Forearm fractures in children indications for surgical management

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Forearm fractures in children

- Wrist fractures (distal end)
- Midshaft fractures
- Proximal radius and ulna fractures
- Fractures dislocations

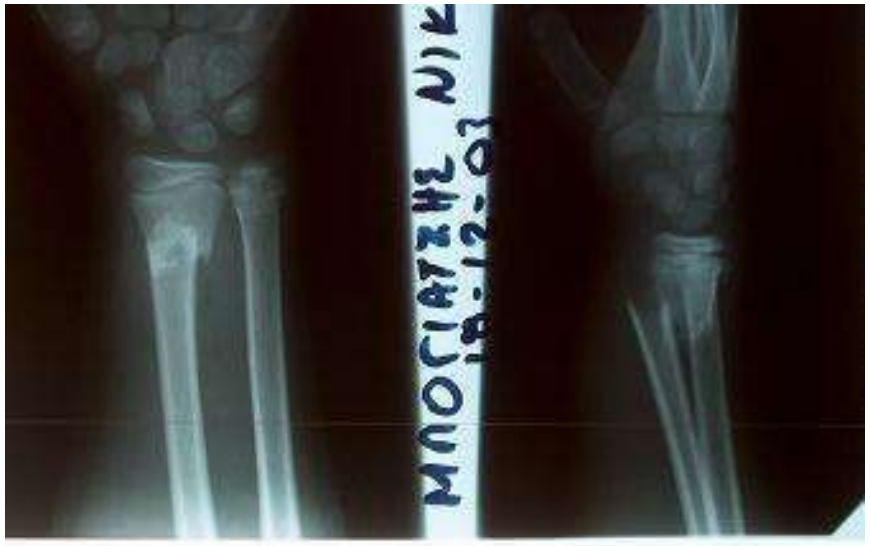
Distal end fractures

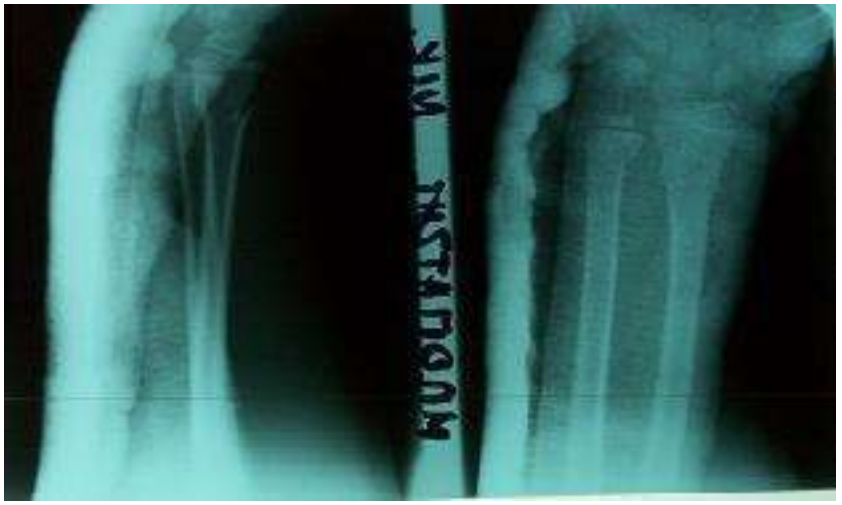
- Undisplaced (torus - green stick fractures)
- Physeal fractures
- Metaphyseal fractures

Distal end fractures

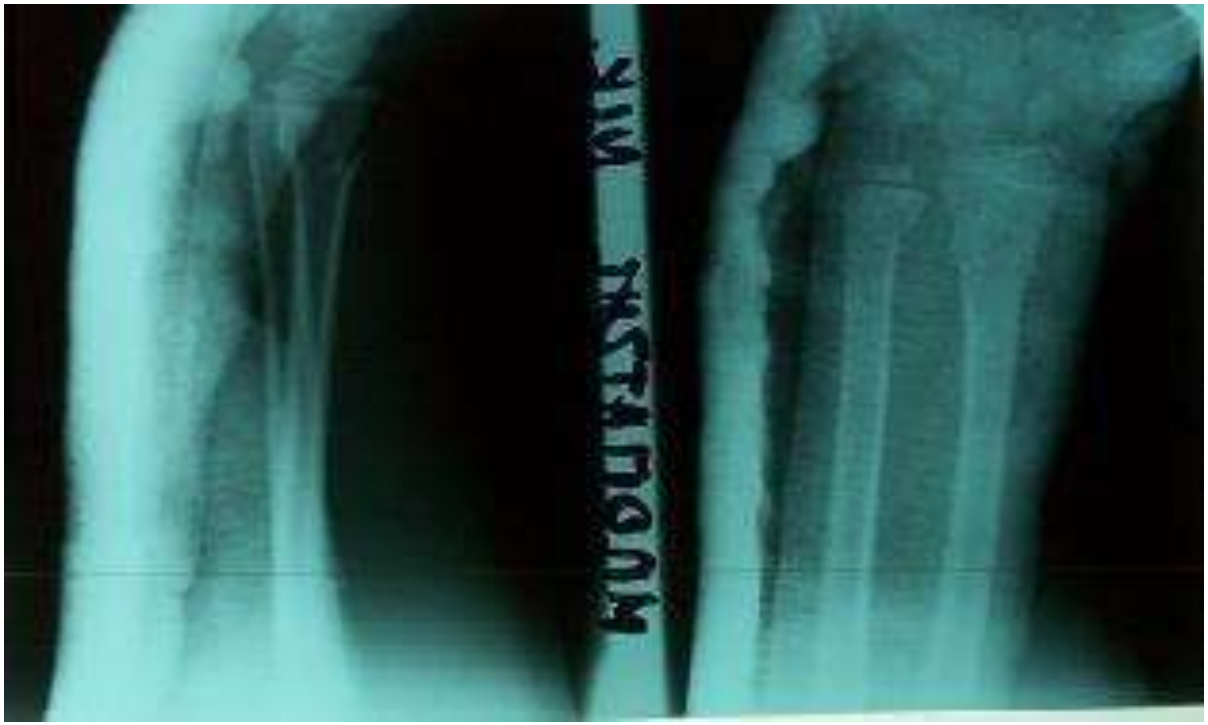
- **METAPHYSEAL FRACTURES**
- **Reduction with NO PAIN**
- **Sedation - C arm**
- **Stable unstable (difficult reduction)**
- **Both bones fractured**
- **METHOD OF IMMOBILISATION**

