Concept
Distal Radius Fracture

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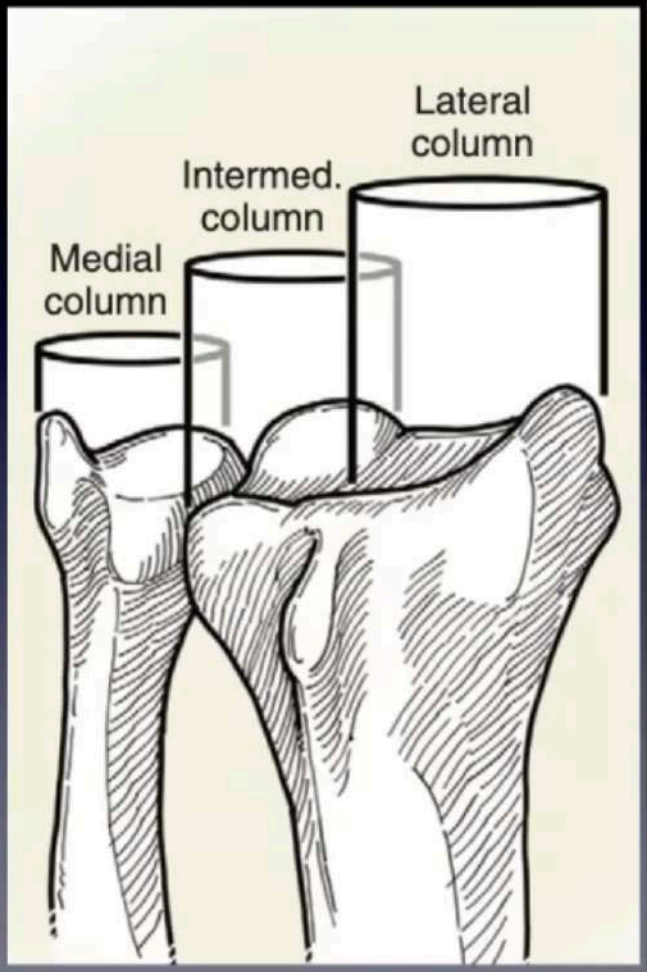
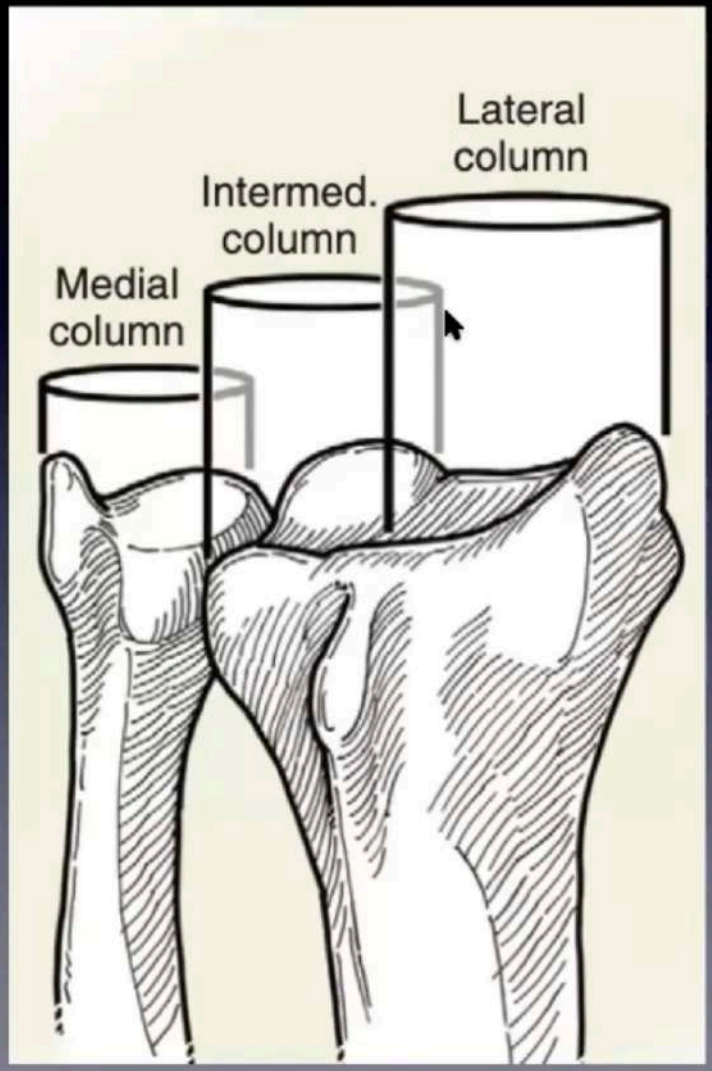


Three column concept



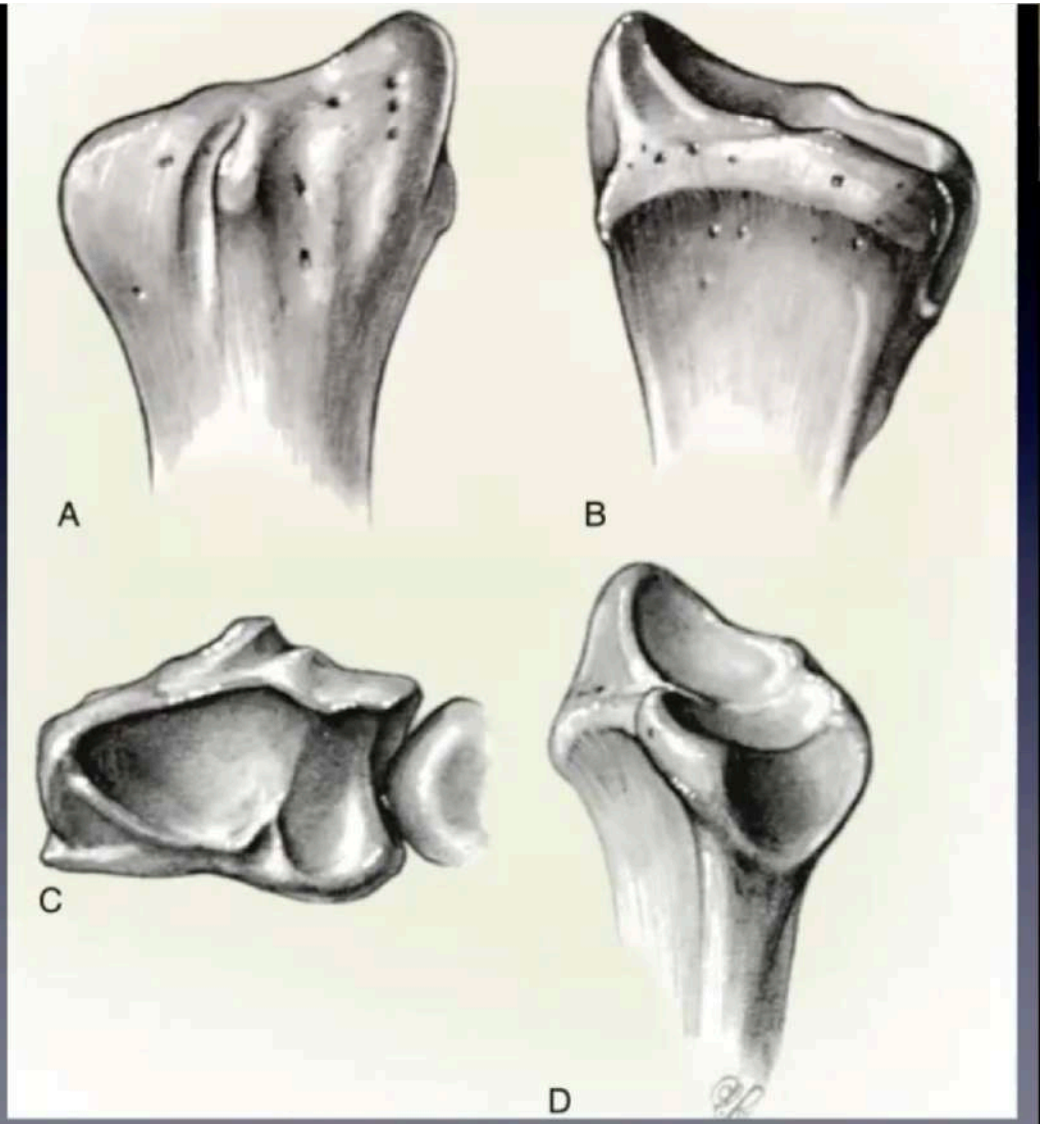
Principle of treatment of wrist fracture

- **A-** **A**rticular congruity
- **R-** **R**adial alignment and length
- **M-** **M**otion
- **S-** **S**tability by preserving length and alignment

Fracture evaluation

Anatomy- Articular surface

- **Sigmoid notch**
- **Scaphoid facet**
- **Lunate facet**



Fractutre evaluation

Anatomy - Radial alignment

- **Radial inclination / slope**

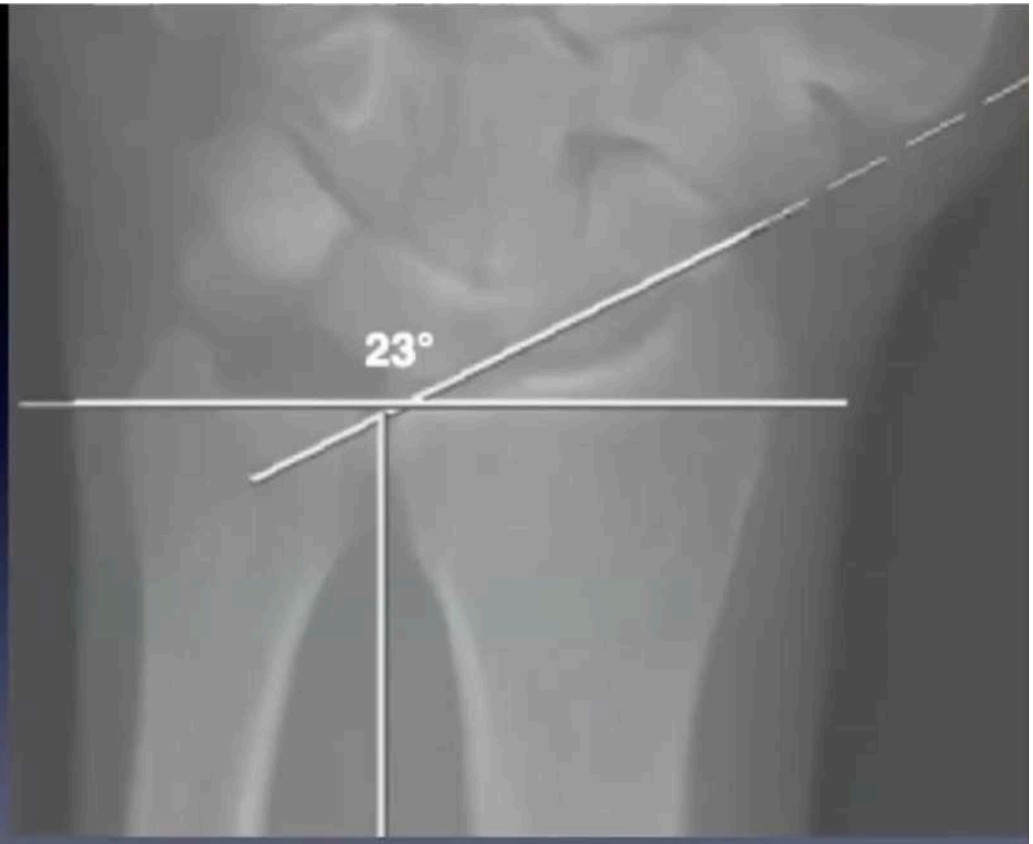


Figure 17.7 A, Posteroanterior radiograph of a wrist demonstrating radial inclination (23 degrees) and neutral ulnar variance. **B,** The "facet lateral" x-ray is performed by aligning the

