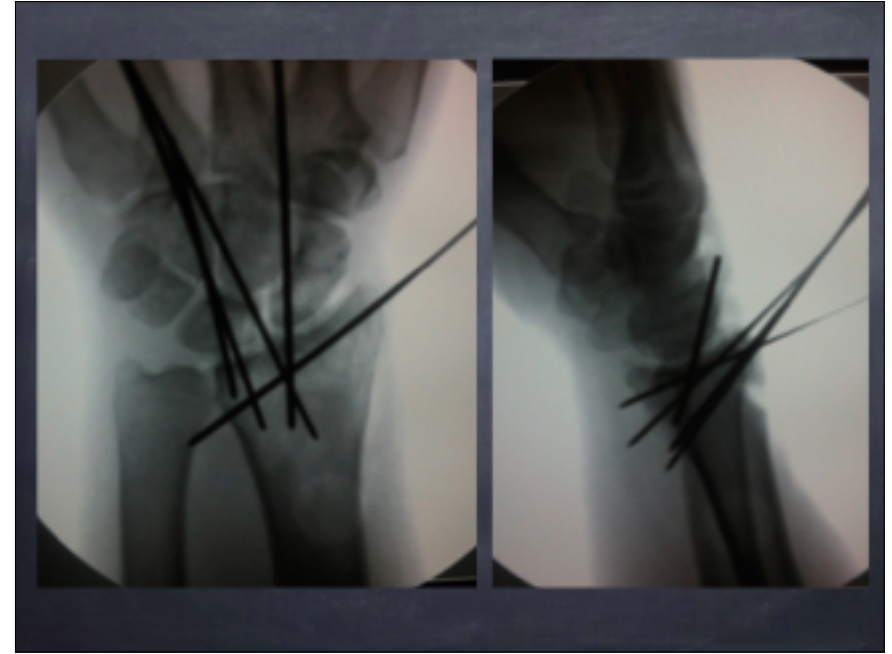
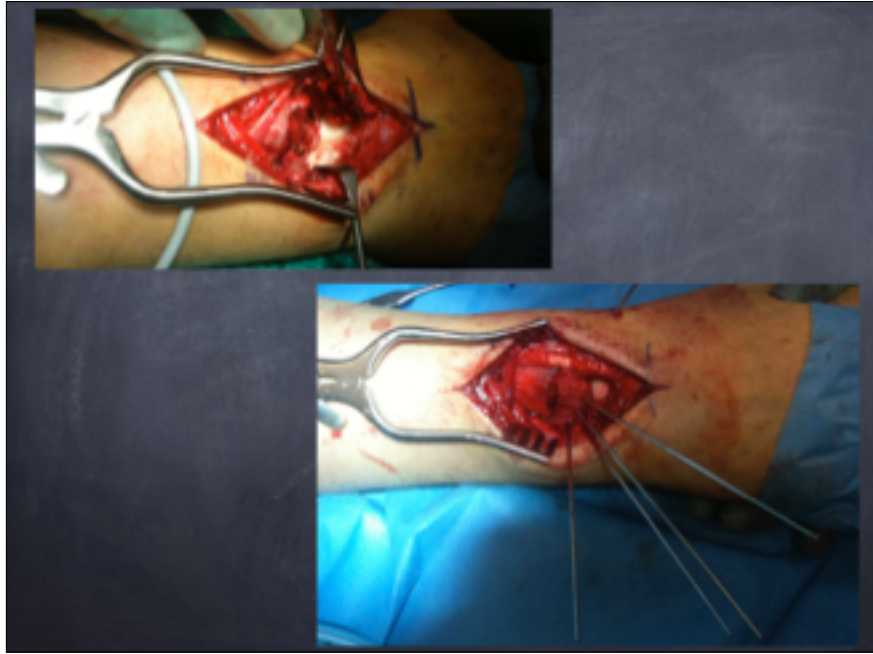