Distal radial fracture

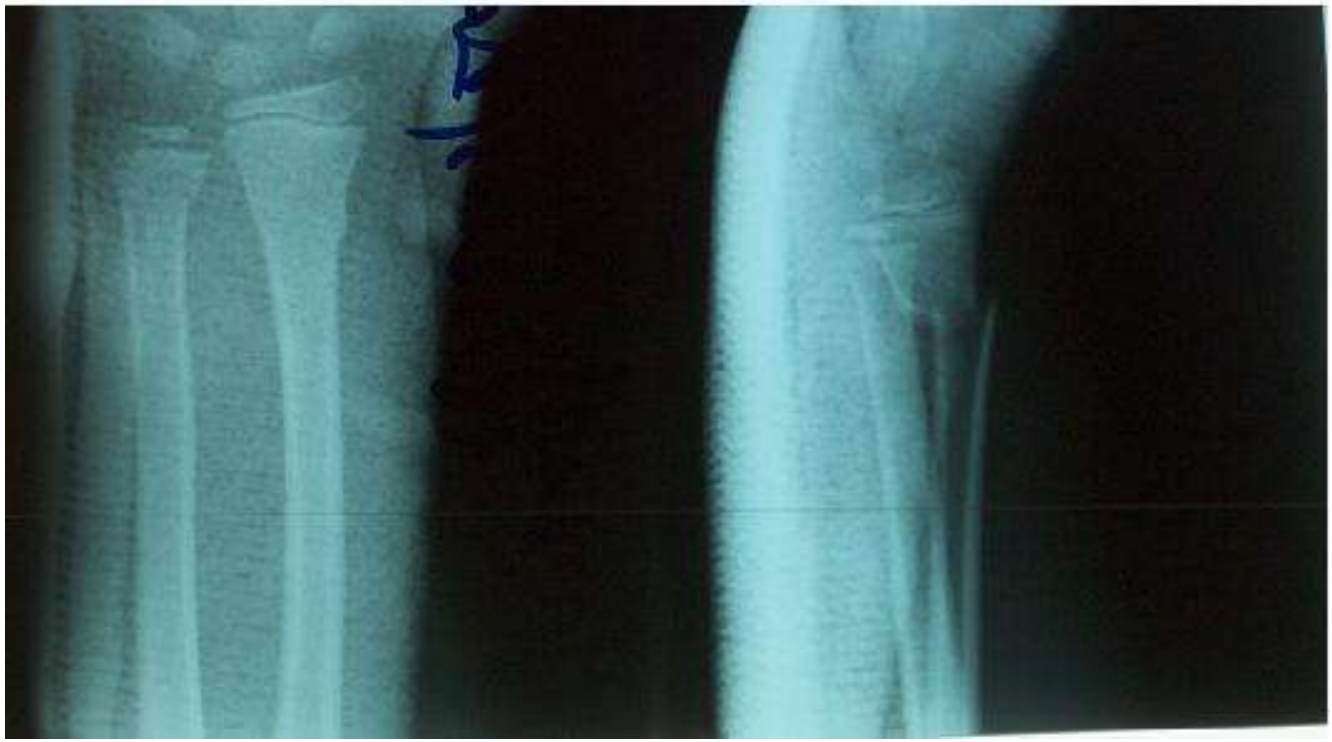




Distal radial fracture initial reduction



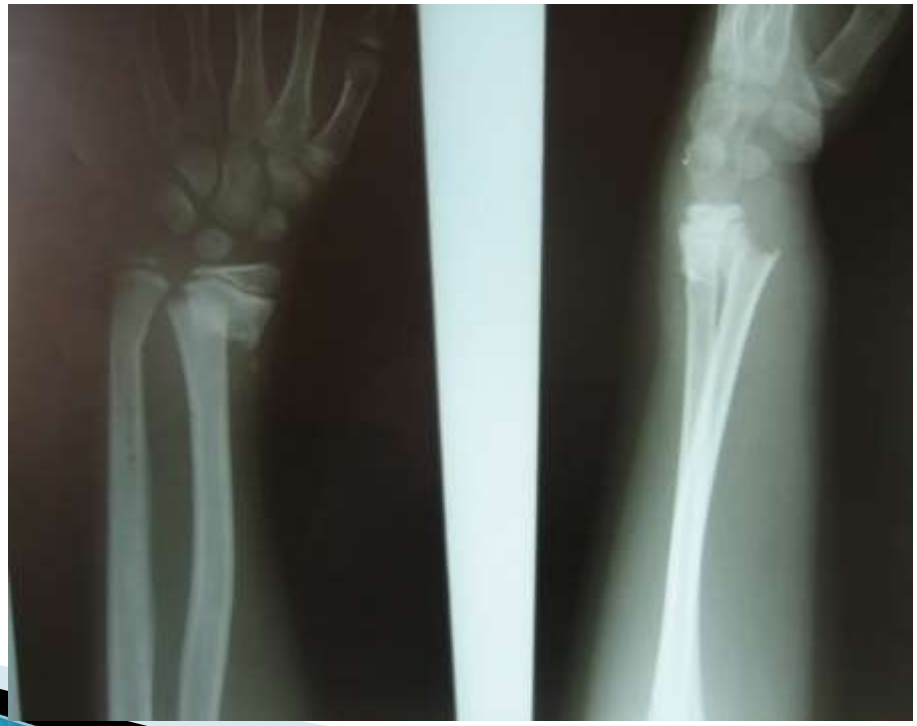
Distal radius 2



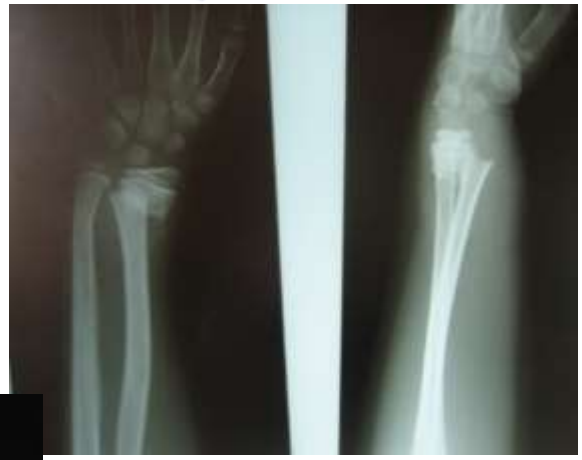
Distal radius 3

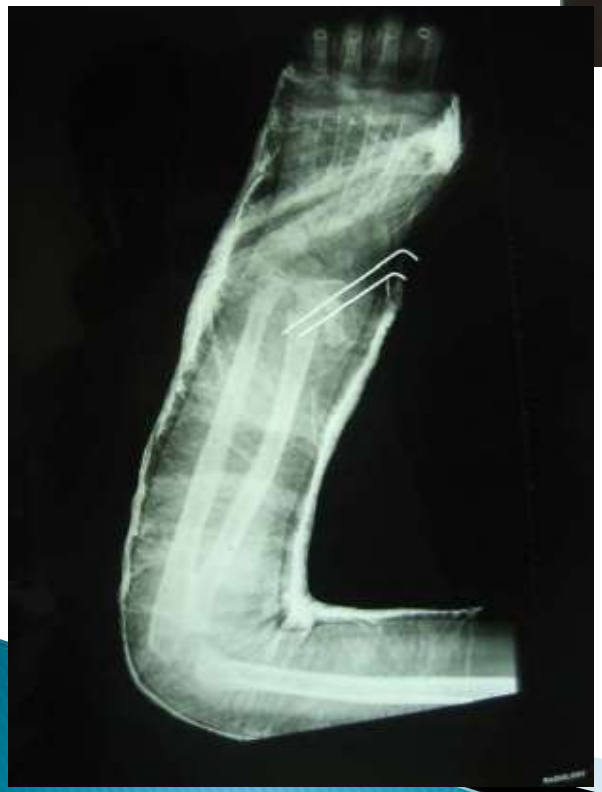
FRACTURE QUADRATUS PRONATOR

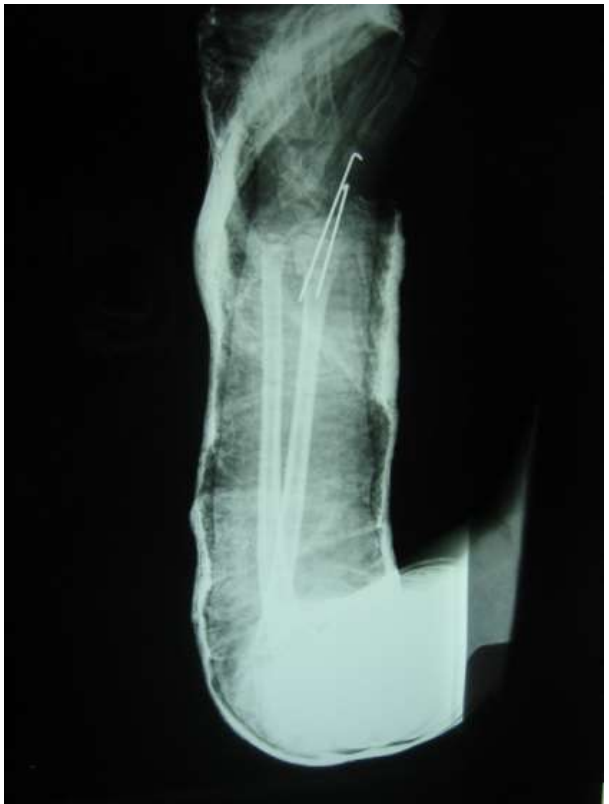
- DIFFICULT REDUCTION ulna undisplaced
- Palmar approach
- stabilisation



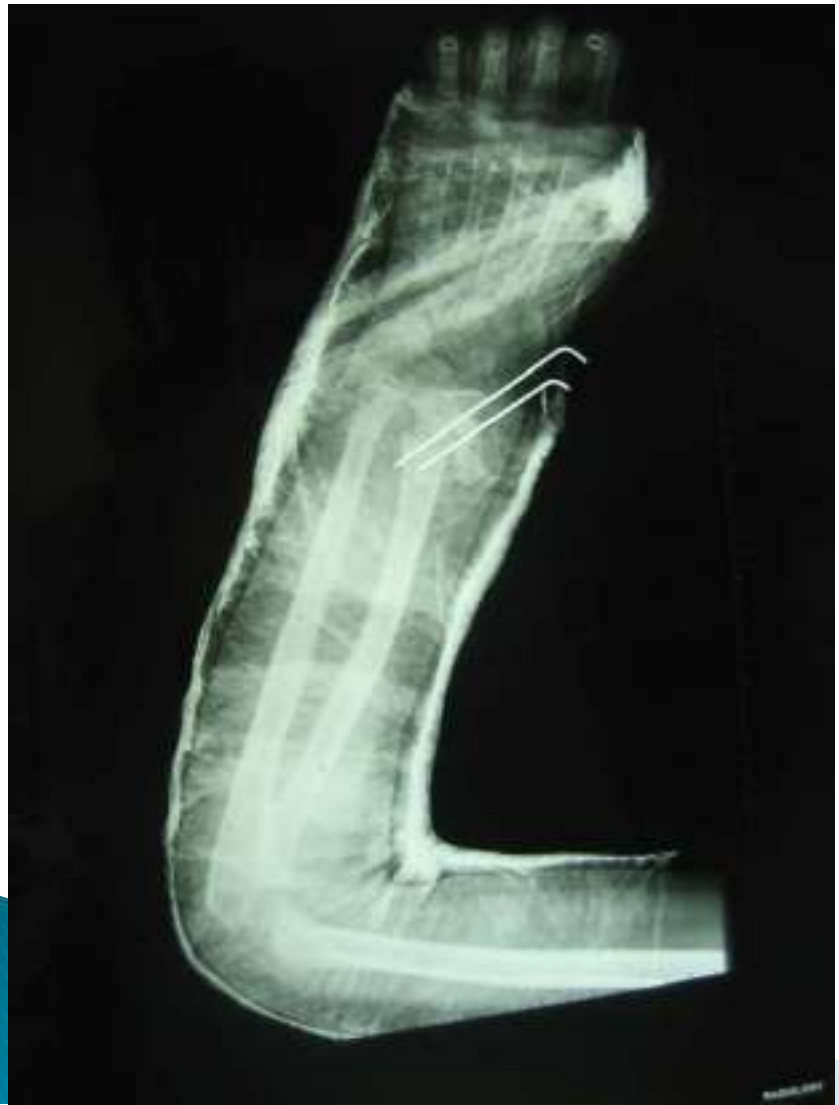
FRACTURE QUADRATUS PRONATOR

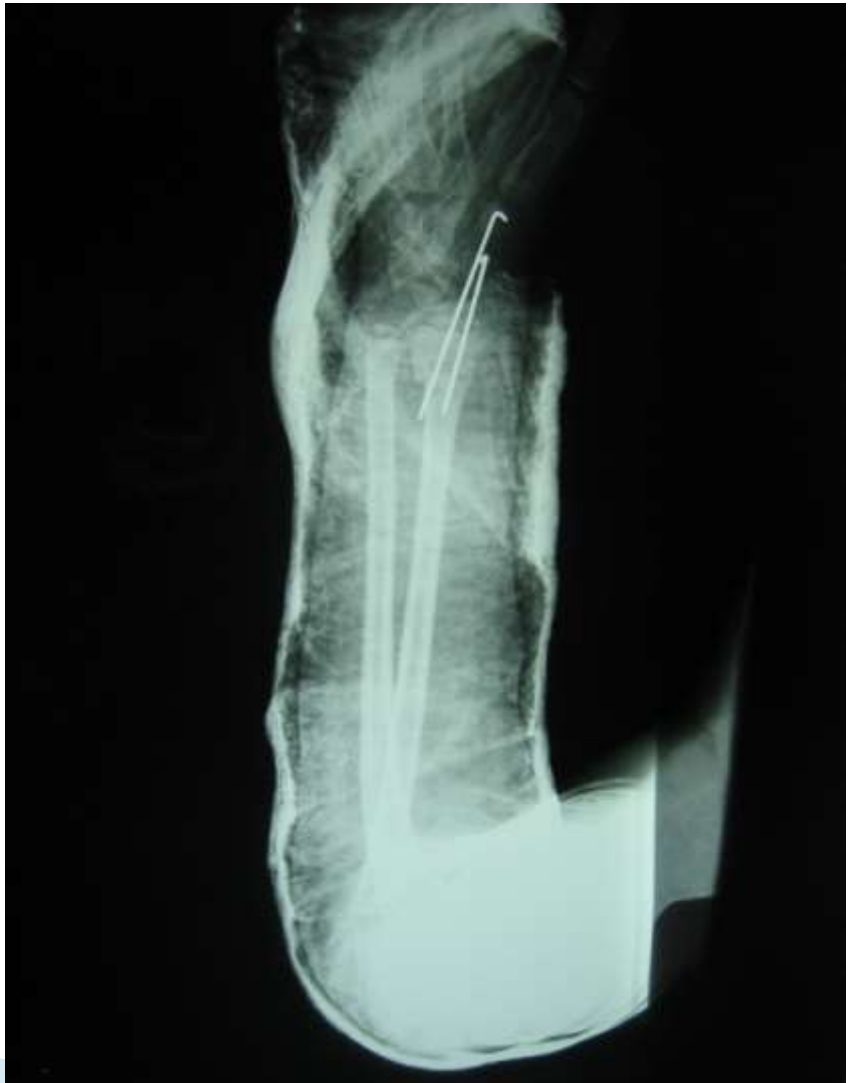






FRACTURE QUADRATUS PRONATOR

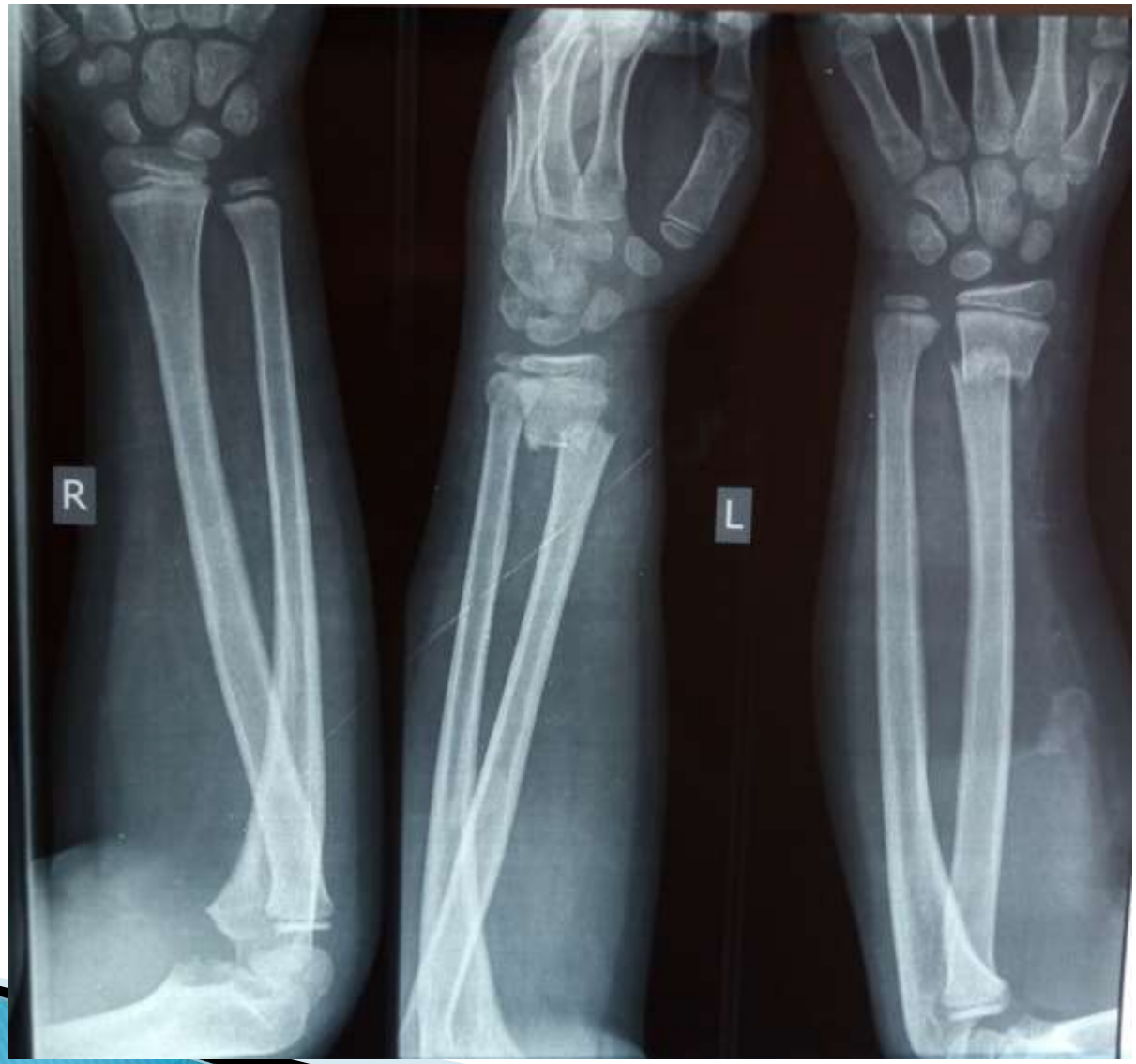




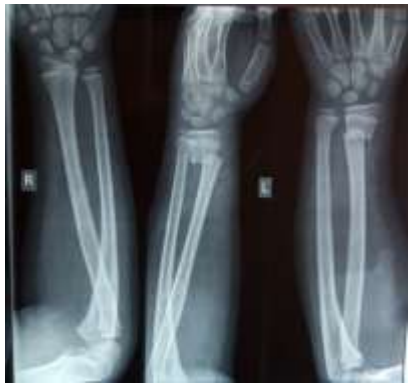
Management of completely displaced metaphyseal fractures of the distal radius in children
A controlled randomised prospective study
McLauchlan J Bone Joint Surg Br 2002 Edimbrugh