Fractutre evaluation

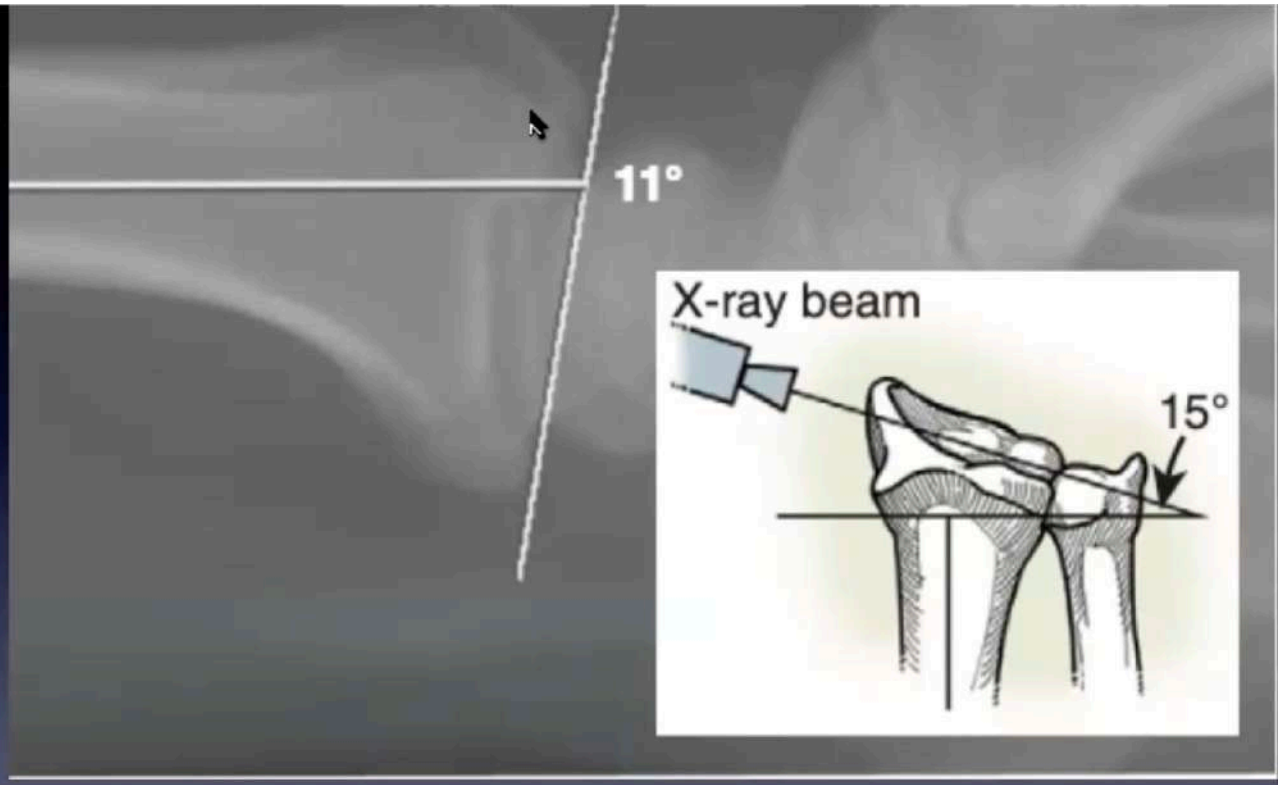
Anatomy - Radial alignment

- **Ulnar variance** - Perpendicular line method is best
- Line B- Distal ulnar aspect of radius
- Line C- distal ulna
- Line A- axis of radius
- Zero - Neutral - < 1 mm of difference in relative length between radius
- Negative — ulna minus
- Positive - ulna plus

Fracture evaluation

Anatomy - Radial alignment

- **Volar tilt**



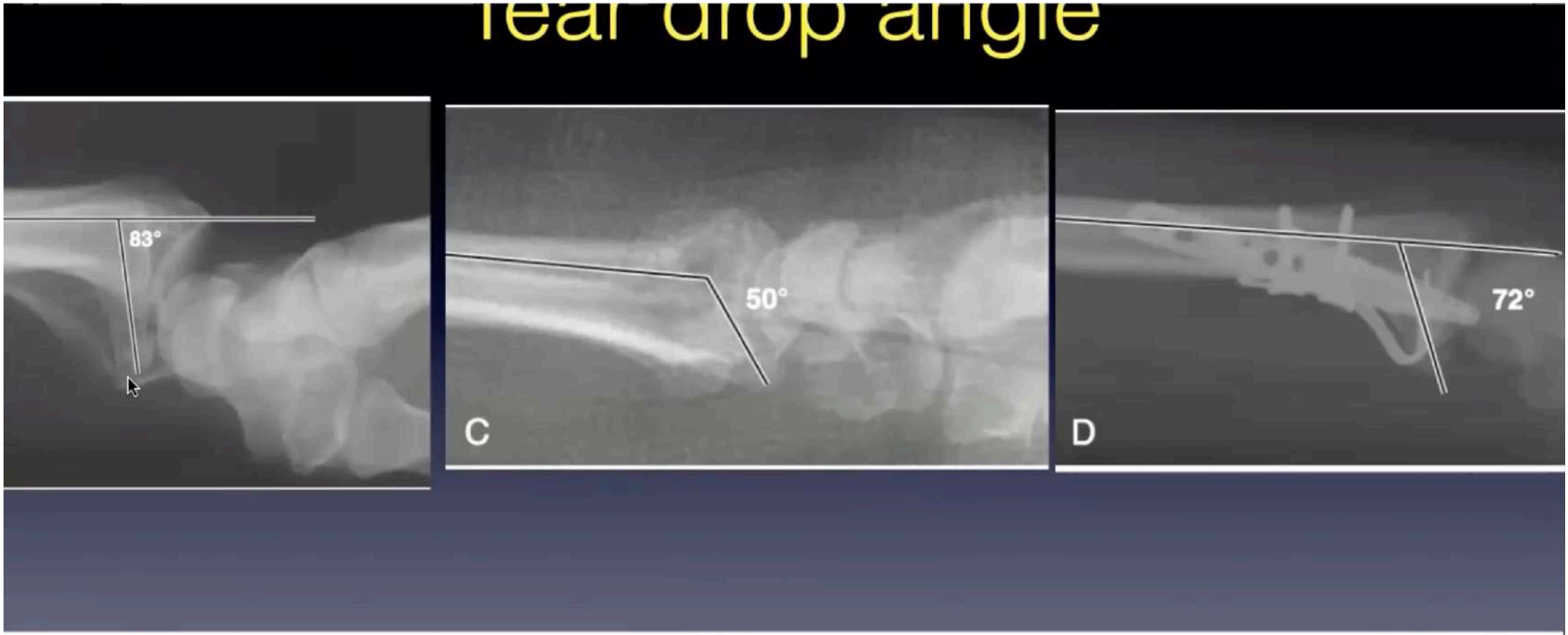
variance. **B,** The "facet lateral" x-ray is performed by aligning the x-ray beam in a plane parallel to the lunate facet of the radius, approximately 15 degrees distal to proximal. *(Drawing copyright*

Fracture evaluation

Radiographic pathanatomy

- **Tear drop angle - Normal 70 degree**
- **Increased - displaced volar margin #**
- **Decreased - dorsal angulated fracture**

Figure 17.8 "Teardrop angle." **A,** The angle is measured as a tangent to the articular surface of the volar teardrop with respect to the longitudinal axis of the radius and is normally 70 degrees. **B,** Increased teardrop angle with a displaced volar marginal fracture. **C,** Decreased teardrop angle with a dorsally angulated extra-articular fracture. **D,** Restoration of a normal teardrop angle after internal fixation of the teardrop.



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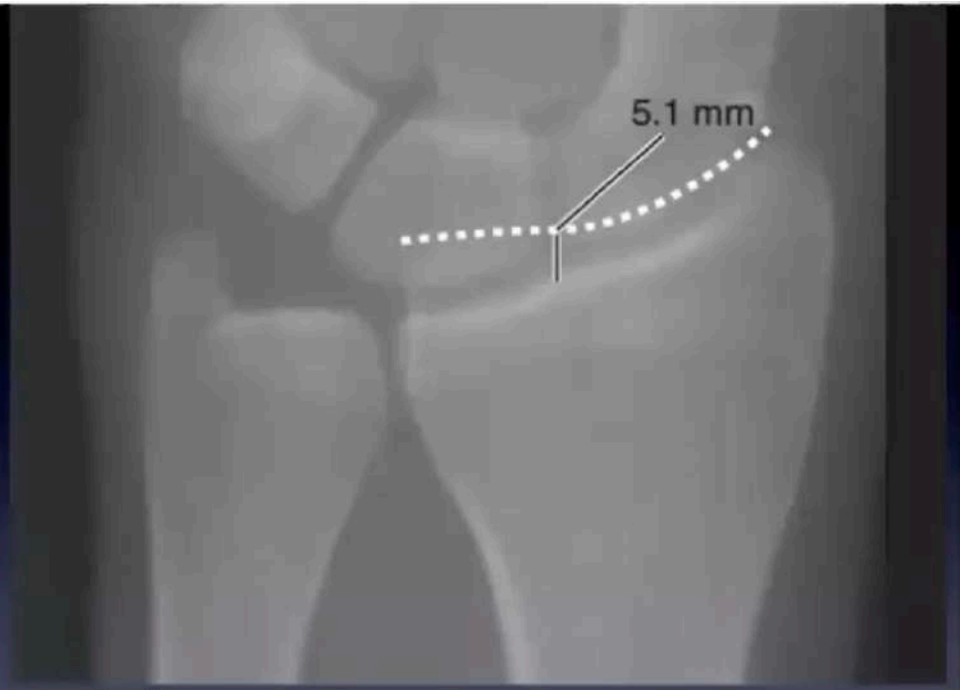
Radiographic pathanatomy



- PA view - distance between
- volar rim [dense subchondral bone] and dorsal rim

Figure 17.10 The dorsal rim of the radius normally projects 3 to 5 mm distal to the dense subchondral bone of the articular surface, and this relationship may be altered by post-traumatic changes in volar tilt or die punch injuries.