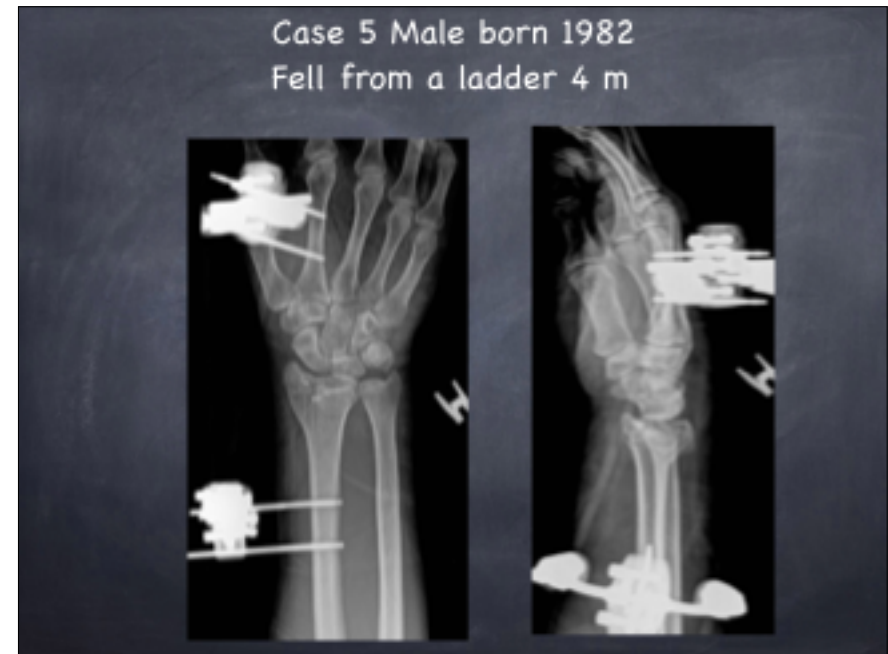
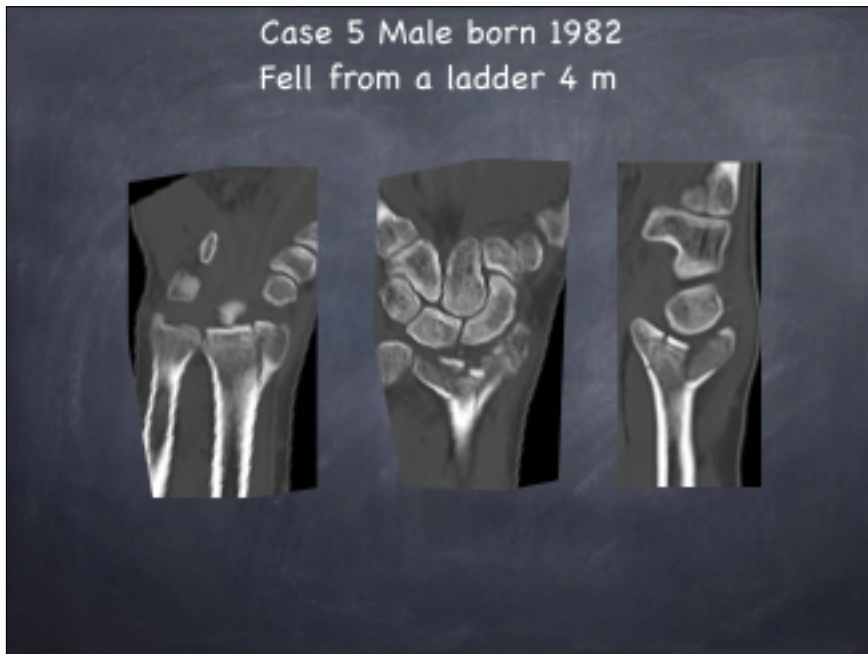