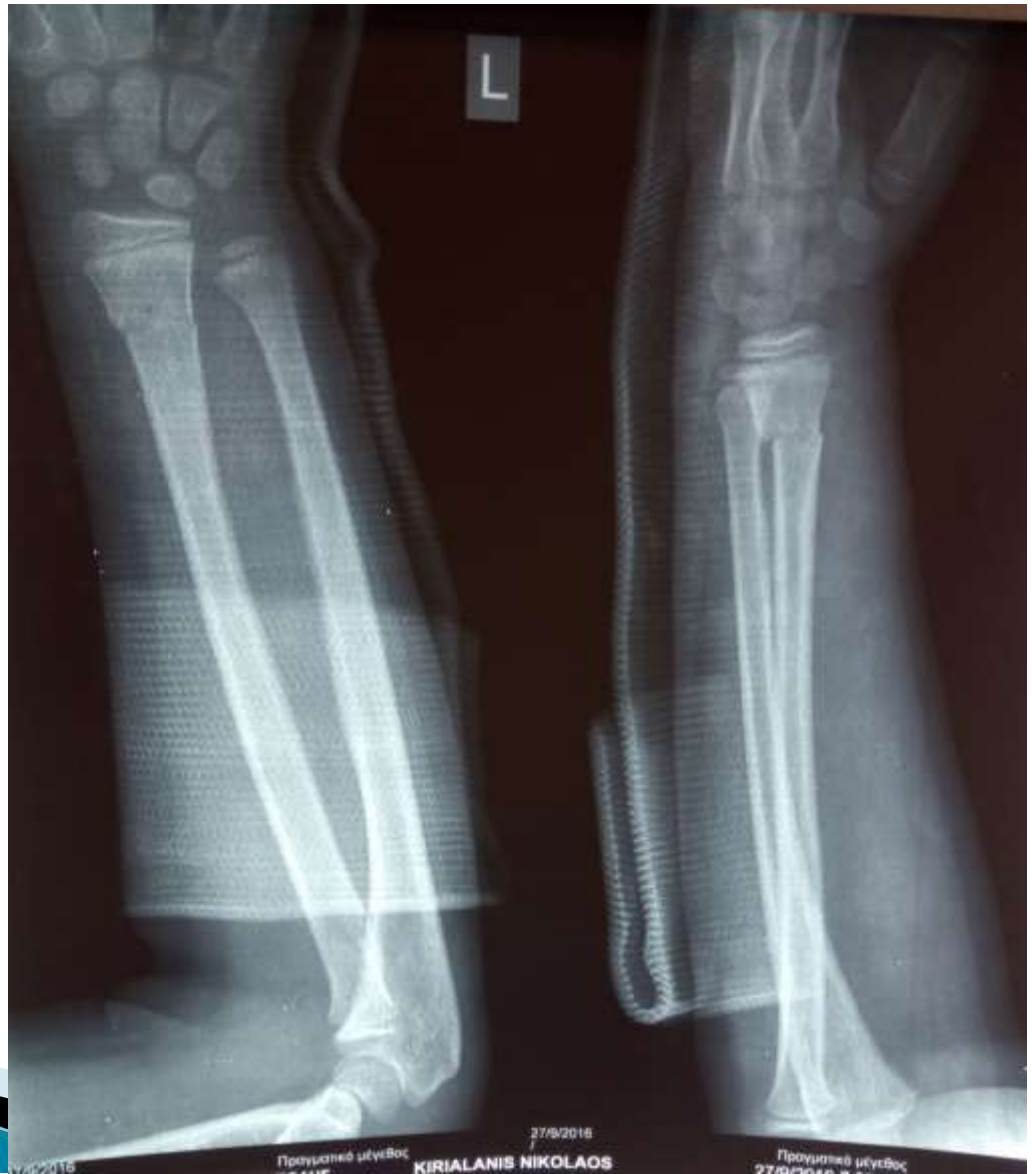
- 35 children MUA and POP
- 7 had another procedure because of loss of position
- 35 children MUA, K wire and POP
- None required a second procedure