Fracture evaluation

Radiographic pathanatomy

- **Tear drop angle - Normal 70 degree**
- **Increased - displaced volar margin #**
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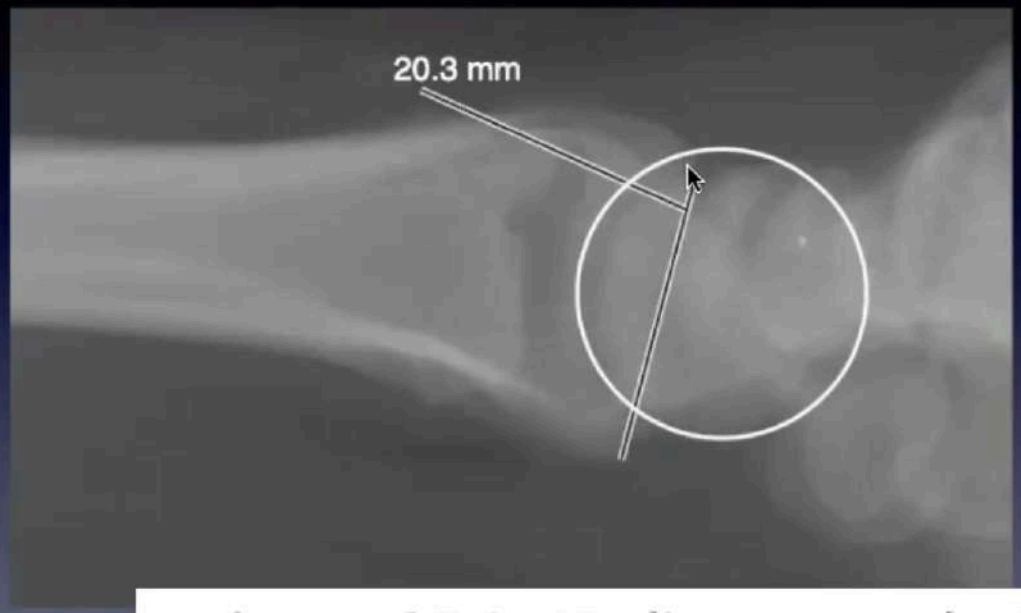
Fracture evaluation

Radiographic pathanatomy - Antero Postero distance



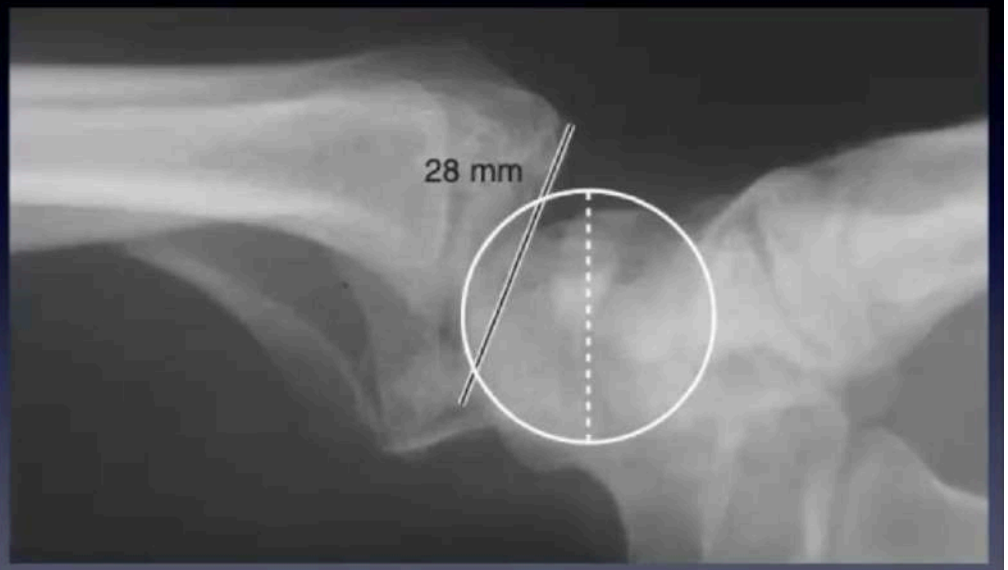
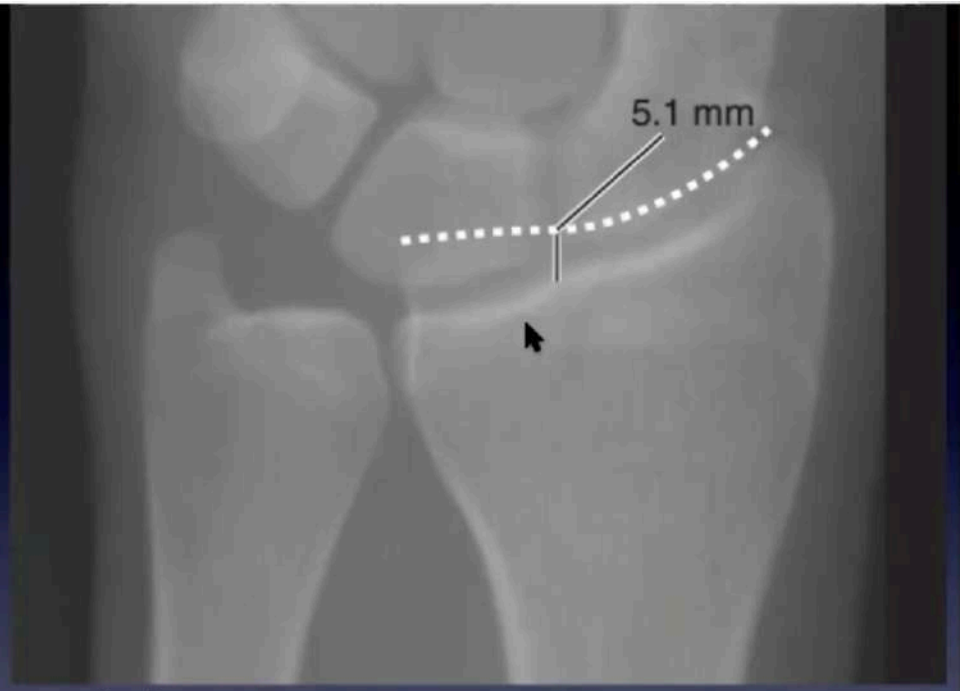


Figure 17.9 AP distance and AP/lunate diameter ratio. **A,** In an uninjured wrist, the AP distance (20.3 mm) is nearly equal to the diameter of a best-fit circle of the lunate contour (19.8 mm). **B,** In an injured wrist, the AP diameter is grossly widened (26 mm), and the AP/lunate diameter ratio is 1.3.

Radiographic pathanatomy



- PA view - distance between
- volar rim [dense subchondral bone] and dorsal rim

Figure 17.10 The dorsal rim of the radius normally projects 3 to 5 mm distal to the dense subchondral bone of the articular surface, and this relationship may be altered by post-traumatic changes in volar tilt or die punch injuries.

Named fracture

Colles fracture

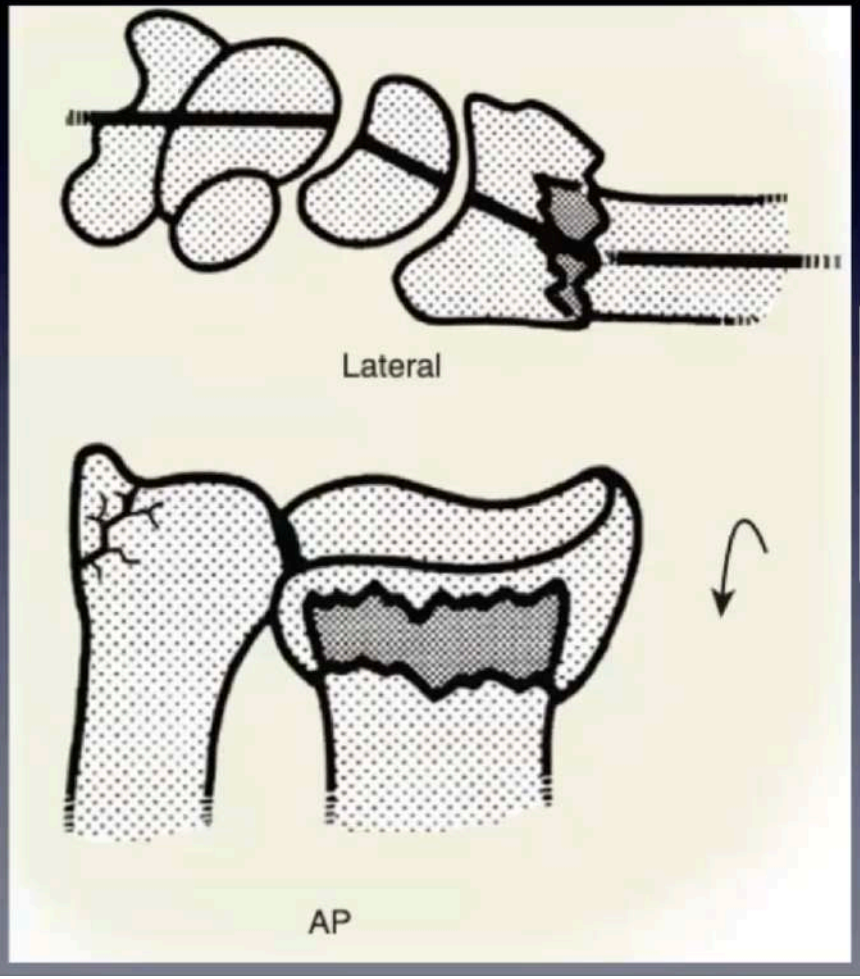


Figure 17.12 Diagrammatic representation of the typical deformity seen in a Colles' fracture. Dorsal comminution and displacement with shortening of the radius relative to the ulna are present. *(Copyright Elizabeth Martin.)*

Chauffer fracture
Die punch fracture

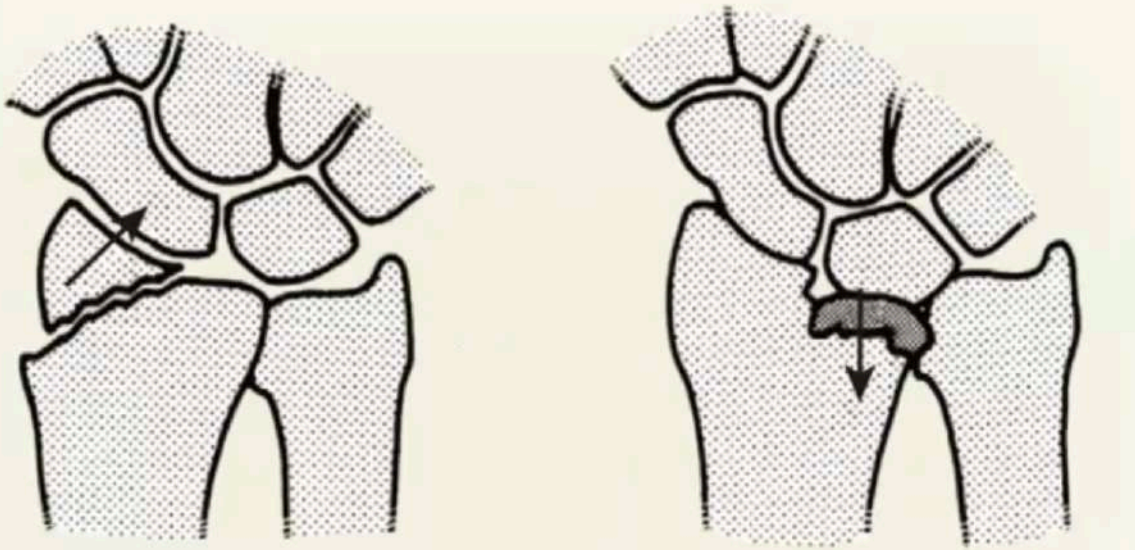


Figure 17.14 A chauffeur's fracture is illustrated with the carpus displaced ulnarly by the radial styloid fracture. A lunate die punch fracture is shown with a depression of the lunate fossa of the radius that allows proximal migration of the lunate or proximal carpal row (or both). *(Copyright Elizabeth Martin.)*

Smith fracture

- Thomas classification
- Type I - extra articular - volar **angulation**
- Type II - intra articular volar displacement
- Type III - extra articular **volar displacement**