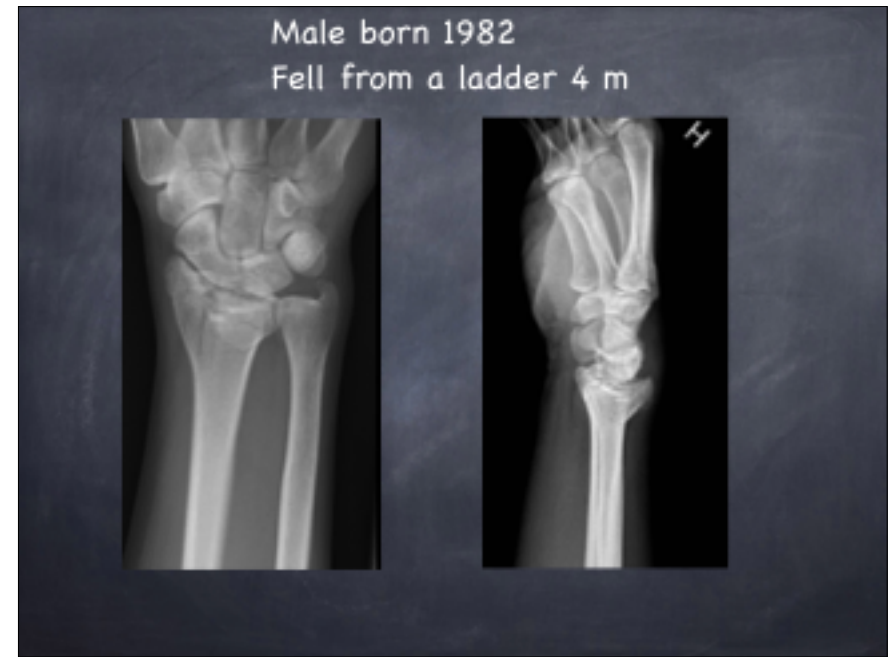
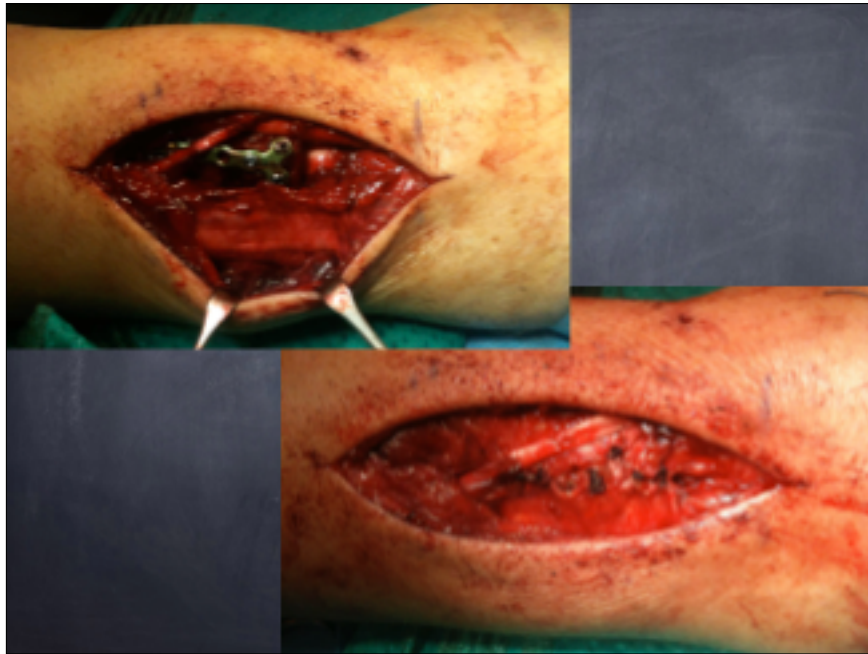
Unstable distal radius fractures