Malunion of fractures, distal radius

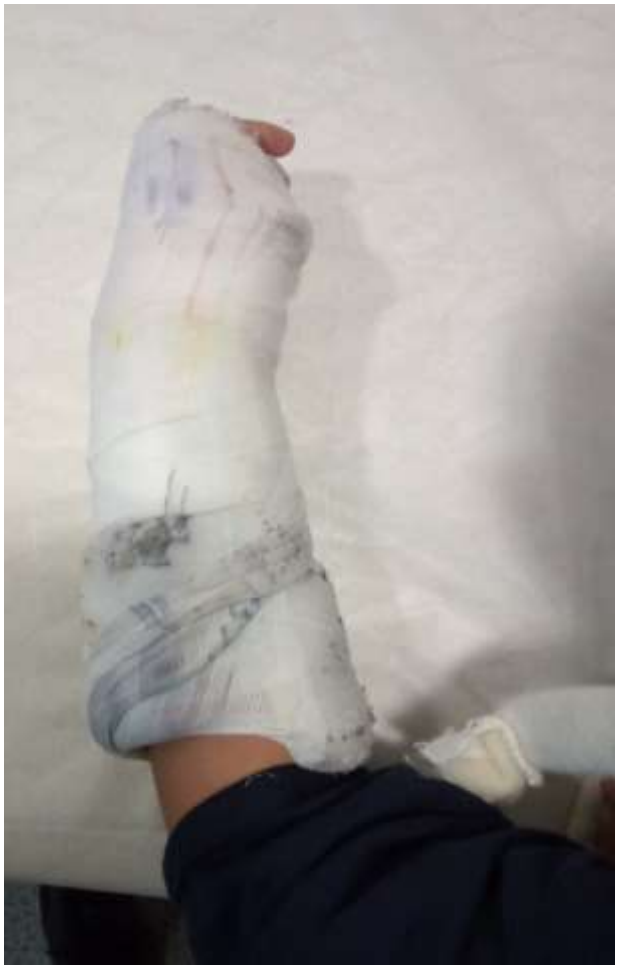


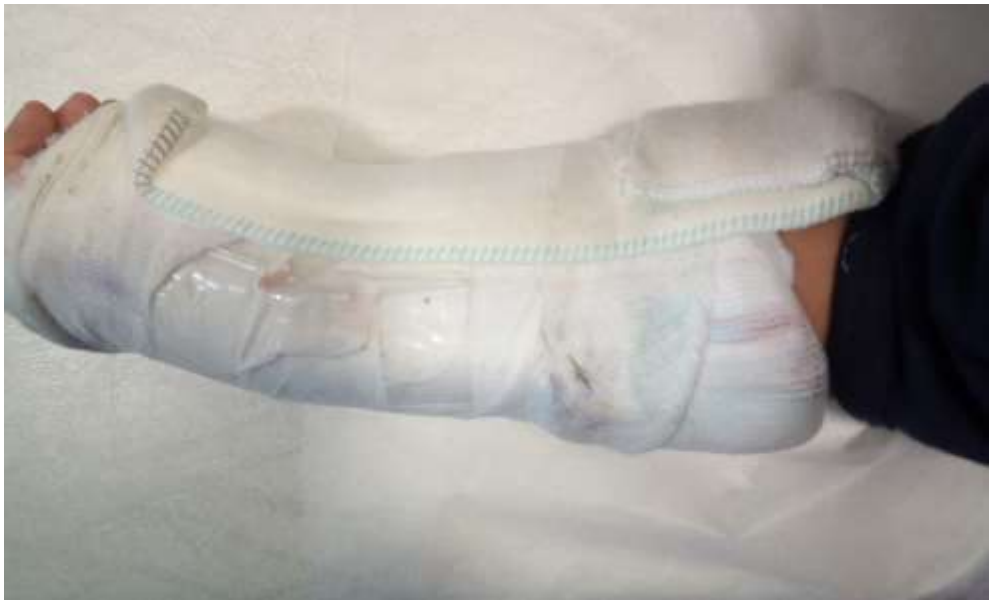
Malunion of fractures, distal radius

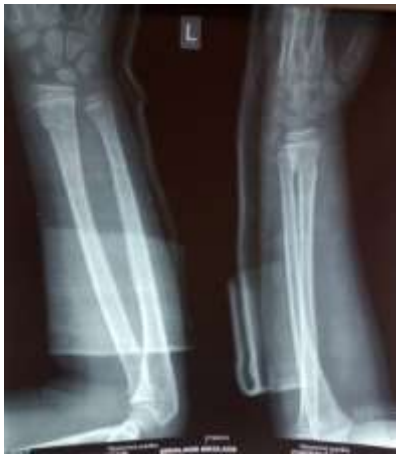




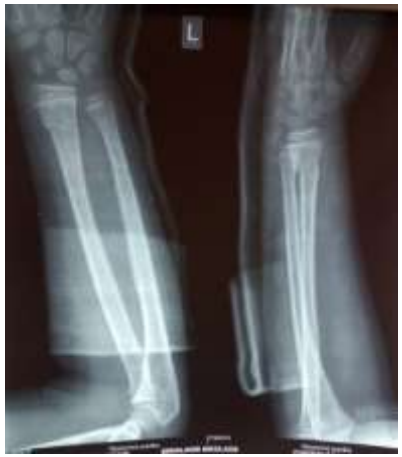
Malunion of fractures, distal radius

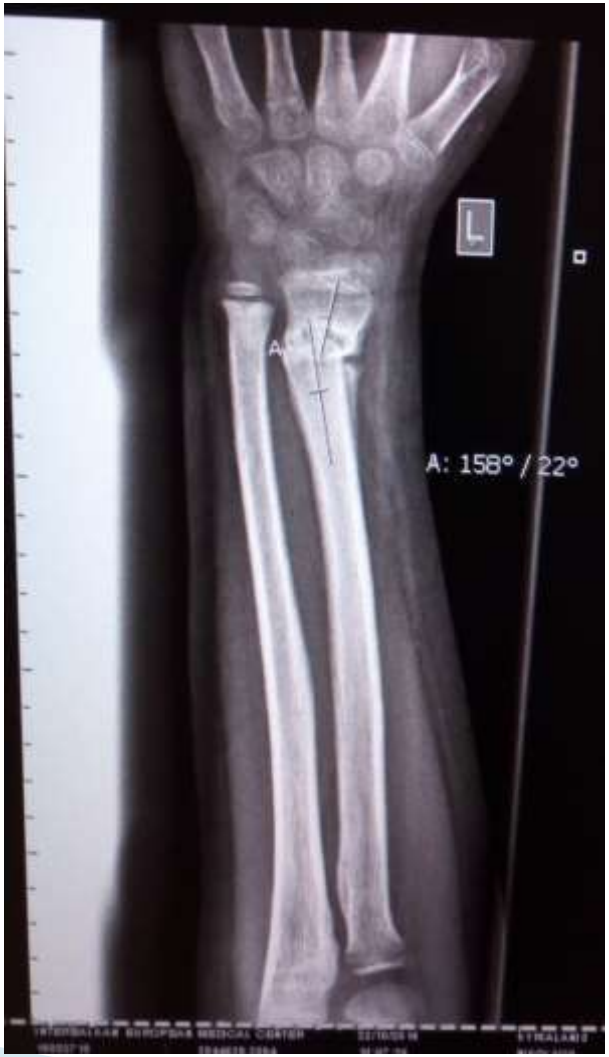


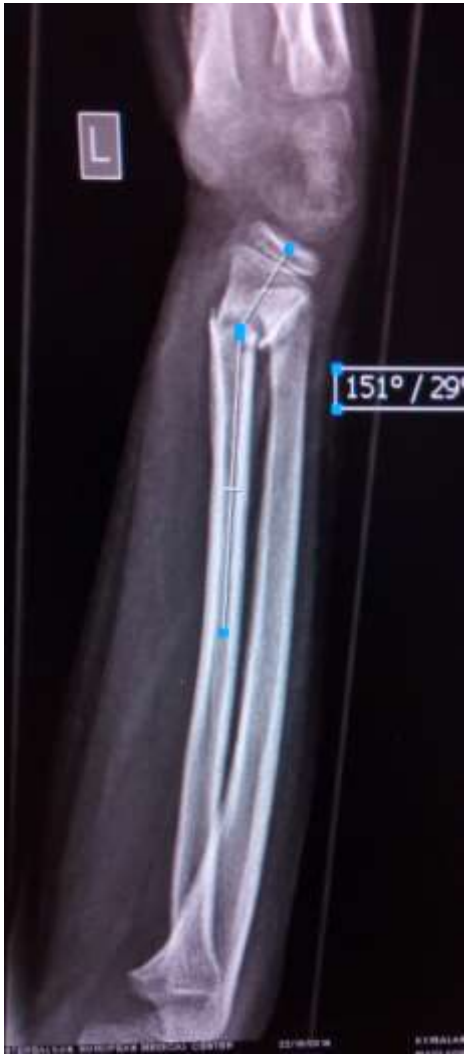




Malunion of fractures, distal radius

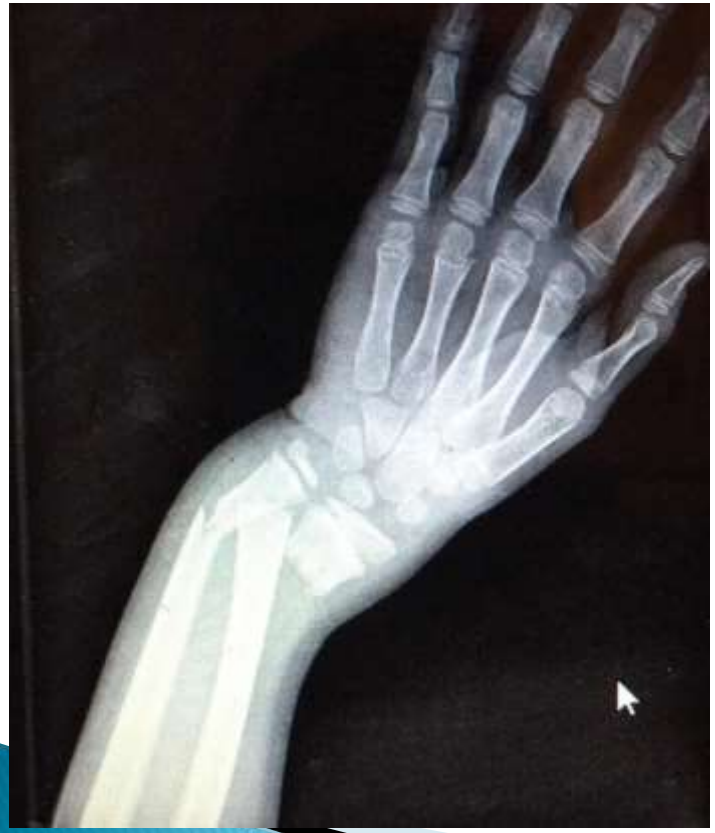


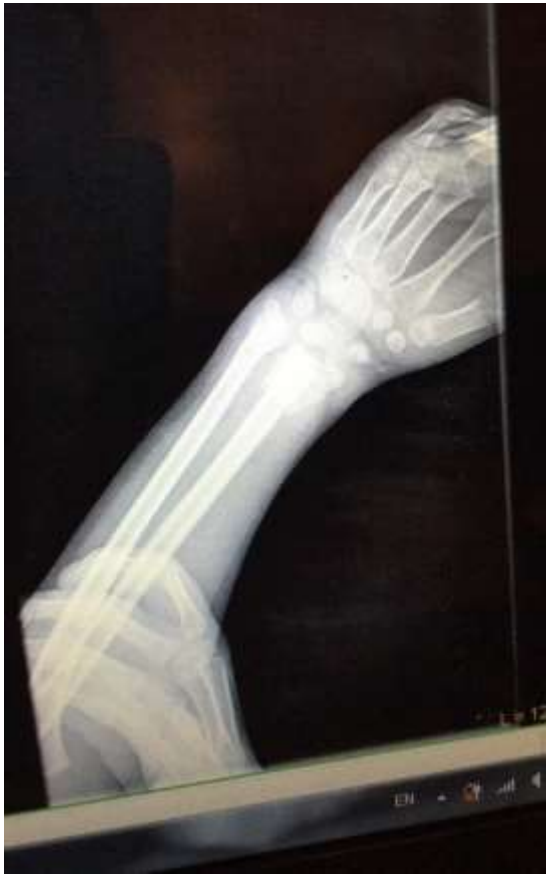




Fracture distal radius ulna

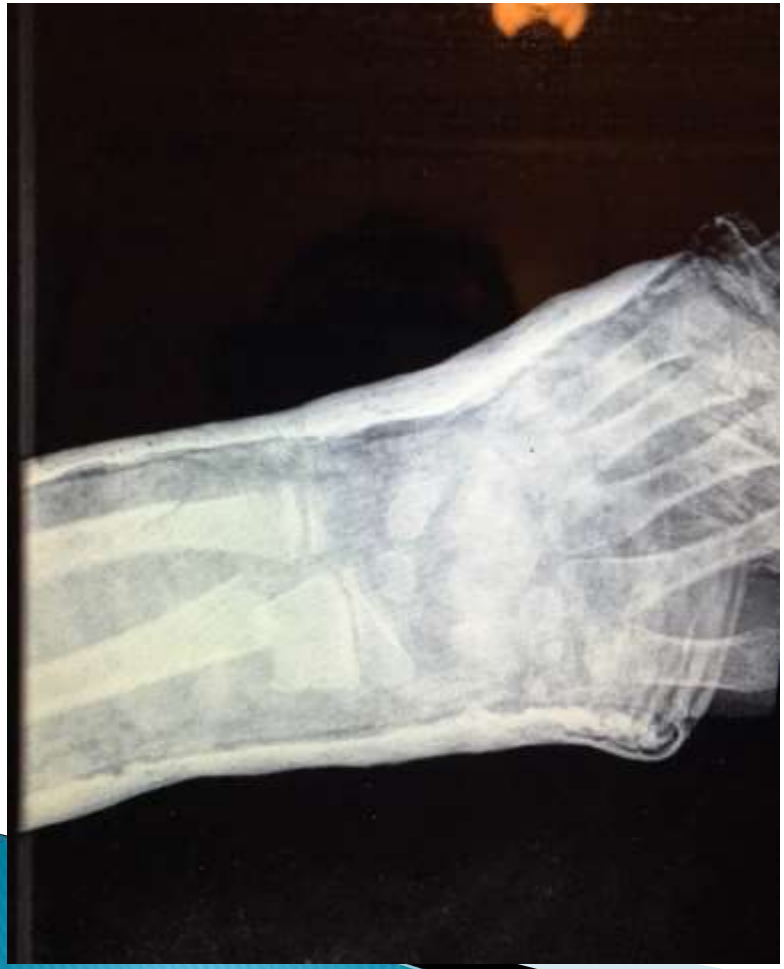
- Initial presentation sten st

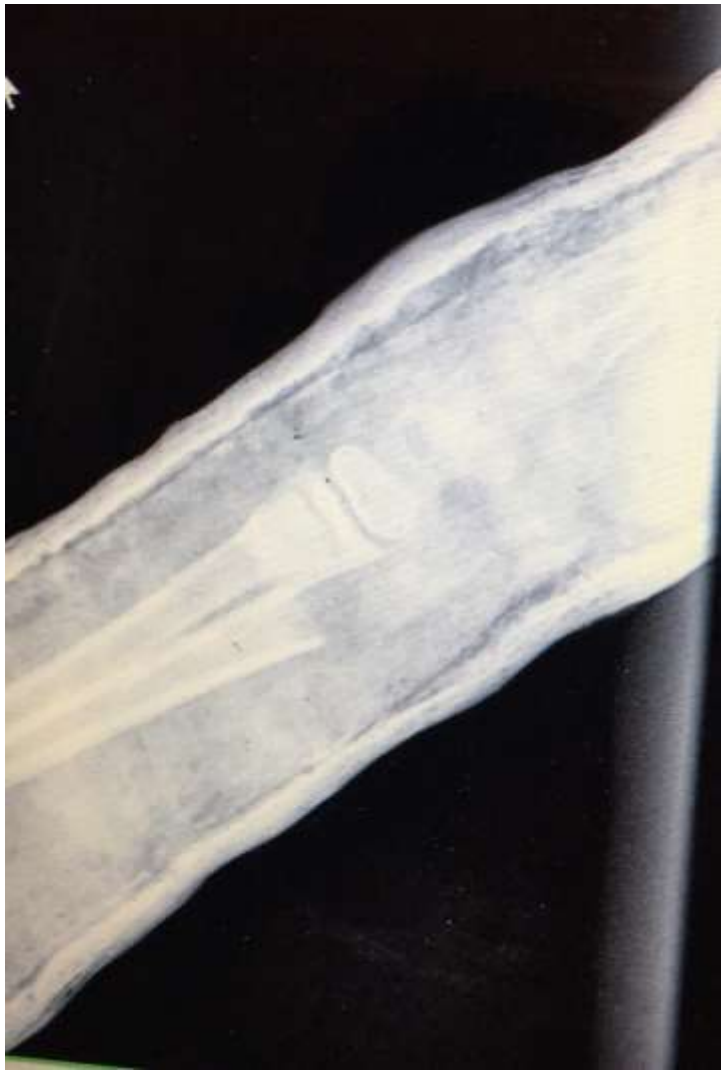




Fracture distal radius ulna

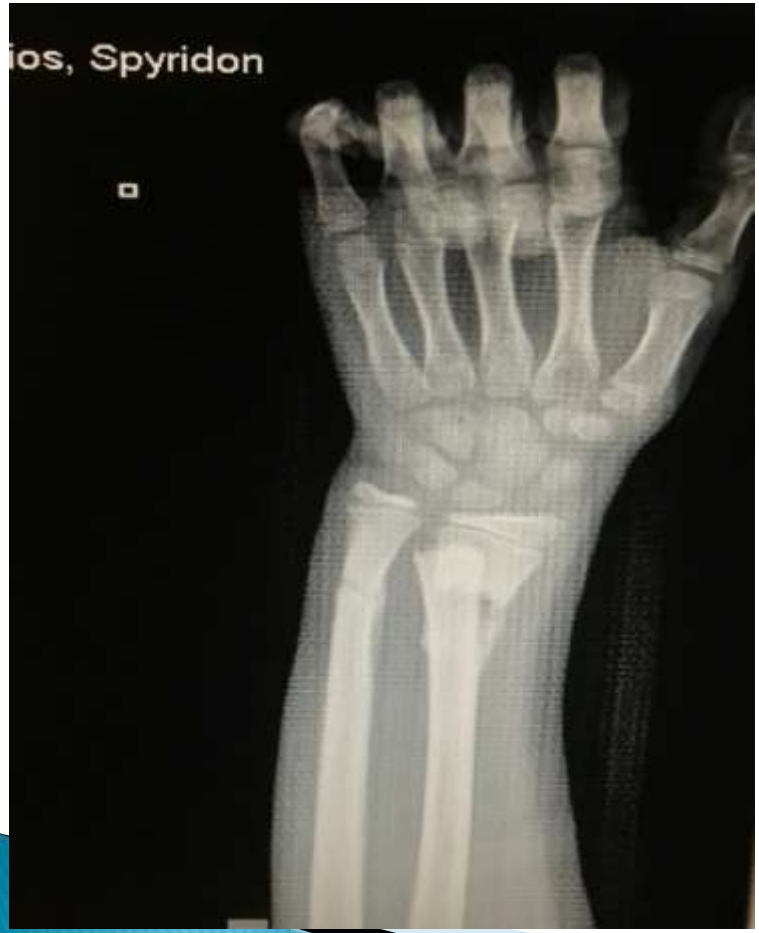
- Reduction MUA sten st

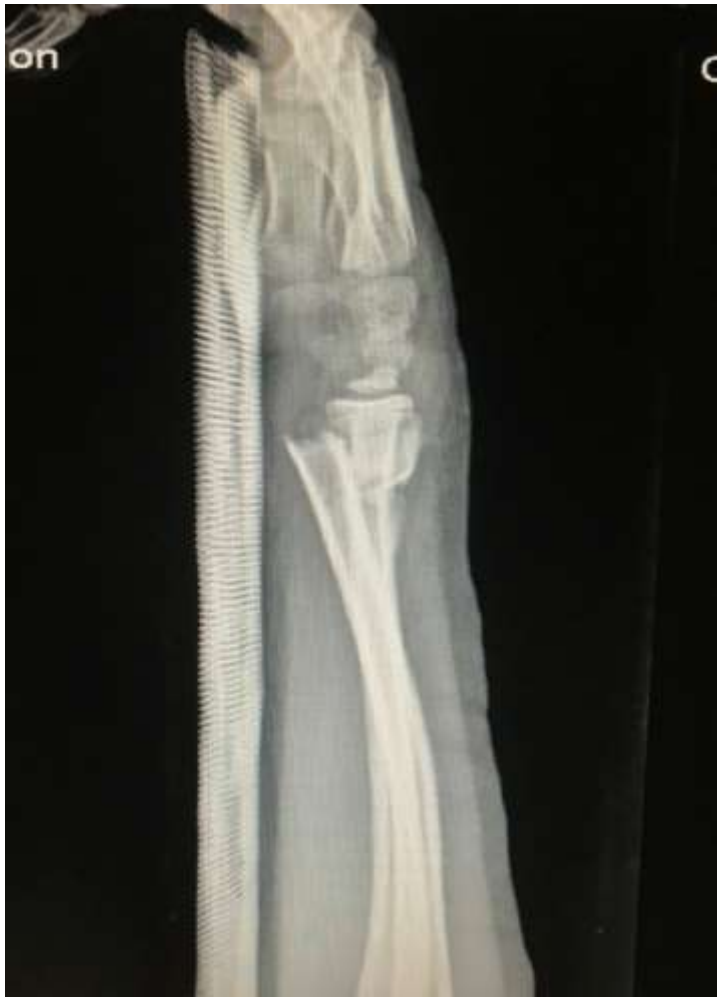




Fracture distal radius ulna

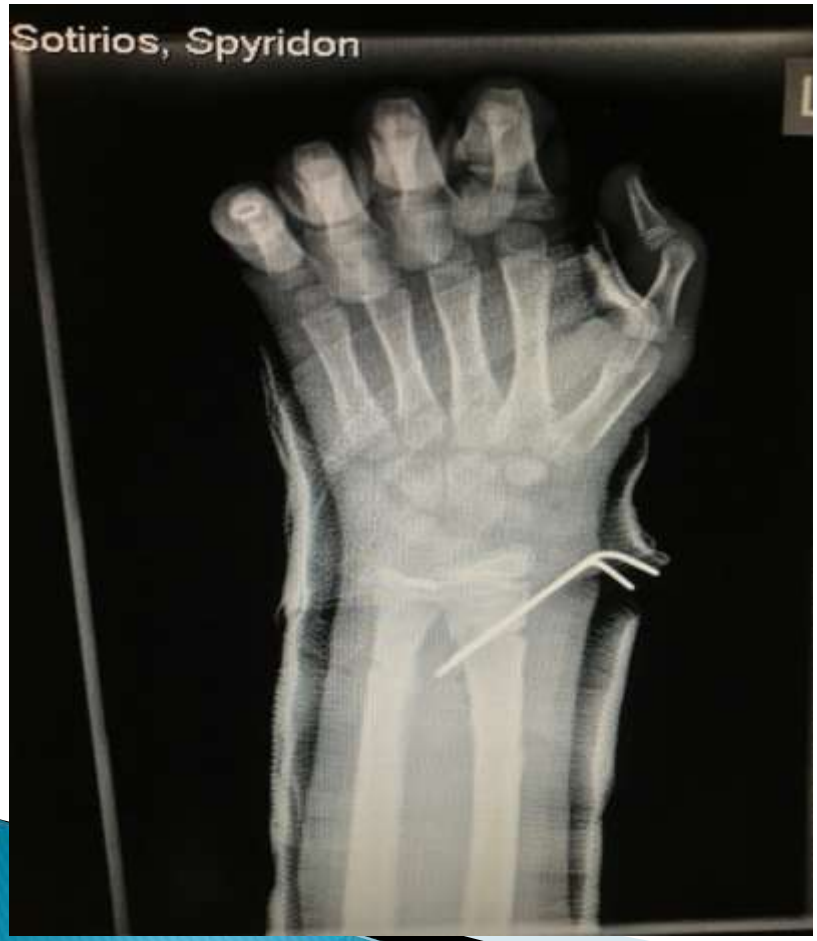