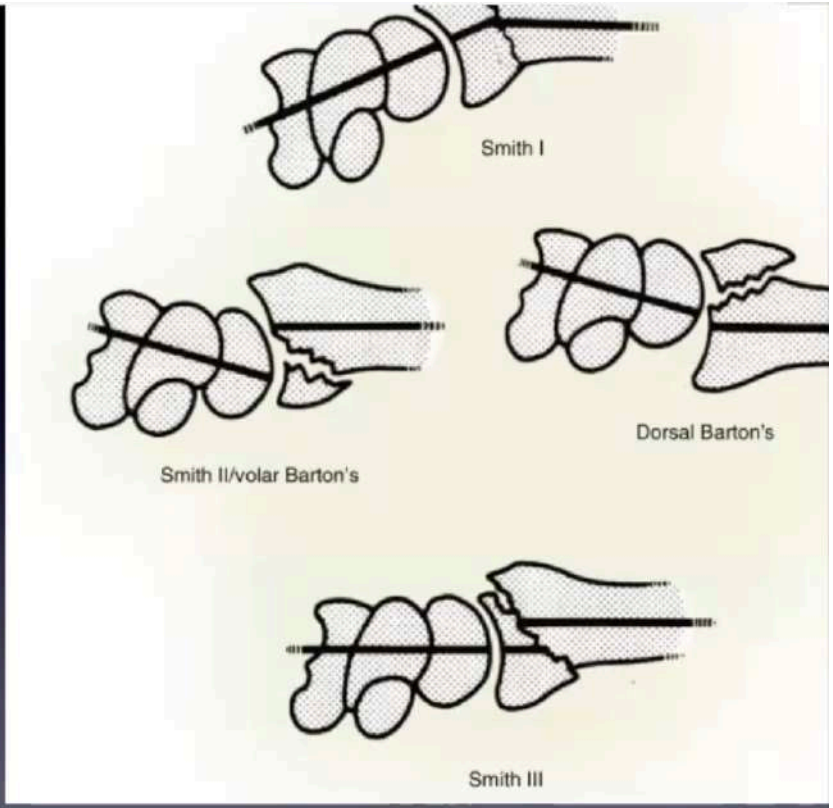
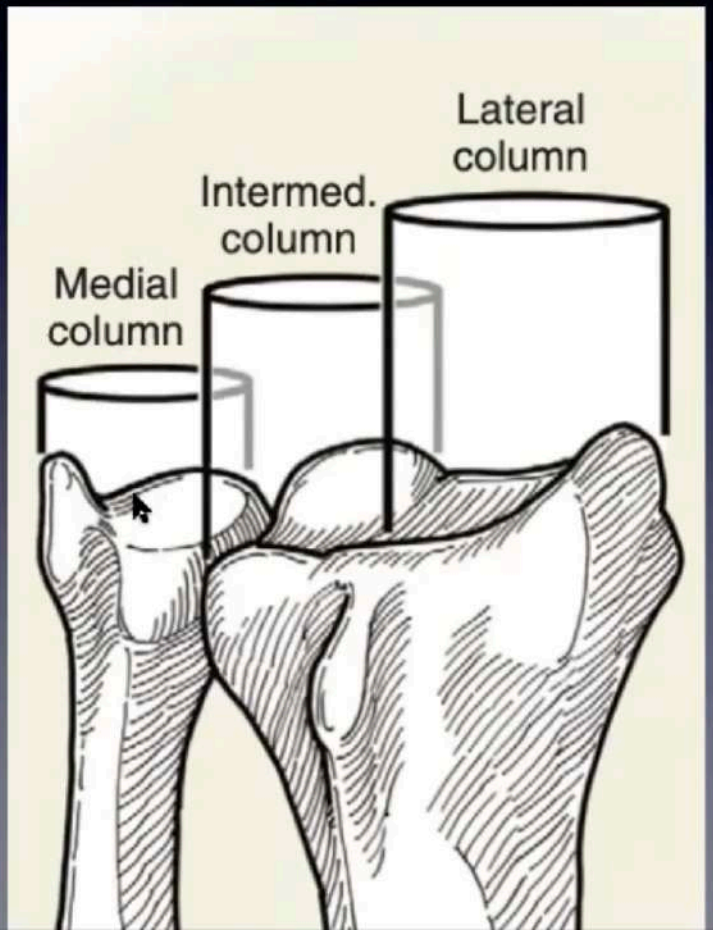


Figure 17.13 Thomas' classification of Smith's fractures. A type I Smith fracture is an extra-articular fracture with palmar angulation and displacement of the distal fragment. A type II Smith fracture is an intra-articular fracture with volar and proximal displacement of the distal fragment along with the carpus. A Smith type II fracture is essentially a volar Barton's fracture. A dorsal Barton's fracture, illustrated for comparison, shows the dorsal and proximal displacement of the carpus and distal fragment on the radial shaft. A type III Smith fracture is an extra-articular fracture with volar displacement of the distal fragment and carpus. (In type III the fracture line is more oblique than in a type I fracture.) *(Copyright Elizabeth Martin.)*

Named - classification



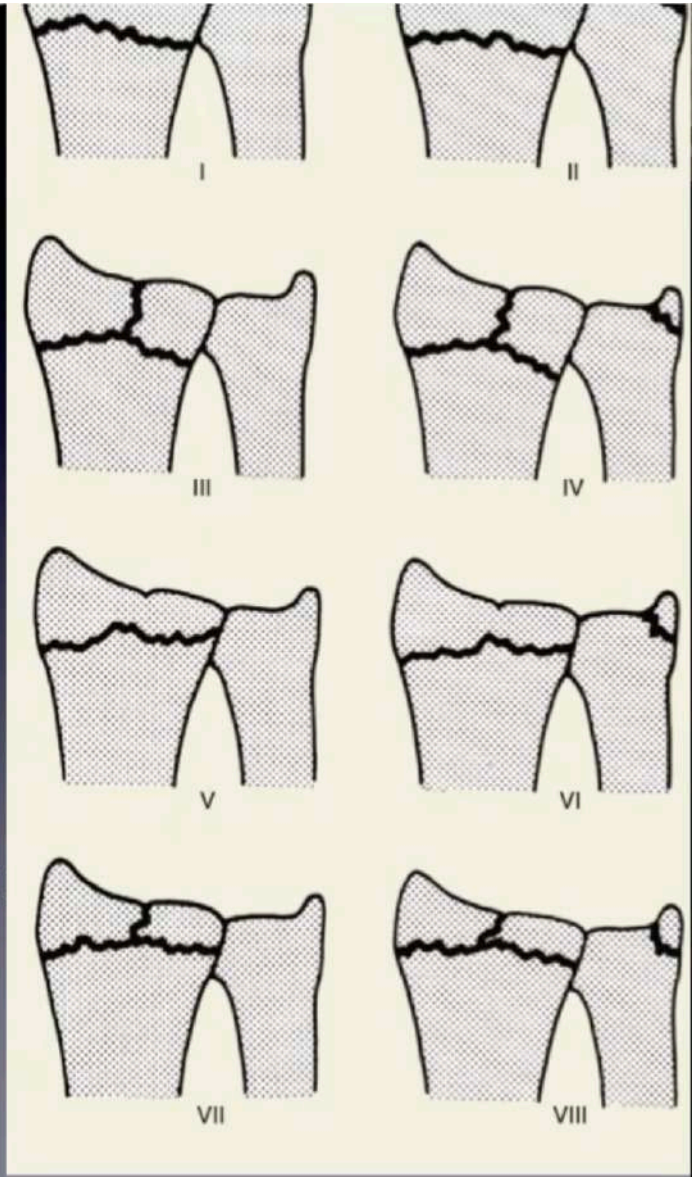
Classification
Fryakman

Distinguish extra articular and intra articular

Presence of ulna styloid fracture , DRUJ joint

Advantage - simple

Disadvantage - Doesn't role in prognostic and treatment



Frykman

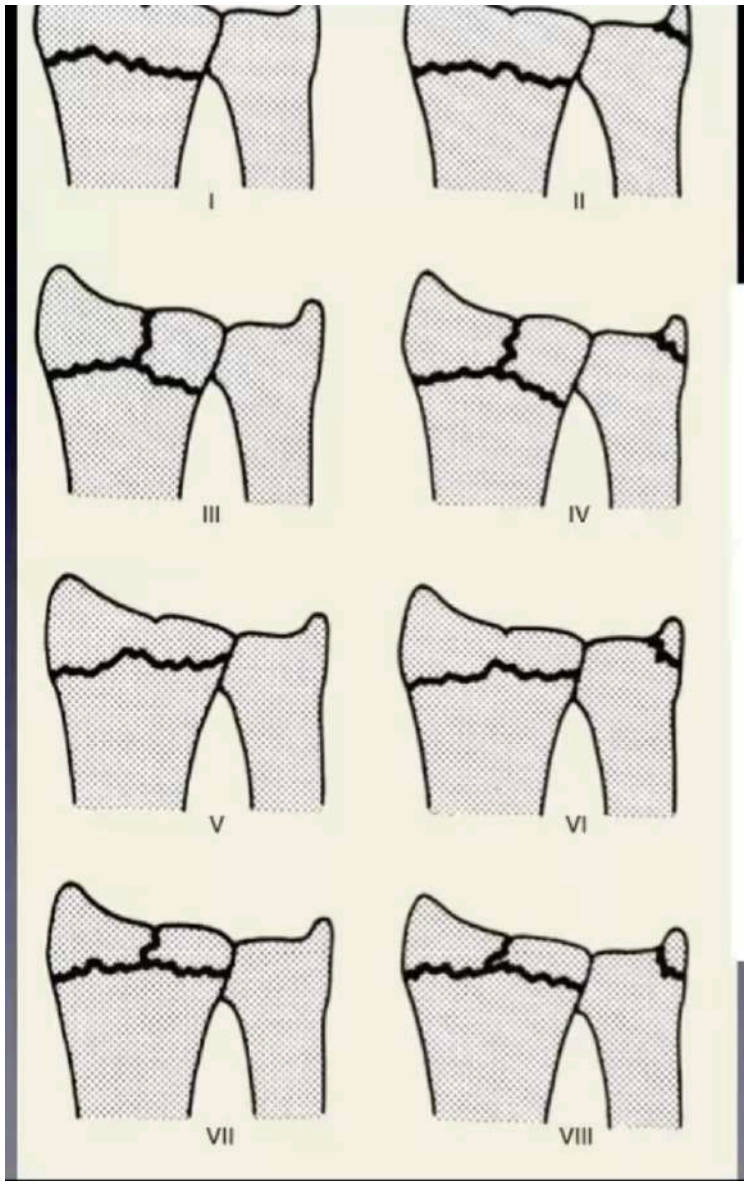
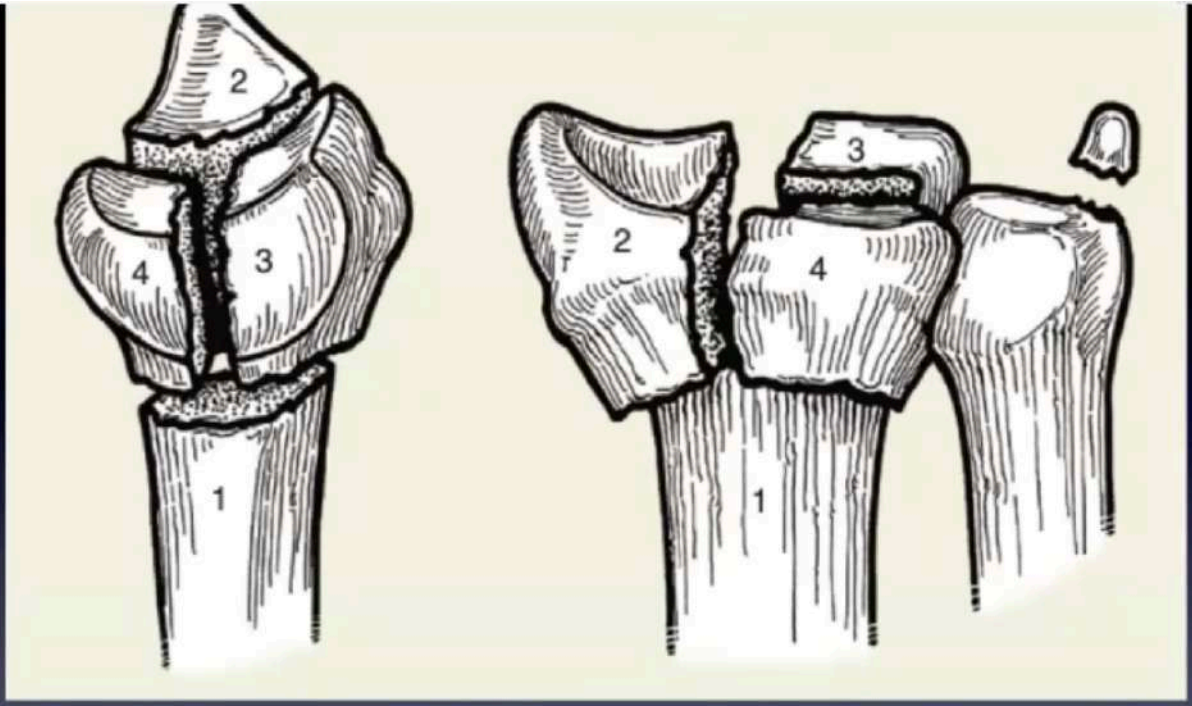