Case 1

- 53 years male
- Fall 3 m from a ladder (high energy)
- Pain and deformity of right wrist, otherwise unharmed







Case 5 Male born 1982
Fell from a ladder 4 m



To do a good job you
need a proper approach

To do a good job you
need a proper approach

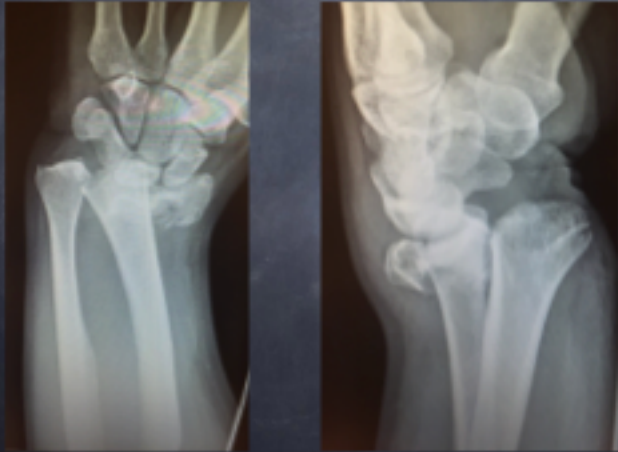


Combined volar and dorsal approach

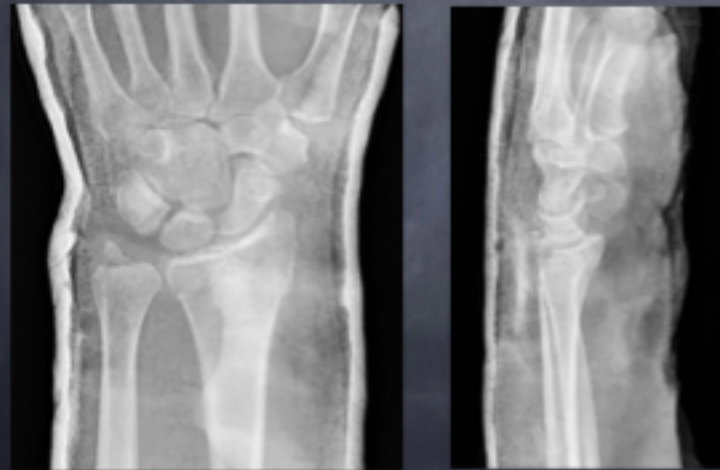
Case

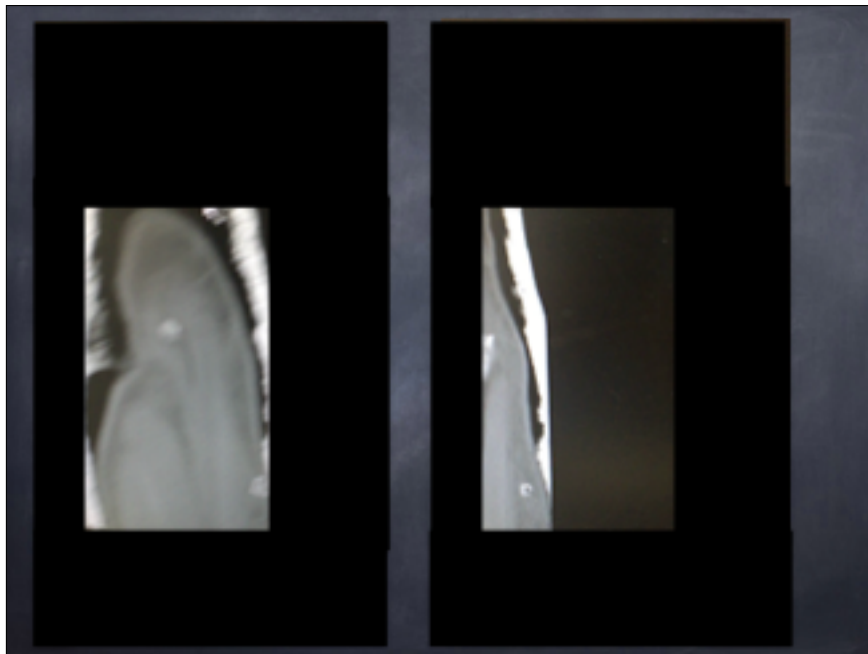
- 42 years male
- Fall into a hole (high energy)
- Pain and deformity of right wrist, otherwise unharmed

X-ray at day one



X-ray at day one





Clinical result 12 weeks



Clinical result 12 weeks



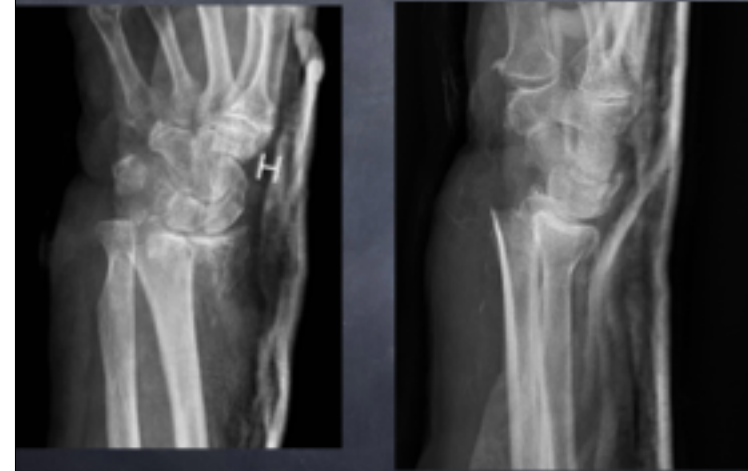
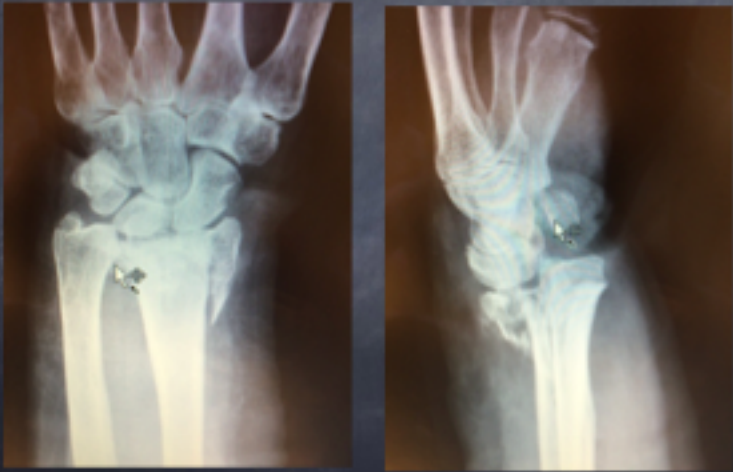
Clinical result 12 weeks