- 15 days later sten st

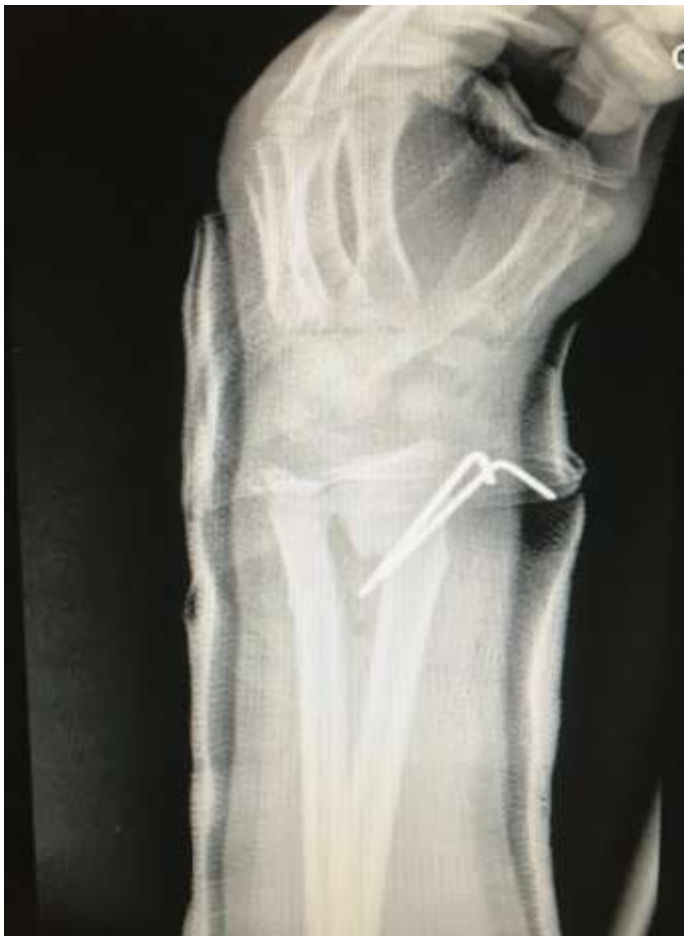




Fracture distal radius ulna

- Treatment ORIF sten st

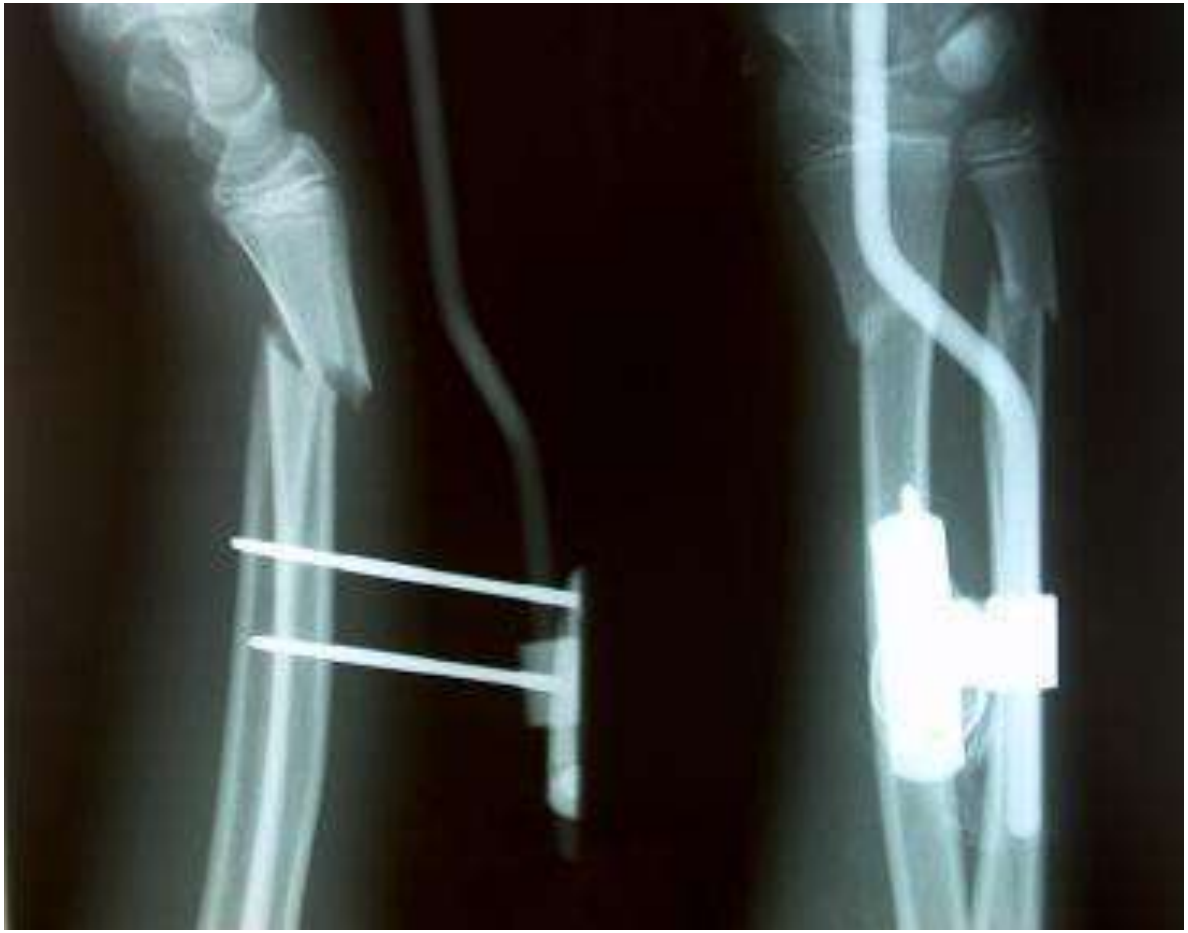




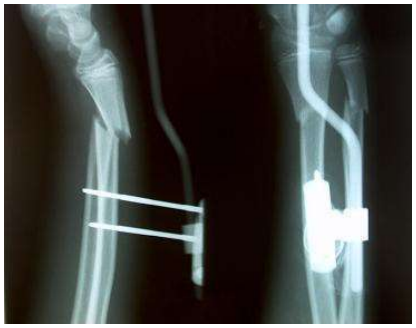
Displaced distal radius and ulna fractures

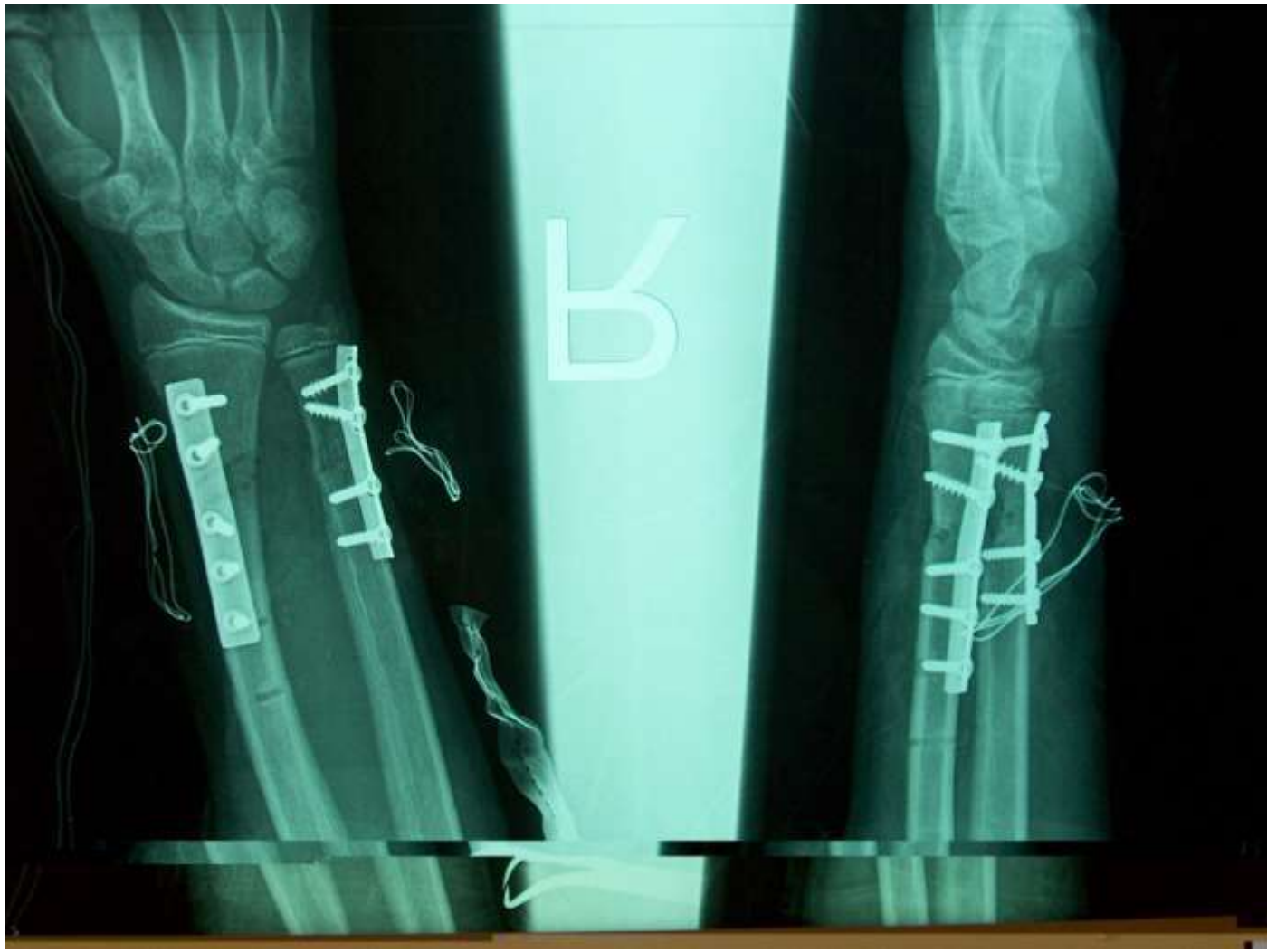
- Proper reduction
- Stabilization with K wire
- ABOVE the elbow cast
- Regular xray examination
- AGE of the patient
- QUADRATUS PRONATOR FRACTURE ORIF

Operative treatment of forearm fracture



Operative treatment of forearm fracture





DISTAL END FRACTURES

- Physeal fractures Salter classification
- Accurate reduction
- **Displacement ?**
- **How much is acceptable?**

Physeal injuries classification

- Salter Harris

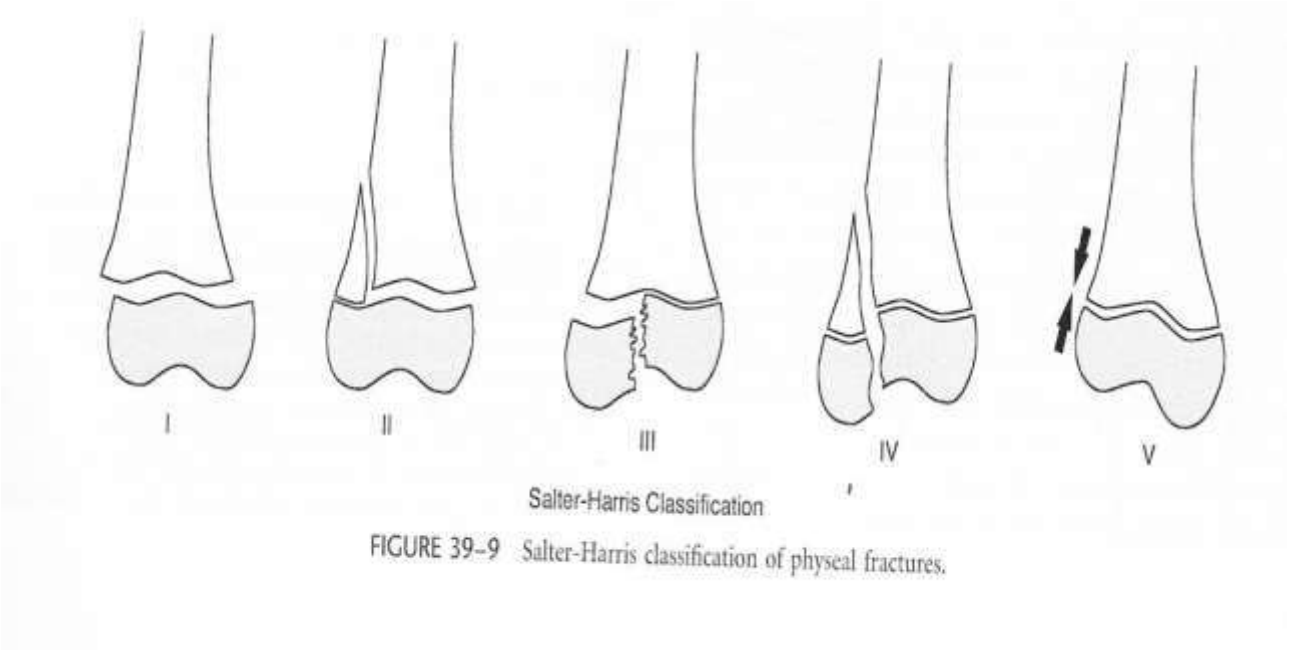


FIGURE 39–9 Salter-Harris classification of physeal fractures.