Figure 17.15 Frykman's classification of distal radius fractures. Types I, III, V, and VII do not have an associated fracture of the distal ulna. Fractures III through VIII are articular fractures. Higher-classification fractures have worse prognoses. *(Copyright Elizabeth Martin.)*

Classification

Melone

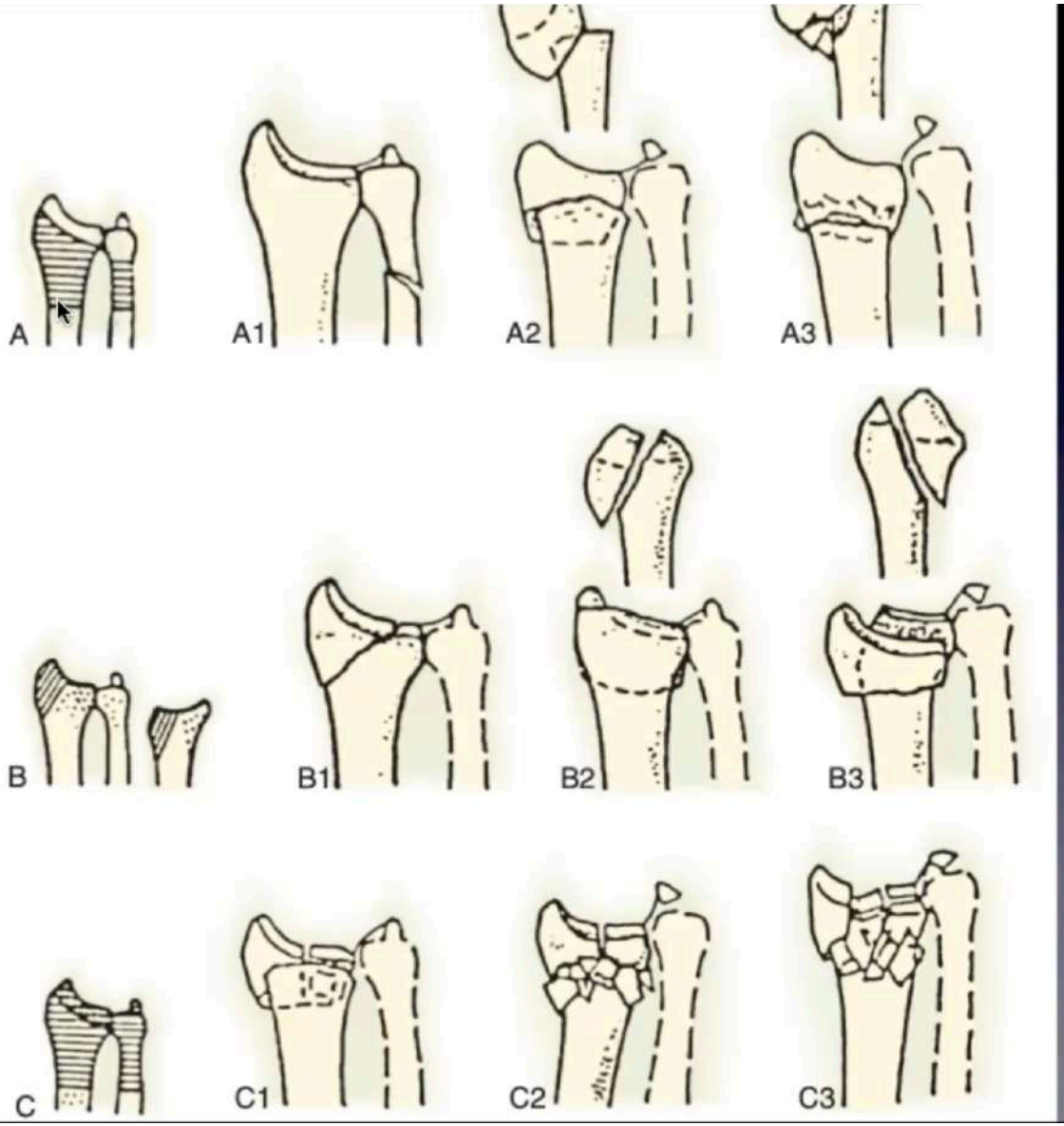


- Radial styloid
- Radial shaft
- Lunate facet - volar / dorsal
- **Focused on intermediate column or tear drop or medial complex**

Classification - AO

- TYPE A - Extra articular
- Type B- Partial intra articular - some portion of articular surface remain attached to metaphysis
- Type C - Complete articular - no articular portion attached to metaphysis .

AO CLASSIFICATION

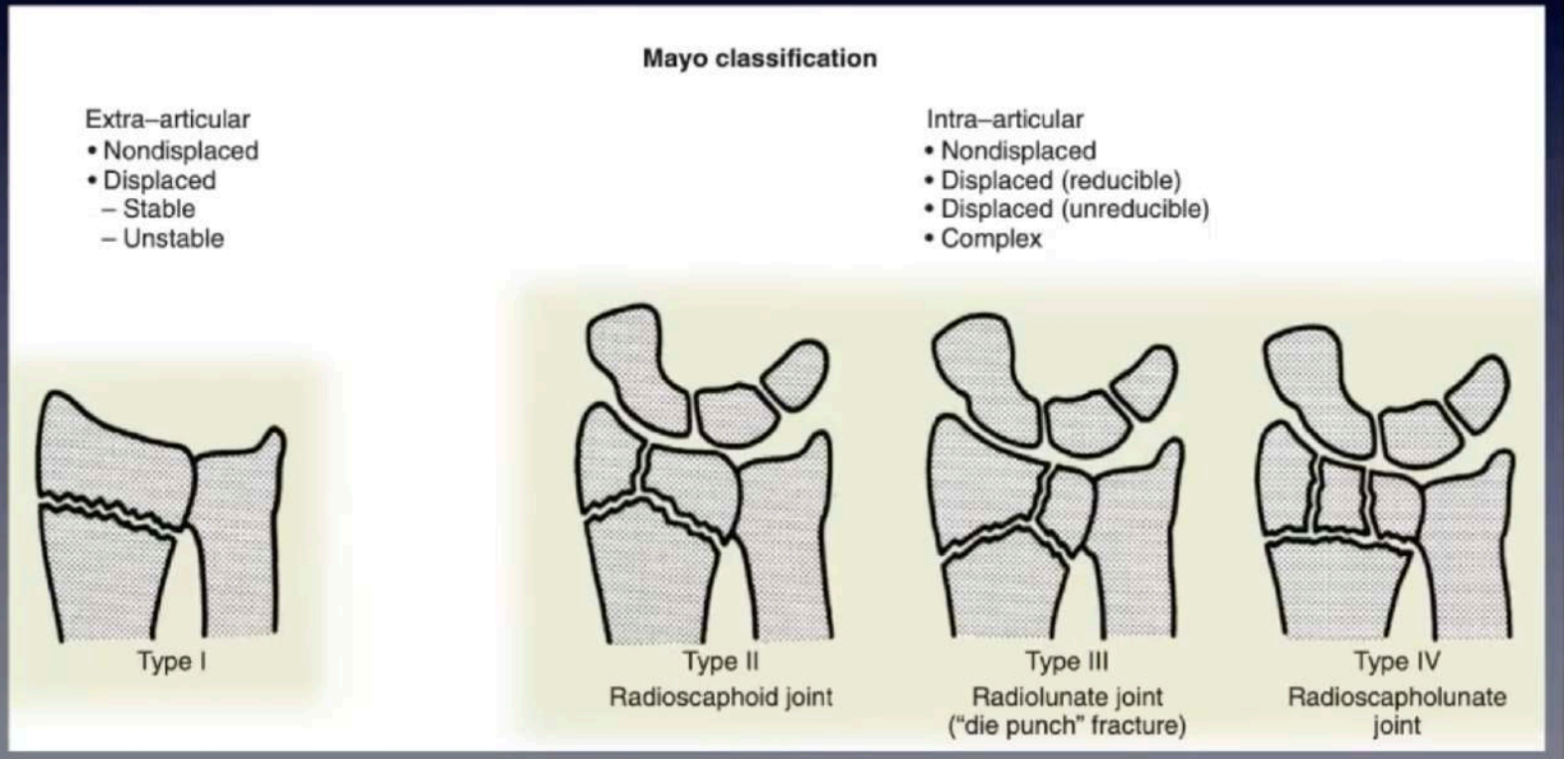


AO classification

Figure 17.17 The comprehensive classification of fractures (AO). **A,** Extra-articular. This fracture affects neither the articular surface of the radiocarpal nor the radioulnar joints. **A1,** Extra-articular fracture of the ulna with the radius intact. **A2,** Extra-articular fracture of the radius, simple and impacted. **A3,** Extra-articular fracture of the radius, multifragmentary. **B,** Partial articular. This fracture affects a portion of the articular surface, but continuity of the metaphysis and epiphysis is intact. **B1,** Partial articular fracture of the radius, sagittal. **B2,** Partial articular fracture of the radius, dorsal rim (Barton's). **B3,** Partial articu fracture of the radius, volar rim (reverse Barton's, Goyrand-Smith II). **C,** Complete articular. This fracture affects the joint surfac (radioulnar, radiocarpal, or both) and the metaphyseal area. **C1,** Complete articular fracture of the radius, articular simple and metaphyseal simple. **C2,** Complete articular fracture of the radius, articular simple and metaphyseal multifragmentary. **C3,** Complete articular fracture of the radius, multifragmentary.