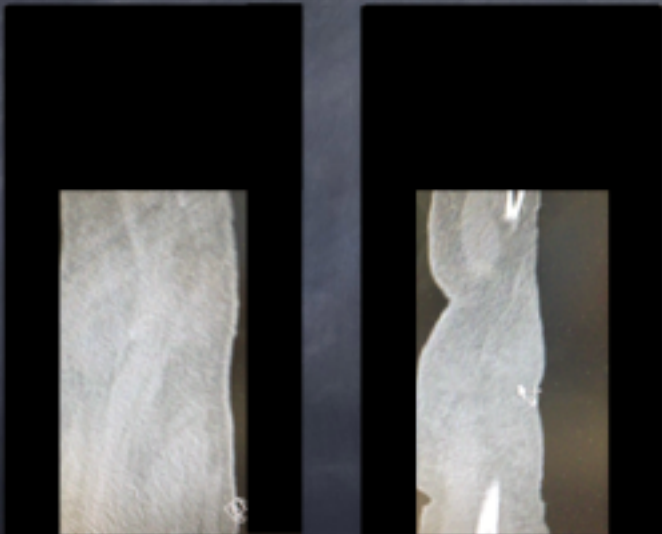
And the reason for the good result!!



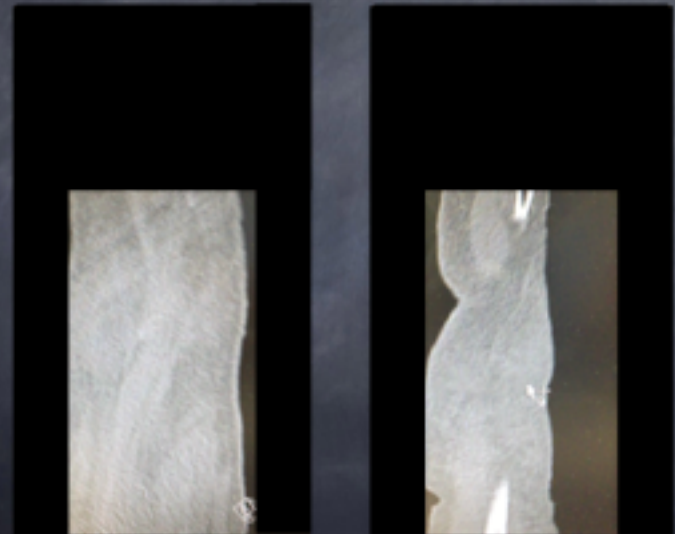
Woman born 1936, osteoporosis



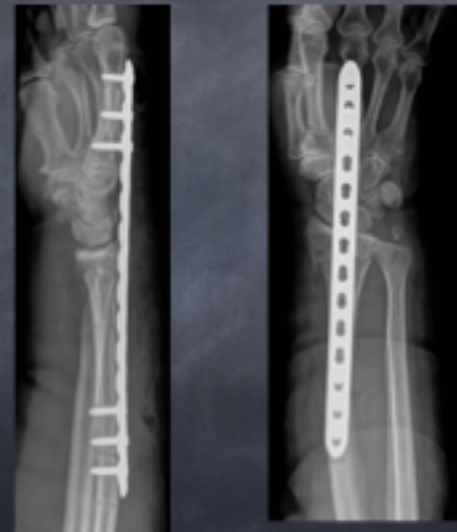
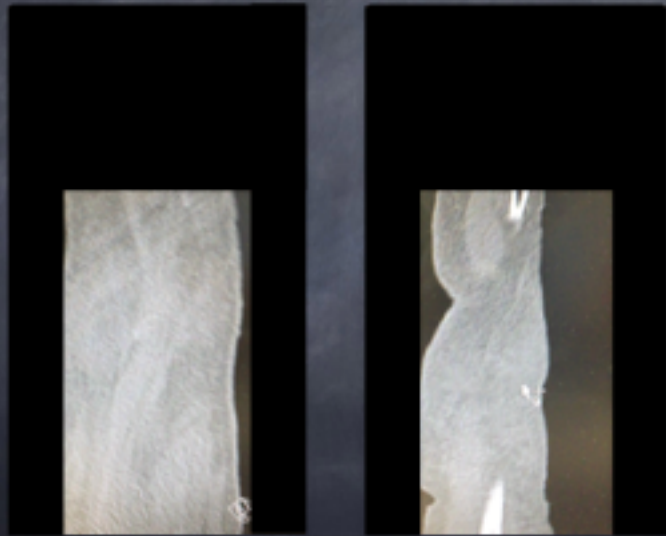
CT after Ex Fix