Physeal fractures of distal radius

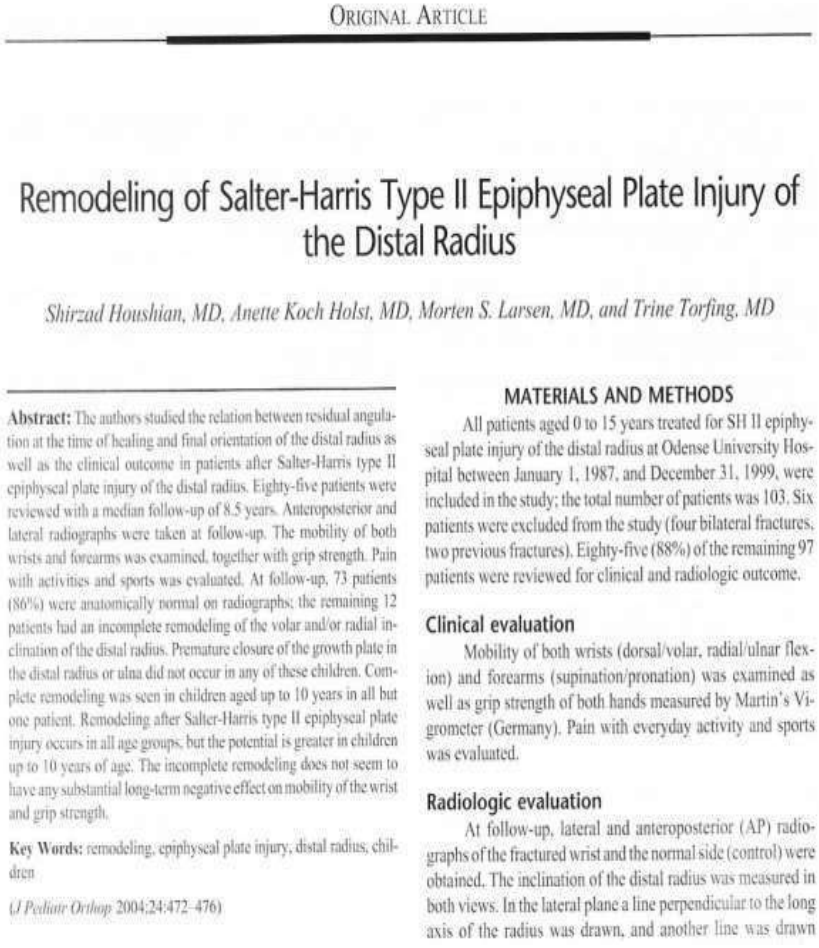
- Most common of pediatric fractures
- Main growth of the radius (75% of radial length
- Common in preadolescent period
- Common Salter Harris 2

Physeal fractures of distal radius

- Closed reduction when displaced with an angle > 10-15 d
- Accurate reduction (ORIF) in SH 3,or 4
- They are healed quickly , they have great remodelling potential, mainly in younger children
- **Repeat reduction or reduction after 10 days MUST BE AVOIDED**

Physeal fractures of distal radius REMODELLING POTENTIAL

- GOOD POTENTIAL FOR REMODELLING , MAINLY IN YOUNGER THAN 10 YRS
- We accept angulation up to 20d and axial deviation up to 40%
- No reduction in minimal displacement !
- growth arrest when attempted REPEATED manipulation



ORIGINAL ARTICLE

Remodeling of Salter-Harris Type II Epiphyseal Plate Injury of the Distal Radius

Shirzad Houshian, MD, Anette Koch Holst, MD, Morten S. Larsen, MD, and Trine Torfing, MD

Abstract: The authors studied the relation between residual angulation at the time of healing and final orientation of the distal radius as well as the clinical outcome in patients after Salter-Harris type II epiphyseal plate injury of the distal radius. Eighty-five patients were reviewed with a median follow-up of 8.5 years. Anteroposterior and lateral radiographs were taken at follow-up. The mobility of both wrists and forearms was examined, together with grip strength. Pain with activities and sports was evaluated. At follow-up, 73 patients (86%) were anatomically normal on radiographs; the remaining 12 patients had an incomplete remodeling of the volar and/or radial inclination of the distal radius. Premature closure of the growth plate in the distal radius or ulna did not occur in any of these children. Complete remodeling was seen in children aged up to 10 years in all but one patient. Remodeling after Salter-Harris type II epiphyseal plate injury occurs in all age groups, but the potential is greater in children up to 10 years of age. The incomplete remodeling does not seem to have any substantial long-term negative effect on mobility of the wrist and grip strength.

Key Words: remodeling, epiphyseal plate injury, distal radius, children

(*J Pediatr Orthop* 2004;24:472–476)

MATERIALS AND METHODS

All patients aged 0 to 15 years treated for SH II epiphyseal plate injury of the distal radius at Odense University Hospital between January 1, 1987, and December 31, 1999, were included in the study; the total number of patients was 103. Six patients were excluded from the study (four bilateral fractures, two previous fractures). Eighty-five (88%) of the remaining 97 patients were reviewed for clinical and radiologic outcome.

Clinical evaluation

Mobility of both wrists (dorsal/volar, radial/ulnar flexion) and forearms (supination/pronation) was examined as well as grip strength of both hands measured by Martin's Vigrometer (Germany). Pain with everyday activity and sports was evaluated.

Radiologic evaluation

At follow-up, lateral and anteroposterior (AP) radiographs of the fractured wrist and the normal side (control) were obtained. The inclination of the distal radius was measured in both views. In the lateral plane a line perpendicular to the long axis of the radius was drawn, and another line was drawn

Remodeling of physeal fractures

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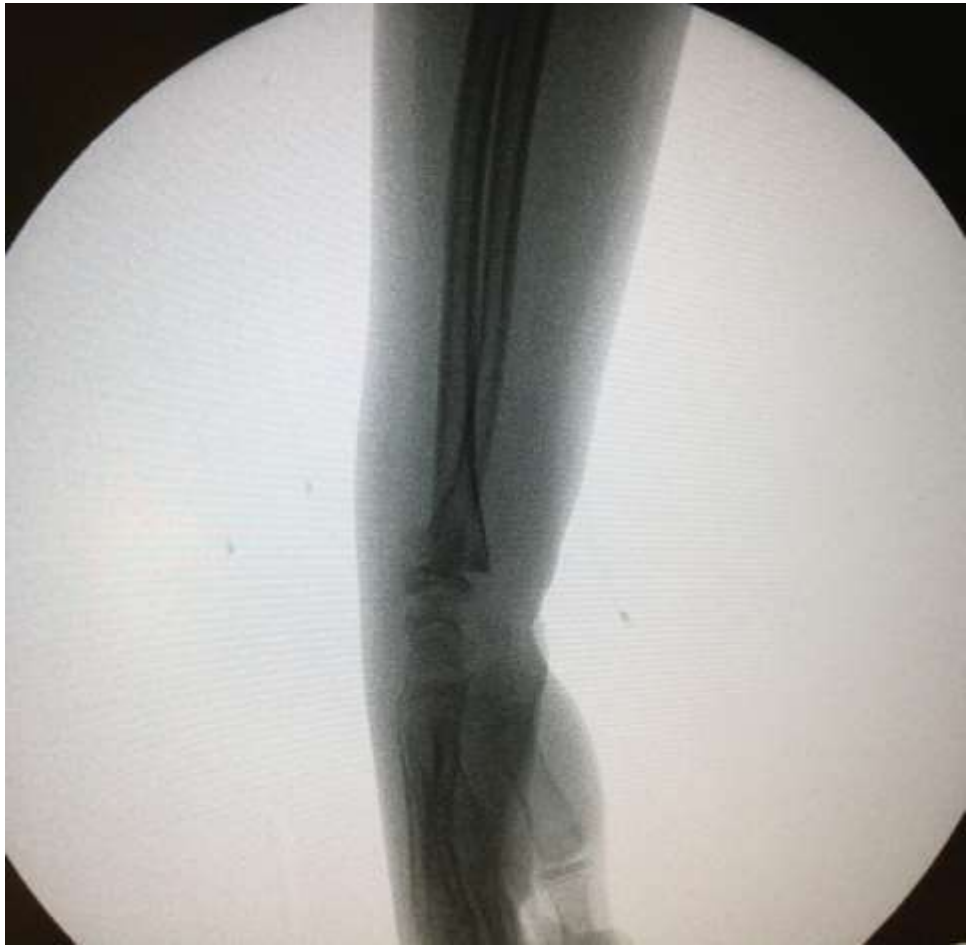
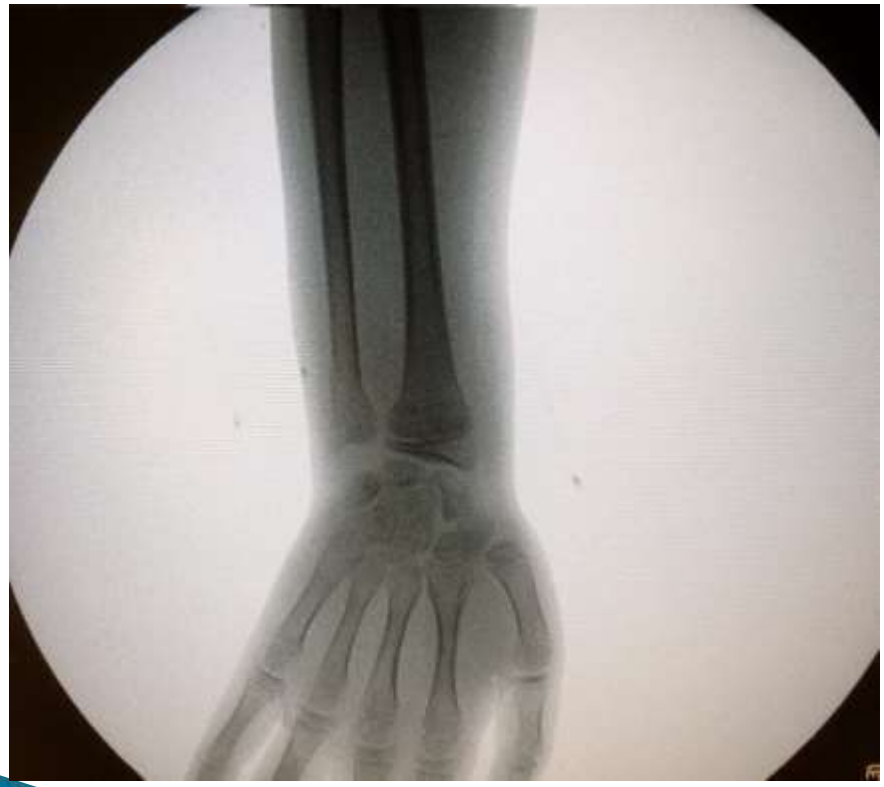
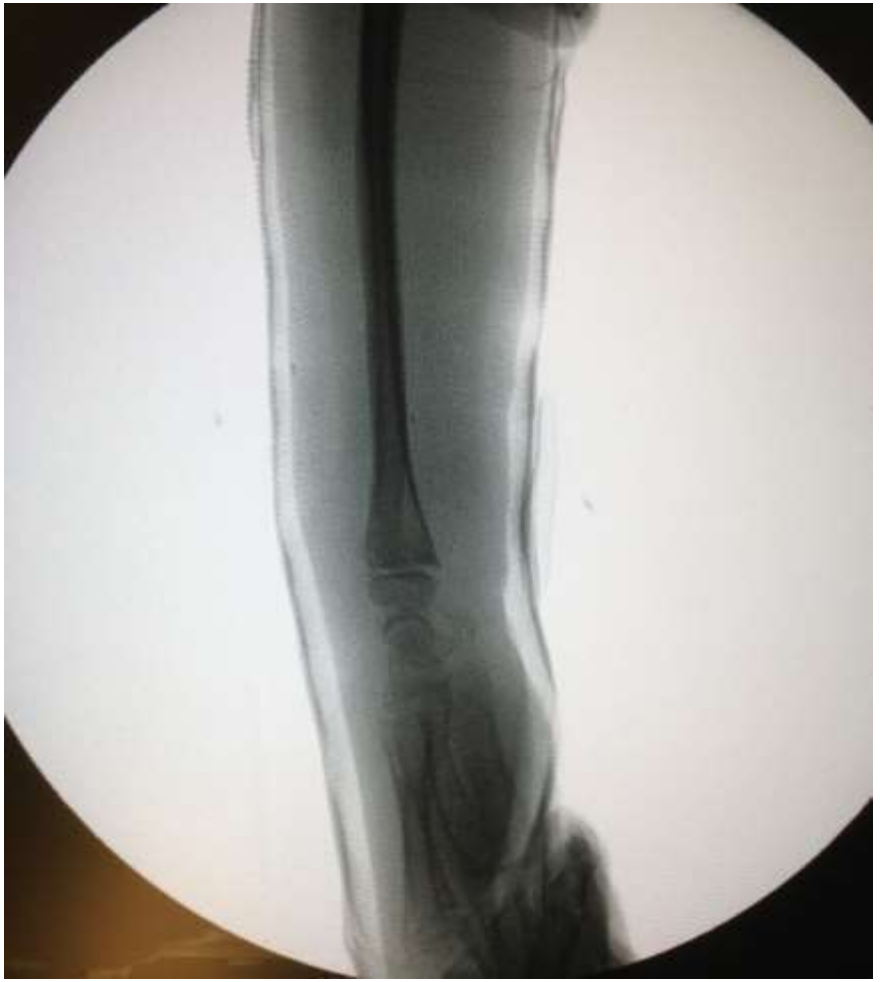
Physeal fractures