Classification
Mayo

- Sub classified into 4 types
- Extra articular
- Intra articular
- **Reducible**
- **Irreducible**

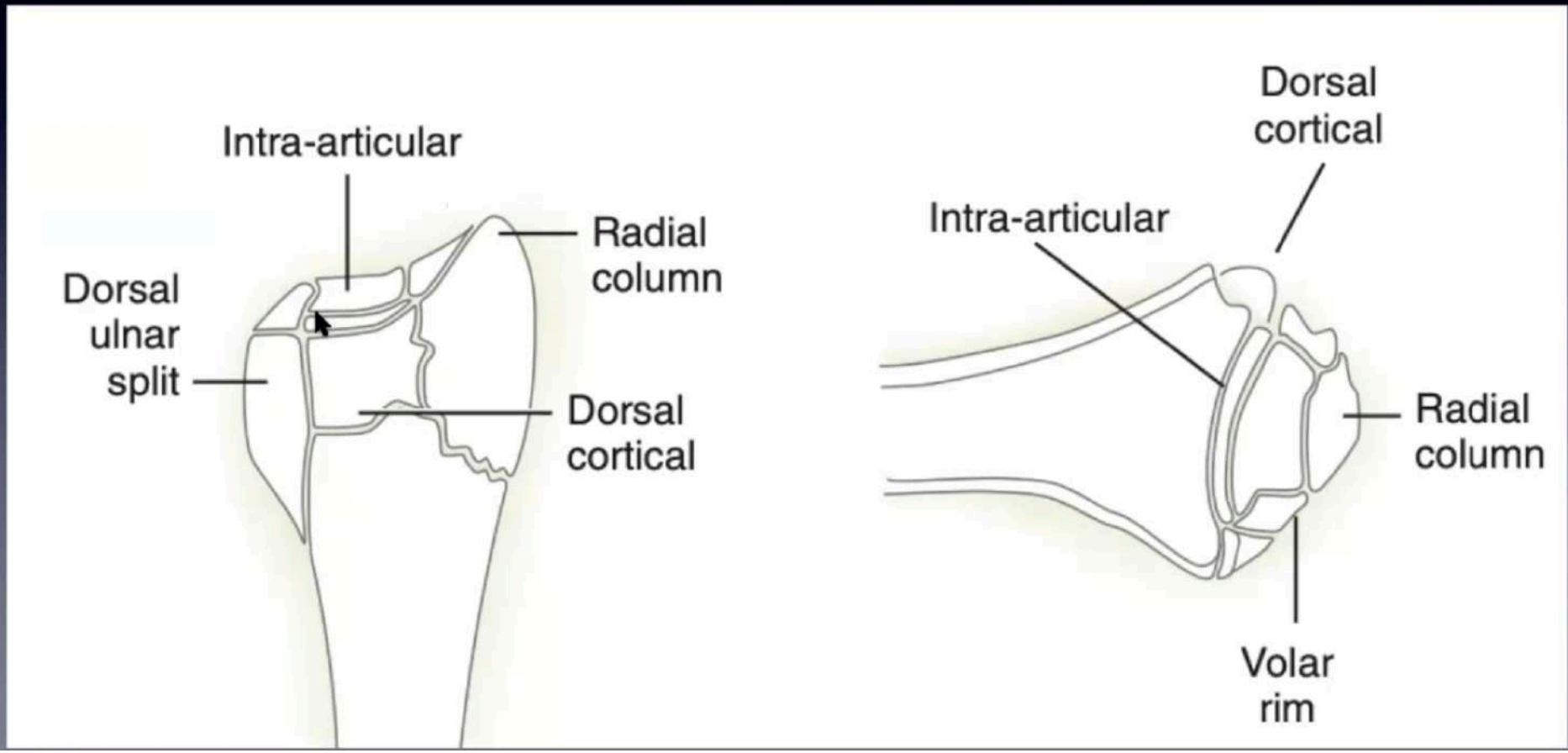


Classification - Fragment specific
5 fragments

- Radial styloid
- Dorsal wall
- Impacted articular fragment - alone or in combination
- Volar tear drop fragment
- Dorsal ulnar fragment

Fragments specification

- **To plan a treatment - Need to use Fernandez classification and primary direction of fracture angulation**



Classification - Fragment specific
5 fragments

- Radial styloid
- Dorsal wall
- Impacted articular fragment - alone or in combination
- Volar tear drop fragment
- Dorsal ulnar fragment

Classification Fernandez

- **Based on mechanism of injury** - means direction and magnitude of impact directly related to the bony injury ligament Injury , soft tissue injury

Classification - Fernandez

- **Type I- Bedning fracture of metaphysis** - one cortex fail with tension and other cortex with variable degree of communication [Colles # , Smith Type I]
- **Type II - Shear fracture** of joint surface [Barton , chauffeur]
- **Type III - Compression fracture** of subchondral and metaphysis - high velocity injury ususally involve radial and intermediate column

Subdivided - Dorsal shear fracture

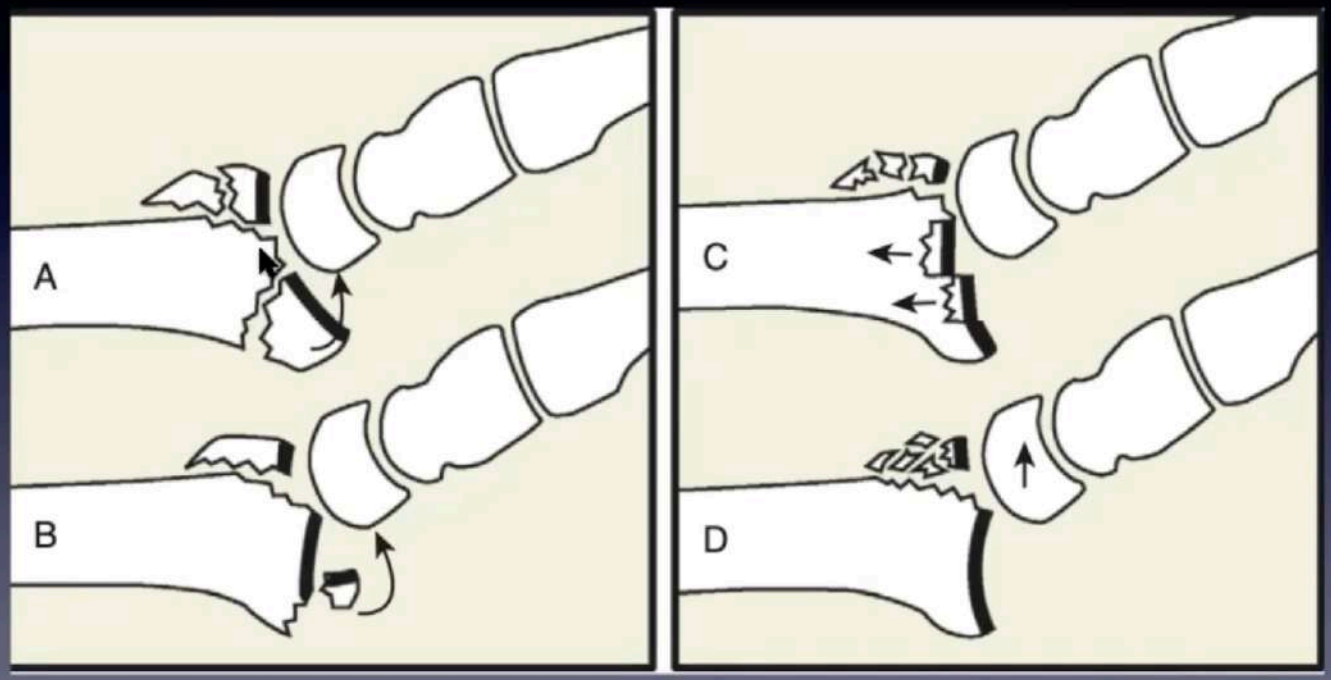


Figure 17.60 Four discrete types of dorsal shear fractures have been described by Lozano-Calderón and colleagues.[78] **A,** A relatively common variant has a large rotated volar fracture fragment that constitutes the majority of the articular surface. **B,** The most common subtype demonstrates a small volar lip (teardrop) fragment, from which the important short and long radiolunate ligaments originate. **C,** The central impaction pattern, associated with the shear fracture of the dorsal margin, is relatively uncommon, as is the true radiocarpal fracture-dislocation (**D**), which constitutes a serious combined ligamentous and bony injury. *(Copyright Elizabeth Martin.)*

Subdivided - compression fracture

Single fracture - Intermediate column [punch fracture]

- Volar ulnar
- Dorsal ulnar
- Fragment specific approach -volar butters of volar ulnar , dorsal contured plate to buttress dorsal ulnar corner

Classification - Fernandez

- **Type IV - Avulsion fracture** of ligamentous attachment - Dorsal rim , Radial styloid associated with radoiocarpal # dislocation
- **Type V - High velocity injury** - combination of Type I,II,III,IV

Subdivided - Radial styloid shear fracture

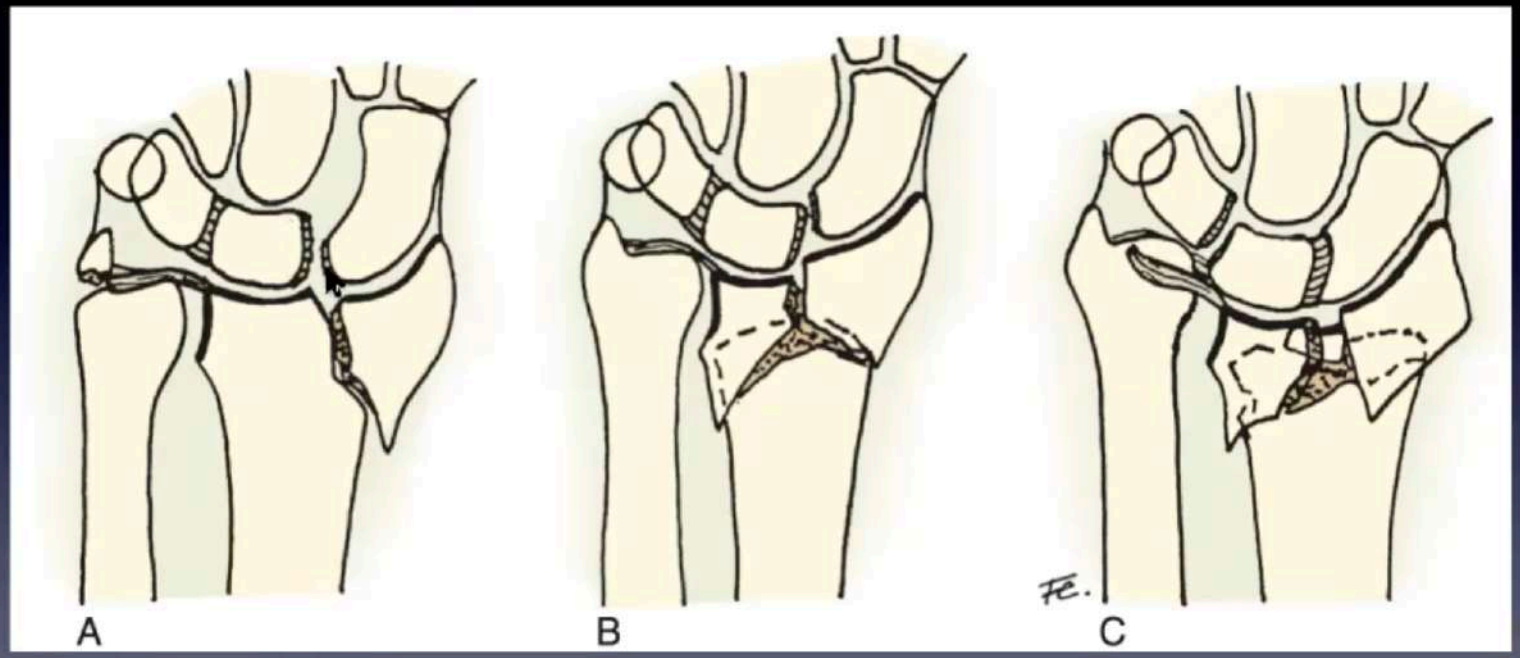


Figure 17.62 Mechanism of injury of intercarpal ligament disruption. **A,** Extension and radial deviation produce a proximally displaced shearing fracture of the radial styloid, scapholunate dissociation, and an avulsion fracture of the ulnar styloid. **B,** Axial compression with severe impaction of the lunate fossa accounts for shearing loading of the scapholunate junction and tearing of the ligaments at this level. **C,** Axial compression and ulnar deviation with severe radial shortening produce acute ulnocarpal abutment and disruption of the lunotriquetral and triangular ligaments.