CT after Ex Fix



CT after Ex Fix





Treatment of distal radius fractures



What's the evidence
for dorsal plating?



Treatment of distal radius fractures- the literature

Low profile Dorsal vs Volar plate locking

Yu, Y.R., et al., *J Hand Surg Am*, 2011; Chau, Y.C., et al., *J Hand Surg Am*, 2011;
Matschke, S., et al., *Injury*, 2011. 42(4): p. 385-92.

Low profile Dorsal vs Volar plate locking

Comparable radiological results

Yu, Y.R., et al., *J Hand Surg Am*, 2011; Chou, Y.C., et al., *J Hand Surg Am*, 2011;
Matschke, S., et al., *Injury*, 2011. 42(4): p. 385-92.

Low profile Dorsal vs Volar plate locking

Comparable functional results

Comparable radiological results

Yu, Y.R., et al., *J Hand Surg Am*, 2011; Chou, Y.C., et al., *J Hand Surg Am*, 2011;
Matschke, S., et al., *Injury*, 2011. 42(4): p. 385-92.

Low profile Dorsal vs Volar plate locking

Comparable functional results

Comparable radiological results

No statistical differences in complication rate

Dorsal plate: Less tolerated?

Volar plate: more neuropathic problems?

Yu, Y.R., et al., *J Hand Surg Am*, 2011; Chou, Y.C., et al., *J Hand Surg Am*, 2011;
Matschke, S., et al., *Injury*, 2011. 42(4): p. 385-92.

What is ok to use , knowing the literature?

- **A fractures:** Volar anatomical fixed angle plates
Ex Fix and Wire and POP
- **B fractures:** Plates
- **C Fractures:** C1 and C2: Volar anatomical fixed angle plates
C3: Anatomical fixed angle plates
or Ex Fix+pins

Leung et al., *JBS*, 2008; Egol et al., *JBS*, 2008; Wei et al., *JBS Am*, 2009; Abramo et al. *Orthop*, 2009;
Widke NKT et al. *Acta Ort Scand*, 2011; Cai Z, et al. *Int Orthop* 2011; 35;

Conclusion

Both low profile volar, dorsal and fragment specific osteosyntheses give good results

All methods have complications

Probably surgeon preference and experience, and the nature of the fracture are more important than dorsal or volar approach



Treatment of distal radius fractures- the literature

Summary

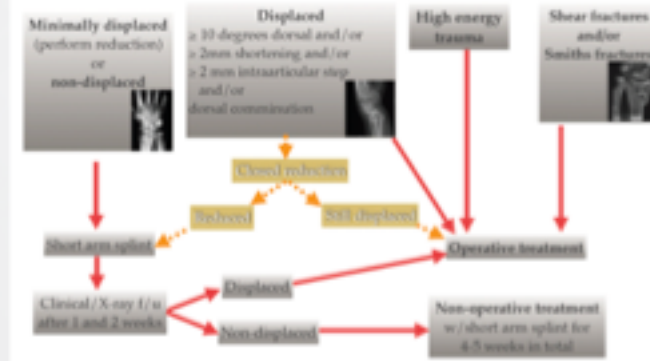


Table 11 Peter Kvarnemo

www.knorrklinik.dk / Peter Kvarnemo, Lars Magnus Rasmussen, Nils-Erik Ohlsson, Katarina Egerstedt Frimodt, Dagmar Hørbæk, Yngve Krollhus

Thank you!