- **IDEAL**
- **Ακριβής ανάταξη**
- **MUA , C arm**



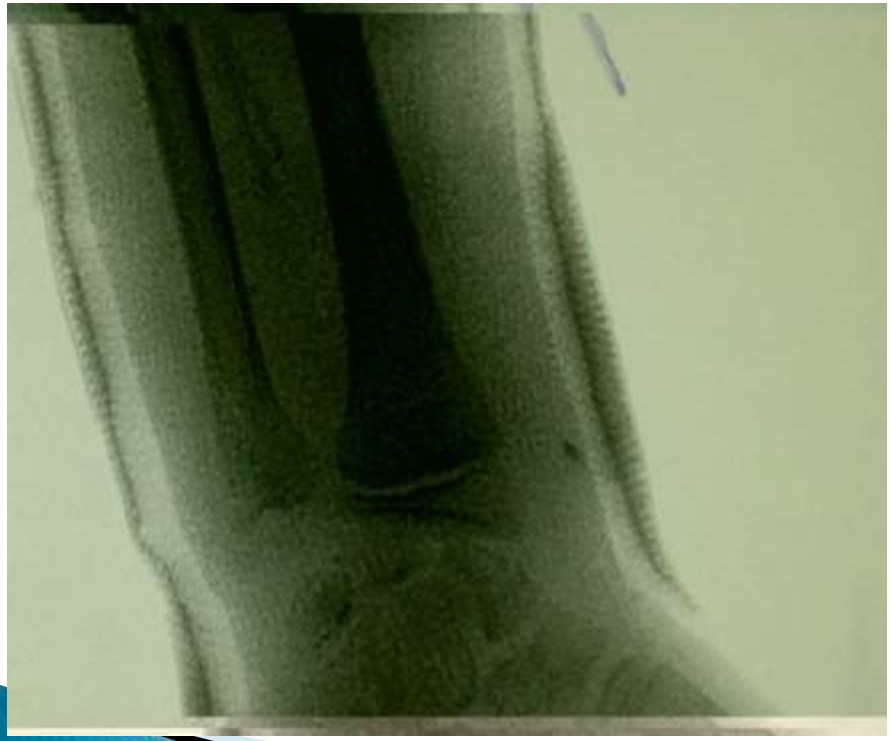
Physeal fractures

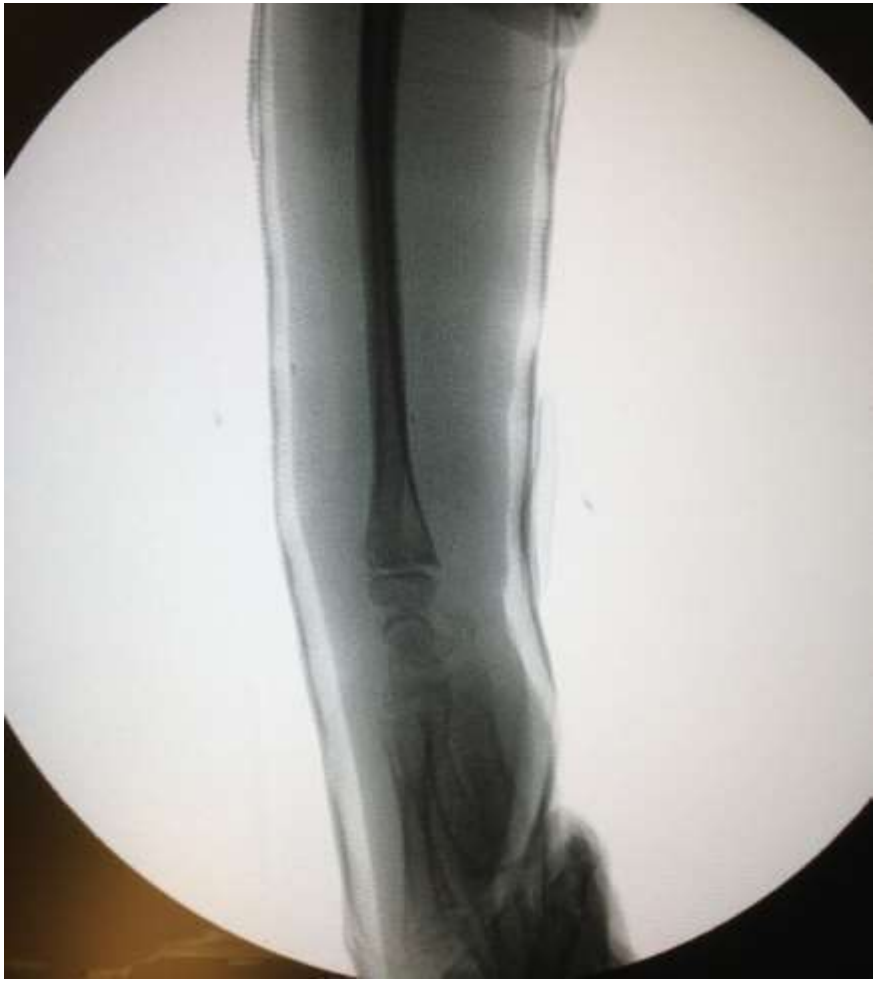




Physeal fractures

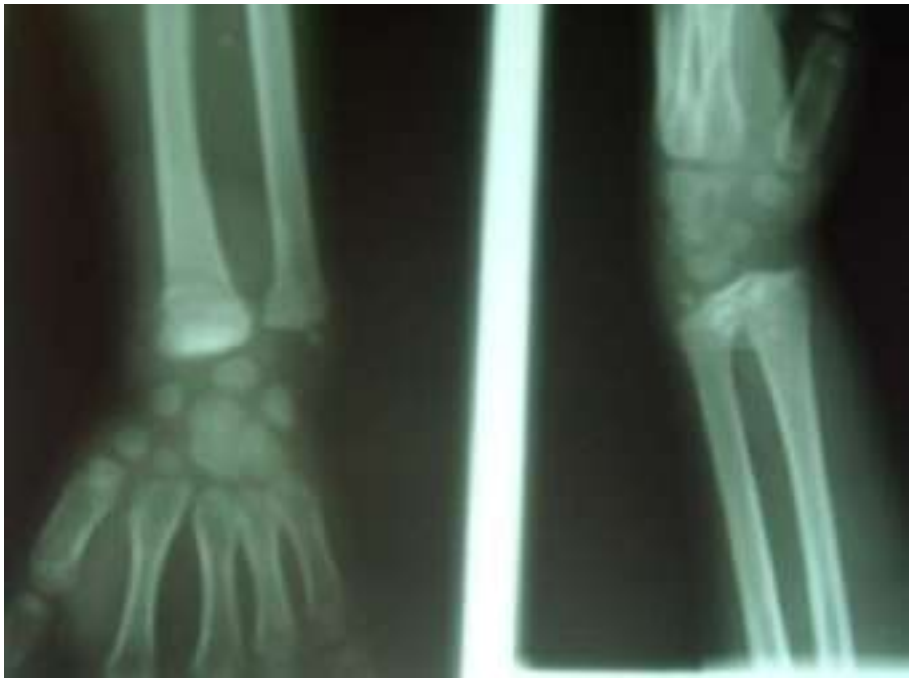
- **CAST Below elbow**





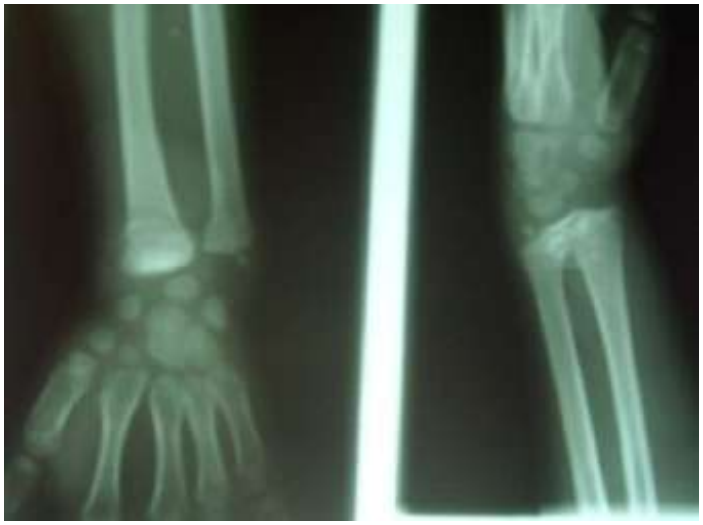
Physeal fractures

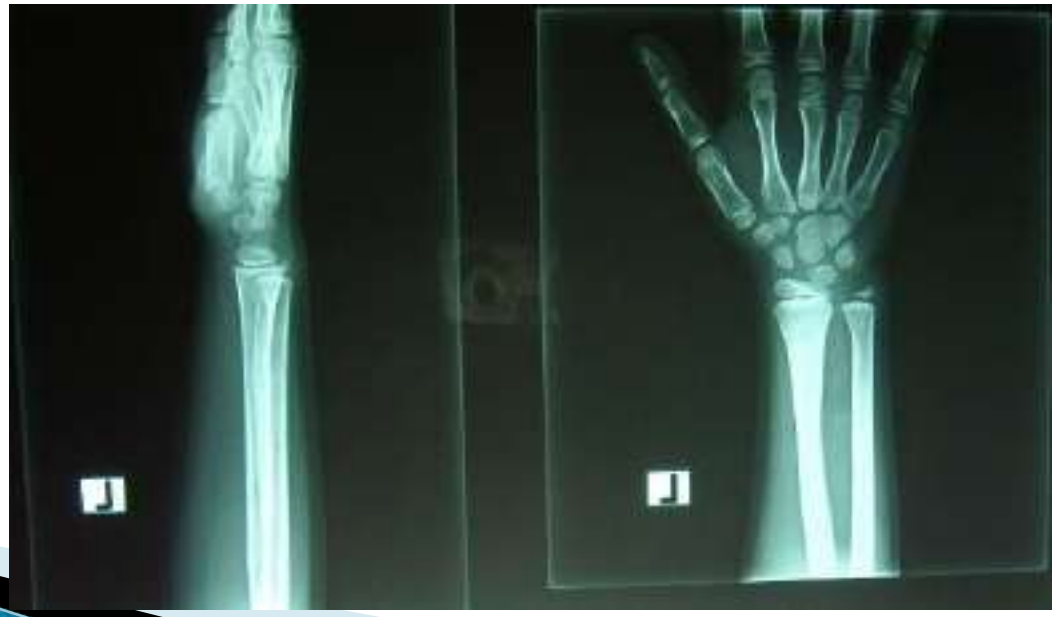
- Ακριβής ανάταξη
- Παρεκτόπιση
- Πόση αποδεχόμαστε?
- Νέα ανάταξη?