Treatment

- Type I - stable fracture by plaster , unstable - percutaneous / ORIF
- Type II - its is highly unstable[obliquity of fracture line] - **ORIF**
- Type III - acutely can be reduced by tension to joint capsule with ext fixation . If unstable than ORIF +/_ External fixation
- Type IV - large fragment by screw / wireform ,TBW
- Type V - fragment specific +/_ external fixation/ bridge plate + BG

Treatment - Bending fracture

- Generally - plaster
- **If Unstable bending Fracture - Volar locking plate**
- Means - > 50 percent dorsal comminution and >3 mm radial shortening

Treatment - compression fracture

Three - four part

- **Volar approach** - disadvantage - dorsal ulnar , central articular fragment
- Dorsal approach - d isadvantage - volar ulnar , irritation of extensor tendon by plate
- Fragment specific approach - radial column , volar butters of volar ulnar , dorsal conjured plate to buttress dorsal ulnar corner

Treatment - Type IV- two variants

Radiocarpal # dislocation

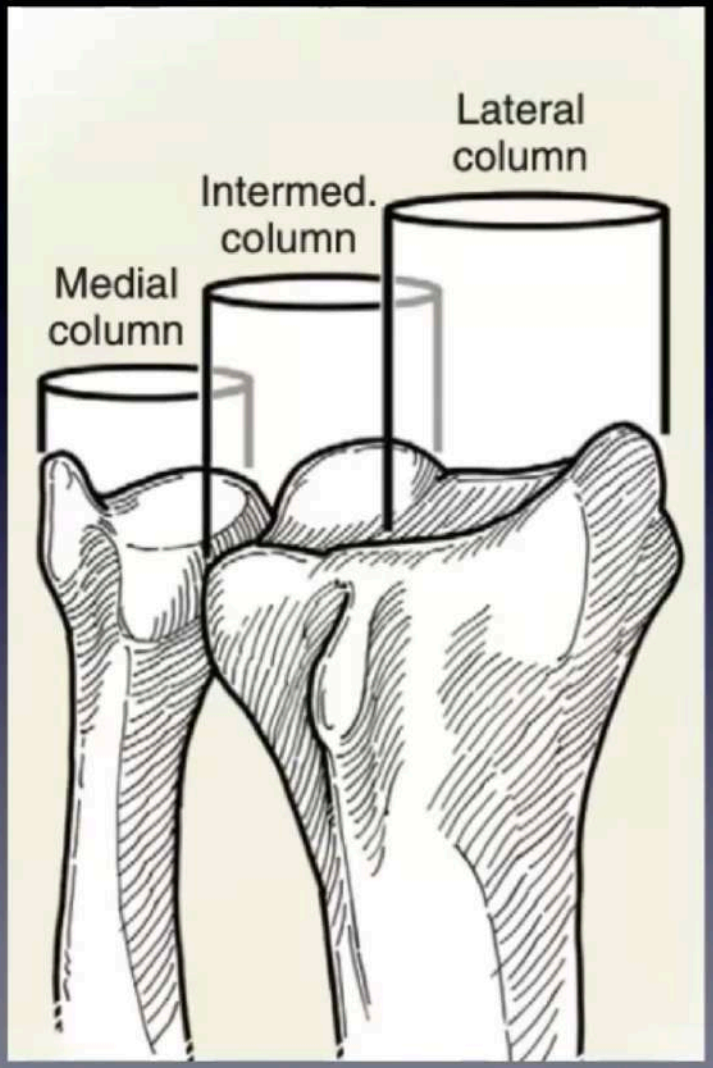
- 1. **Ligamentous or rim avulsion** - treated By ligamentous repair with plate and
- **Avulsion with large radial styloid** fragment with attached lateral third dorsal rim with intact RSC LRL ligament - treated by radial column plate

Treatment -Type V

articular
Metaphysical
Diaphysial

- Interfragmentary screw with fixed angle plating for simple articular fracture
- Bridging plate for extensive articular , metaphysical and diaphysial #

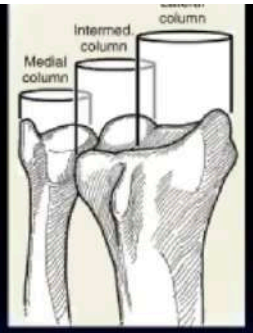
Ulnar column injury
Or
Associated injuries to DRUJ



Classification
Associted injuries to DRUJ

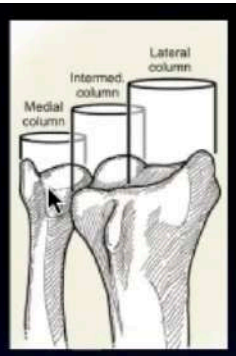
- **After satisfactory attaining radio ulnar alignment [not DRUJ]** by restoring radial length , inclination and volar tilt
- **the outcome**
- **depends on incongruity and instability of DRUJ joint**

Type I



- **Type I** - means Stable DRUJ joint lesion - means no disruption of articular surface of sigmoid notch
- Eg - tip of ulna styloid ,
- Eg - stable ulna neck fracture
- In both primary stabiliser of joint is intact - TFCC

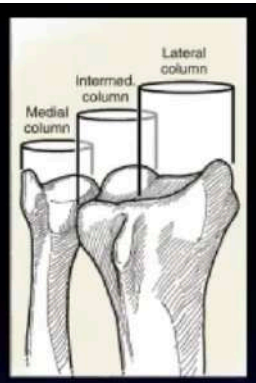
Type II



- Type II - **unstable DRUJ joint** - despite satisfactory reduction of Radius , ulna is unstable [manual shuk test positive]
- Eg - massive Tfcc injury
- Eg - ulna styloid fracture through fovea / base
- These require - Tfcc repair or radio ulnar k wire pinning , above elbow supination cast

distal radius fracture target ortho

Type III



- **Type III - communited articular injury of sigmoid notch or ulna head**

Fracture stability of column concept

Linear relation
Fracture instability with number of parameter

1. Dorsal angulation greater than 20 degrees
2. Dorsal comminution
3. Intra-articular radiocarpal fracture
4. Ulnar fracture
5. Age older than 60 years

- > 3 parameter - need for surgical intervention

On initial fracture film
Risk factors for loss of reduction by plaster

- Advancing age
- Radial length , increased ulnar variance > 3 mm
- Dorsal comminution beteer than dorsal angulation

Mc queen suggested - Carpal malalignment and radial length

- Is single most predictor for worsening functional outcome and grip strength

Carpal malalignmnet

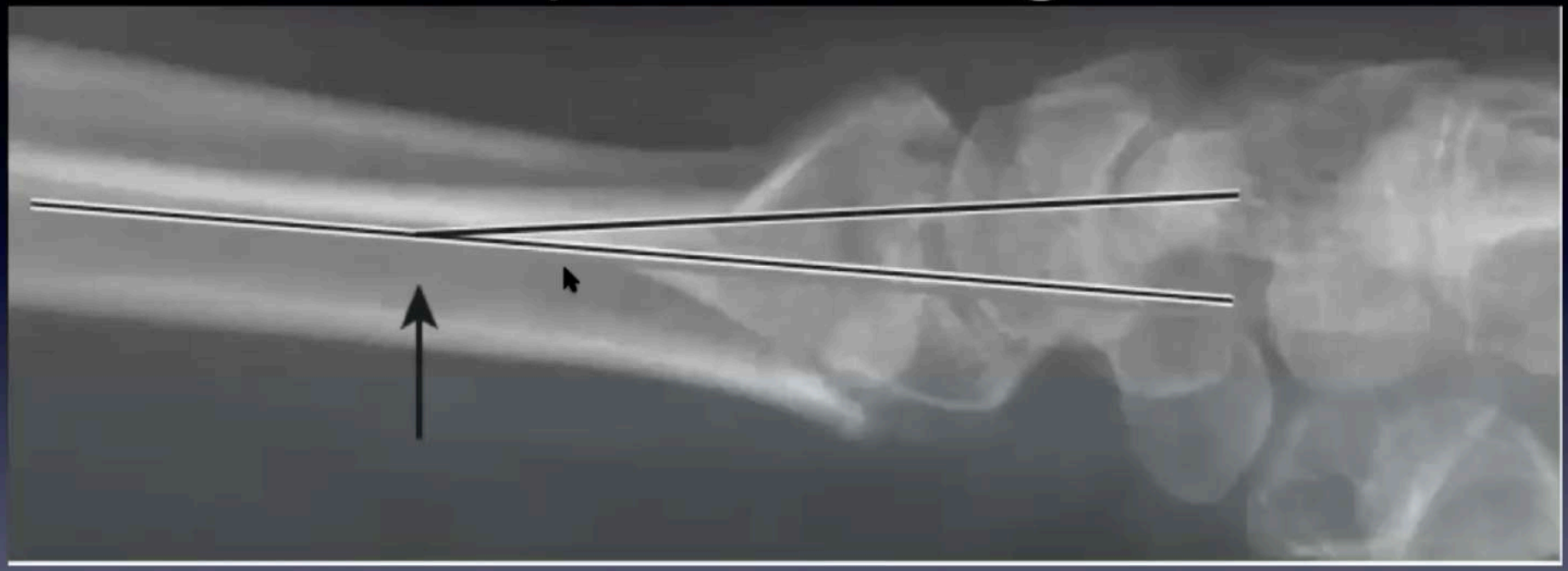


Figure 17.22 According to McQueen and colleagues,[86] carpal malalignment is defined when the longitudinal axis of the capitate and the radius intersect outside the boundaries of the carpus (*arrow*).

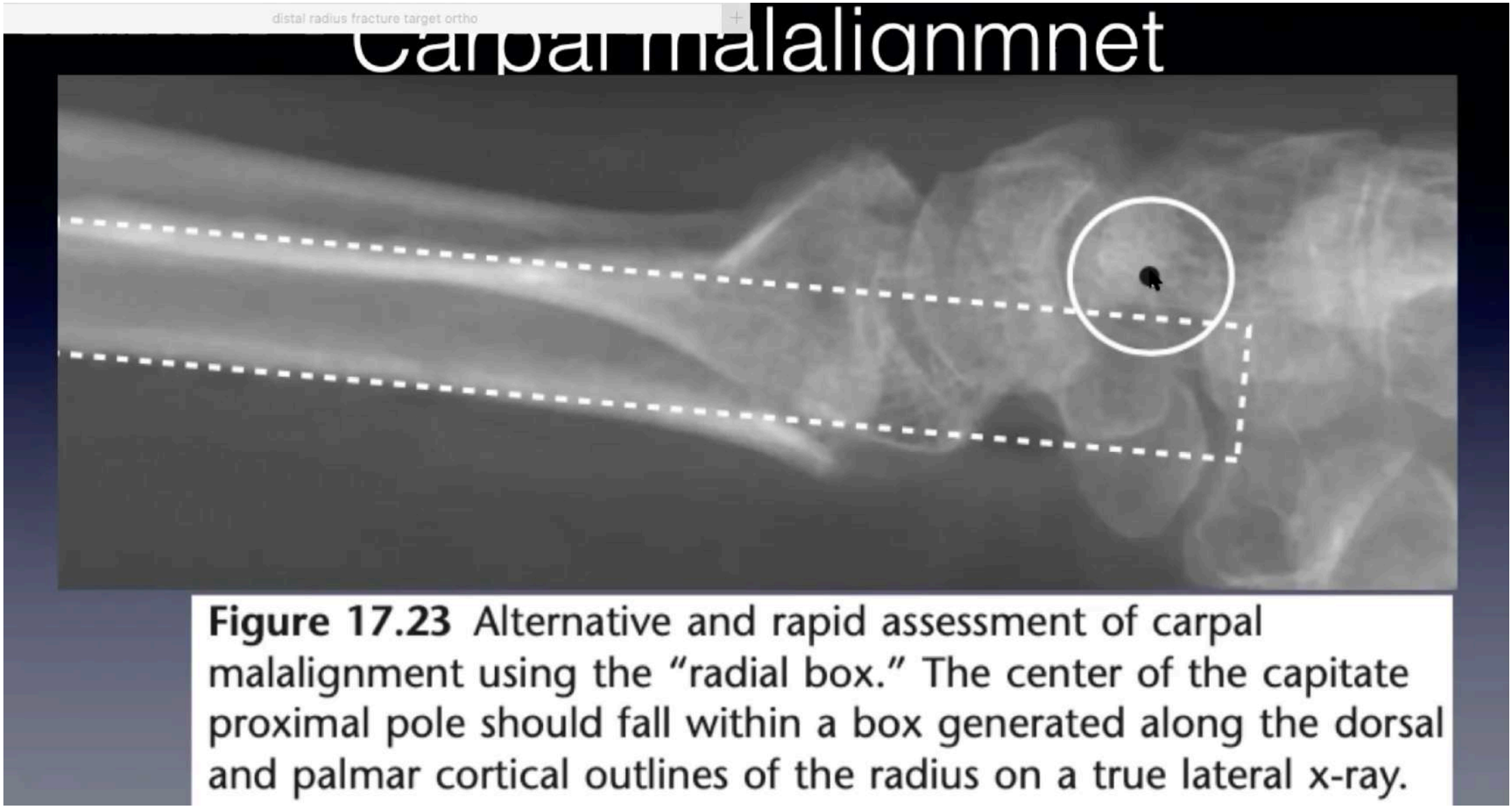
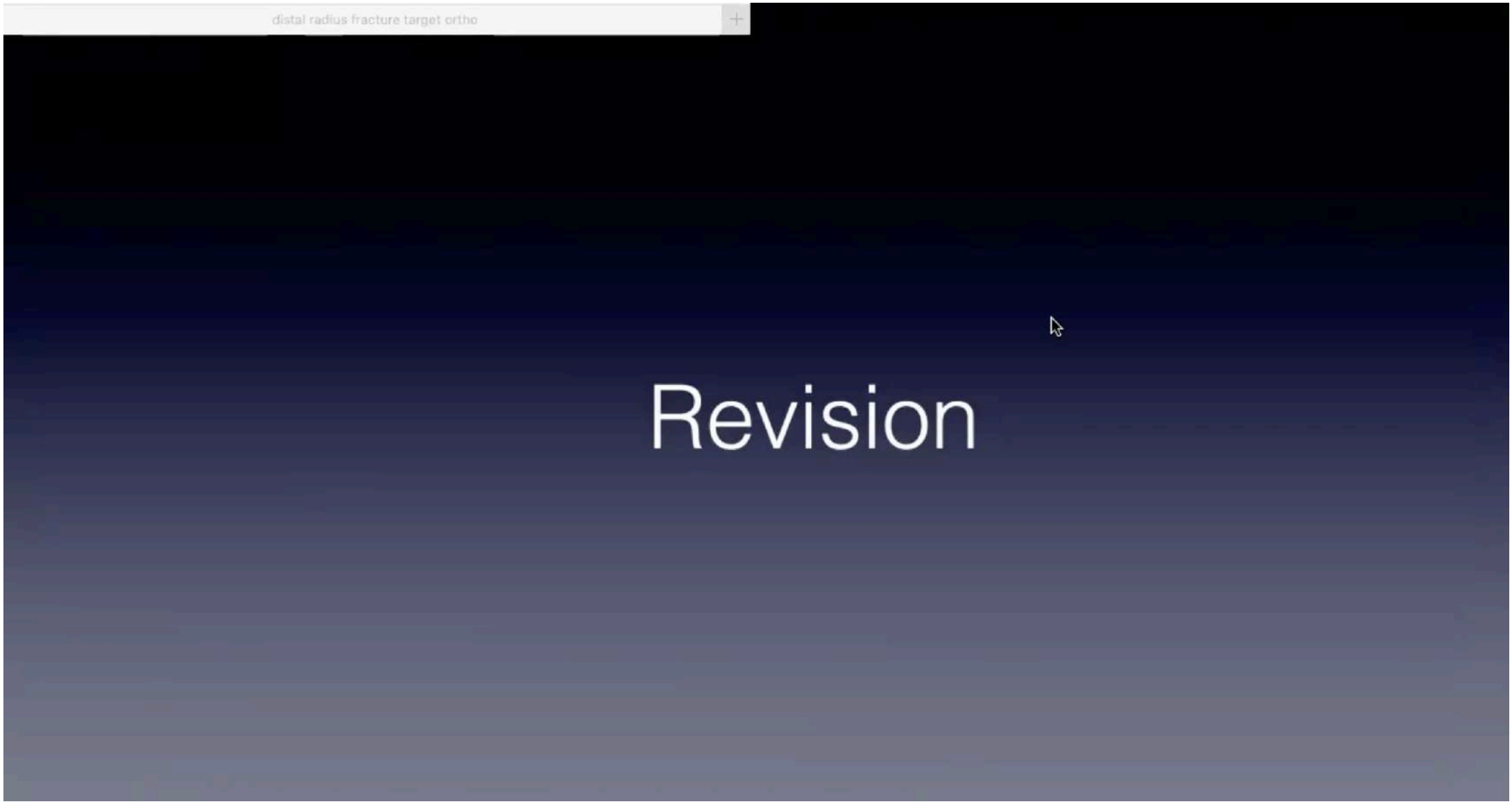
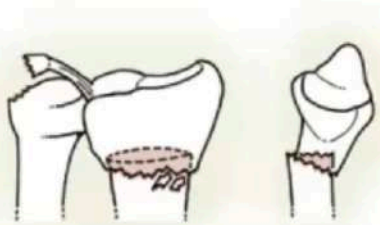


Figure 17.23 Alternative and rapid assessment of carpal malalignment using the "radial box." The center of the capitate proximal pole should fall within a box generated along the dorsal and palmar cortical outlines of the radius on a true lateral x-ray.



TARGET ORTHO

Revision

Fracture type based on the mechanism of injury	Stability/Instability: risk of secondary displacement after initial adequate reduction	Displacement pattern	Number of fragments	Associated lesions carpal ligament, fractures, median, ulnar nerve, tendons, ipsilat. fx upper extremity, compartment syndrome	Author's preferred treatment	Other treatments
Type I Bending fracture of the metaphysis 	Stable Unstable	Nondisplaced Dorsal Colles Volar Smith Proximal Combined	2 main fragments + varying degree of metaphyseal comminution	Uncommon	Cast (stable fxs) Percutaneous pinning External fixation Plate fixation	T-pin Micronail

Revision

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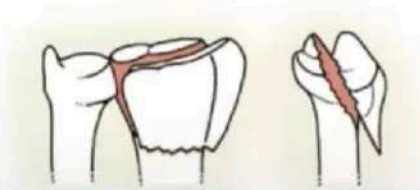
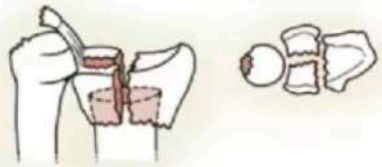
Type II Shearing fracture of the joint surface 	Unstable	Dorsal Barton Radial chauffeur Volar rev. Barton Combined	Two part Three part Comminuted	Less uncommon	Open reduction Fixed-angle plate fixation	Arthroscopic assisted Cannulated screws

Revision

Fracture type based on the mechanism of injury	Stability/Instability: risk of secondary displacement after initial adequate reduction	Displacement pattern	Number of fragments	Associated lesions carpal ligament, fractures, median, ulnar nerve, tendons, ipsilat. fx upper extremity, compartment syndrome	Author's preferred treatment	Other treatments
Type III Compression fracture of the joint surface 	Stable Unstable	Nondisplaced Dorsal Radial Volar Proximal Combined	Two part Three part Four part Comminuted	Common	Closed, limited, arthroscopic assisted, or open reduction, and: Percutaneous pins Multiple plate ("fragment specific") fixation External fixation Plate fixation ± Bone graft	Bridge (distraction) plating

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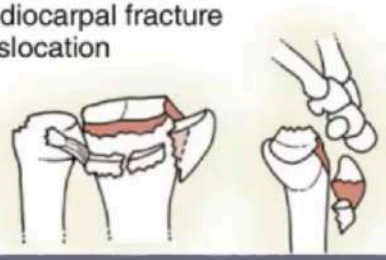
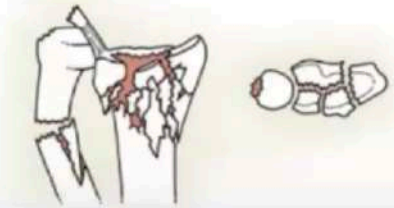
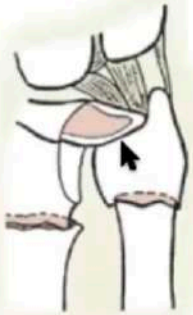
Type IV Avulsion fractures, radiocarpal fracture dislocation 	Unstable	Dorsal Radial Volar Proximal Combined	Two part (radial styloid, ulnar styloid) Three part (volar, dorsal, margin) Comminuted	Frequent	Multiple plate fixation Pin or screw fixation Tension wiring	Bridge plating External fixation

Fracture type based on the mechanism of injury	Stability/Instability: risk of secondary displacement after initial adequate reduction	Displacement pattern	Number of fragments	Associated lesions carpal ligament, fractures, median, ulnar nerve, tendons, ipsilat. fx upper extremity, compartment syndrome	Author's preferred treatment	Other treatments
Type V Combined fractures (I-II-III-IV) High-velocity injury 	Unstable	Dorsal Radial Volar Proximal Combined	Comminuted and/or bone loss	Always present	Combined method	Bridge plating

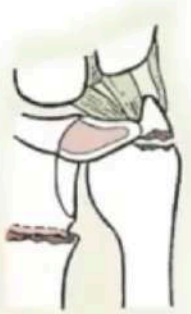
Revision
Associated injury- DRUJ

	Pathoanatomy of the lesion	Joint surface involvement	Prognosis	Recommended treatment

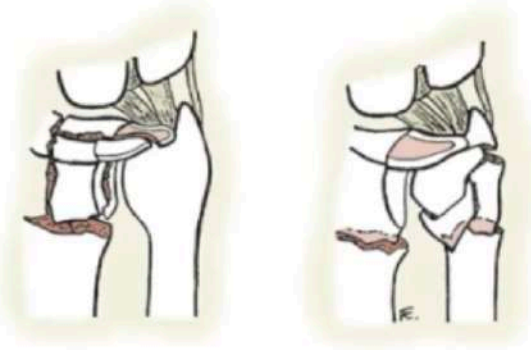
	Pathoanatomy of the lesion	Joint surface involvement	Prognosis	Recommended treatment

Type I Stable (following reduction of the radius the distal radioulnar joint is congruous and stable)	 A Fracture of the tip of the ulnar styloid  B Stable fracture of the ulnar neck	None	Good	A + B Functional aftertreatment Encourage early pronation-supination exercises Note: Extra-articular unstable fractures of the ulna at the metaphyseal level or distal shaft require stable plate fixation

Revision

	Pathoanatomy of the lesion	Joint surface involvement	Prognosis	Recommended treatment
Type II Unstable (subluxation or dislocation of the ulnar head present)	 A Tear of the triangular fibrocartilage complex and/or palmar and dorsal capsular ligaments  B Avulsion fracture of the base of the ulnar styloid	None	• Possible chronic instability • Painful limitation of supination if left unreduced • Possible late arthritic changes	A <u>Closed treatment</u> Reduce subluxation, sugar tong splint in 45° supination 3 to 4 weeks A + B <u>Operative treatment</u> 1) Fix ulnar styloid with tension band, screw, or pin plate 2) Immobilize wrist and elbow in supination long arm cast 3) Transfix ulna and radius with Kirschner wire and long arm cast

Revision

	Pathoanatomy of the lesion	Joint surface involvement	Prognosis	Recommended treatment
Type III Potentially unstable (subluxation possible)	 A Intra-articular fracture of the sigmoid notch B Intra-articular fracture of the ulnar head	Present	• Dorsal subluxation possible together with dorsally displaced die punch or dorsoulnar fragment • Risk of early degenerative changes and severe limitation of forearm rotation if left unreduced	A Anatomic reduction and fixation of palmar and dorsal sigmoid notch fragments. If residual instability, immobilize in supination with or without radioulnar transfixion pins B Functional aftertreatment to enhance remodeling of ulnar head If distal radioulnar joint remains painful: Partial ulnar resection, Darrach, Sauve-Kapandji procedure, or ulnar head prosthesis at a later date