Physeal fractures

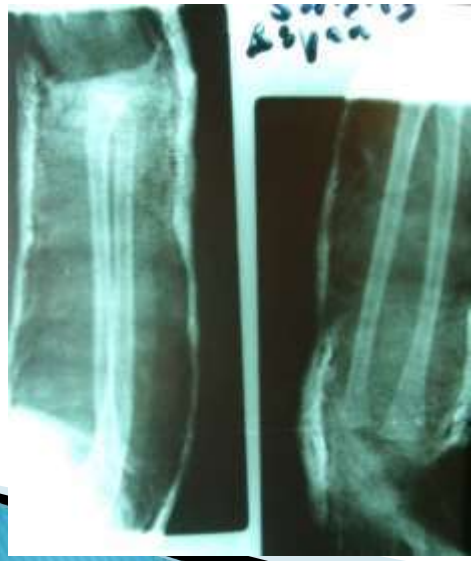
- **Σπάνια η εμφάνιση growth arrest?**

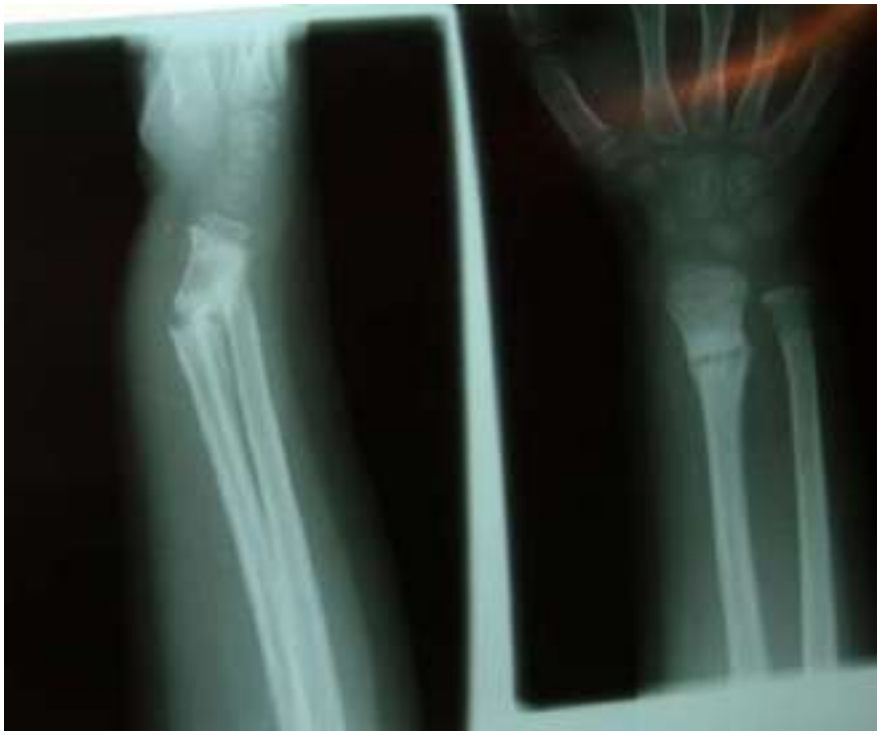




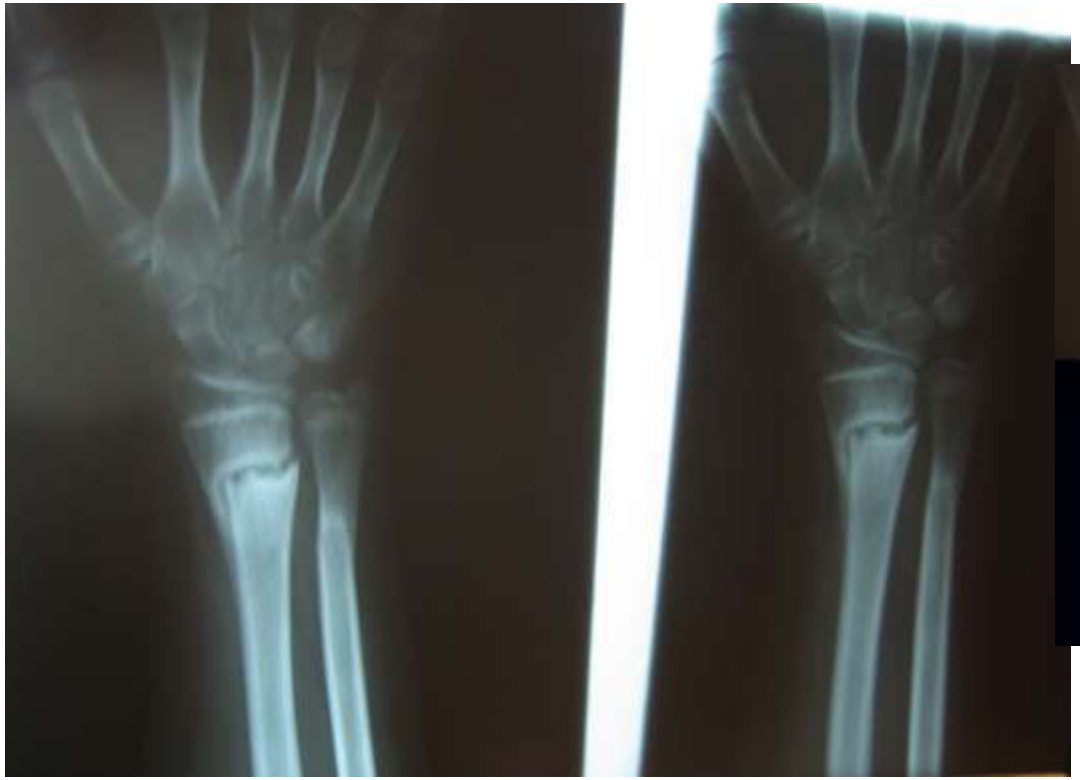
Distal end fractures
Remanipulation? ORIF?

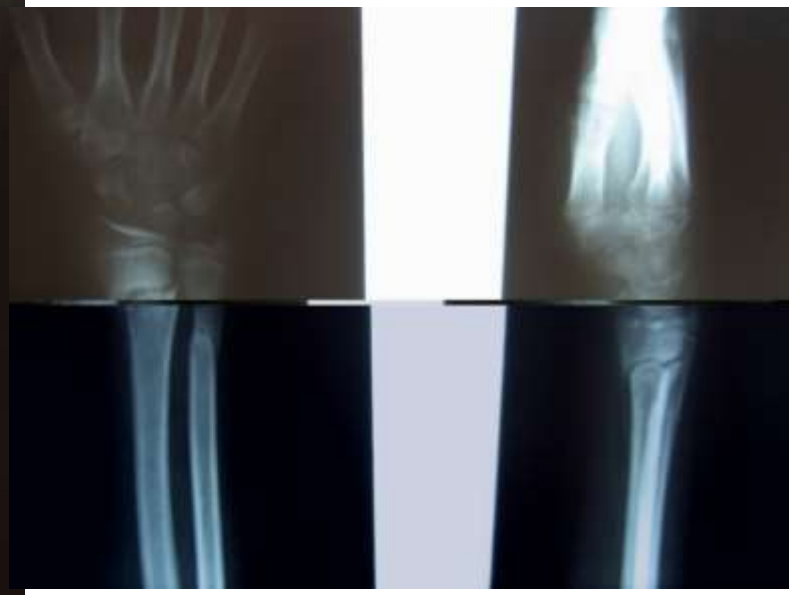
- When ?
- Unclear indications





Delayed union ?





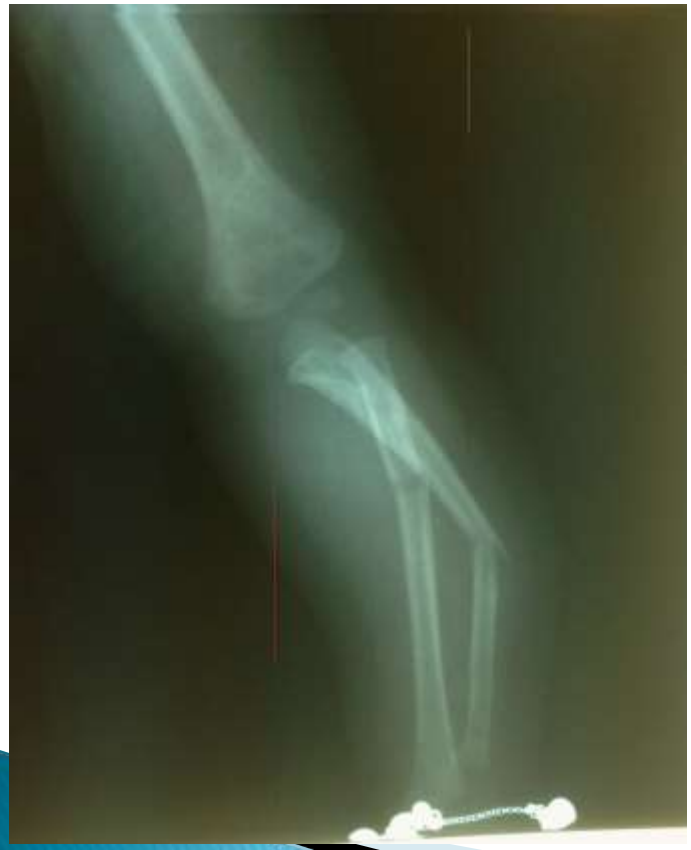
Fractures of the shaft of radius and ulna

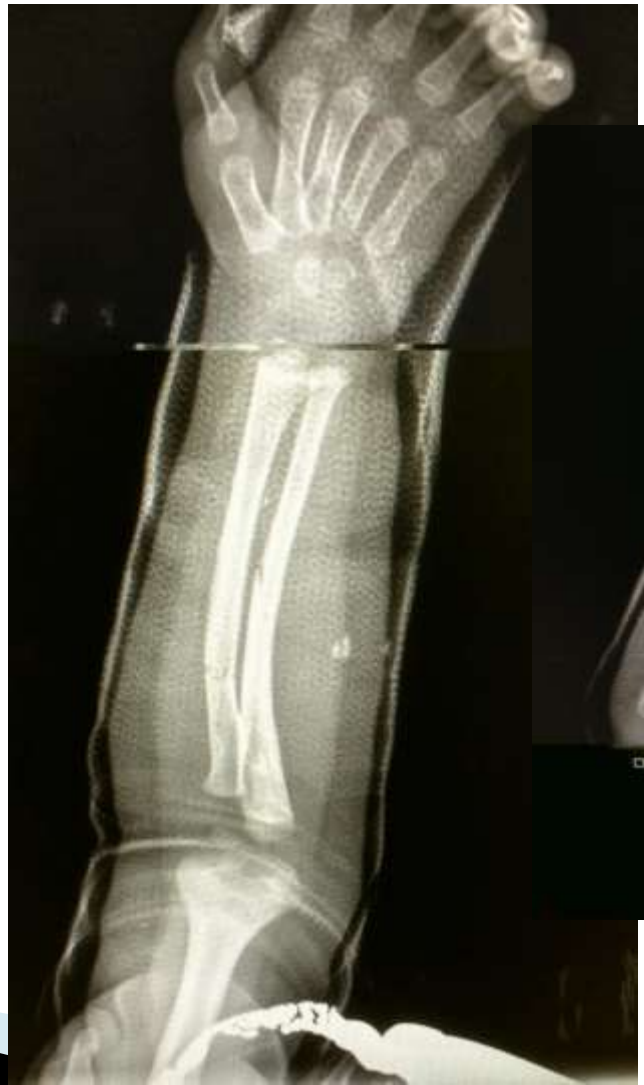
Fractures of the shaft radius ulna

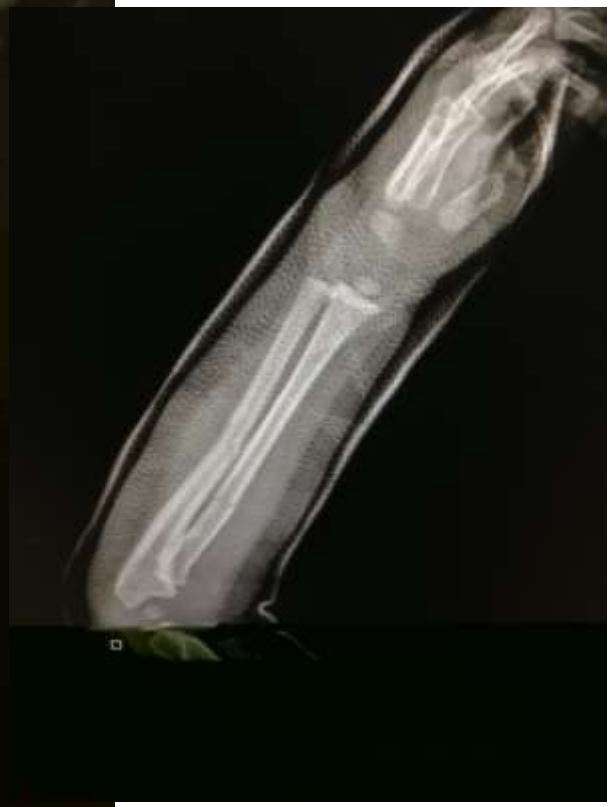
- Age
- Proximal fracture
- stability
- Solitary fracture
- Plastic deformation
- **Overriding of fractured segments**

Fractures of the shaft radius ulna

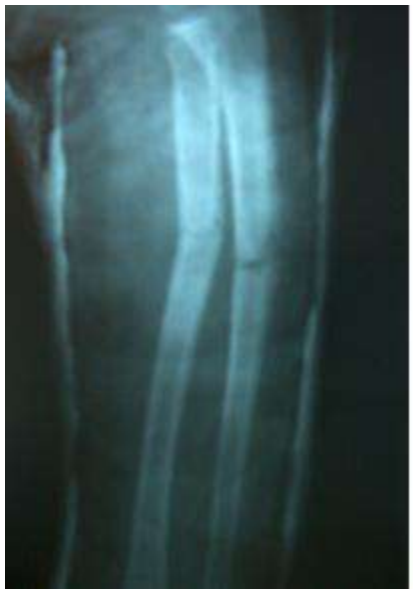
- Ideal conditions

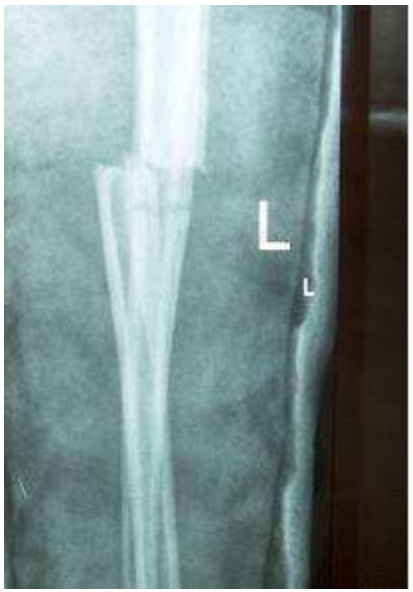


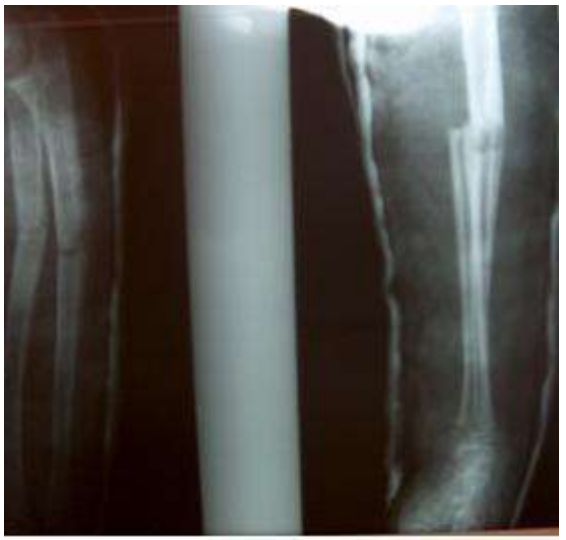




Balance between conservative and operative treatment

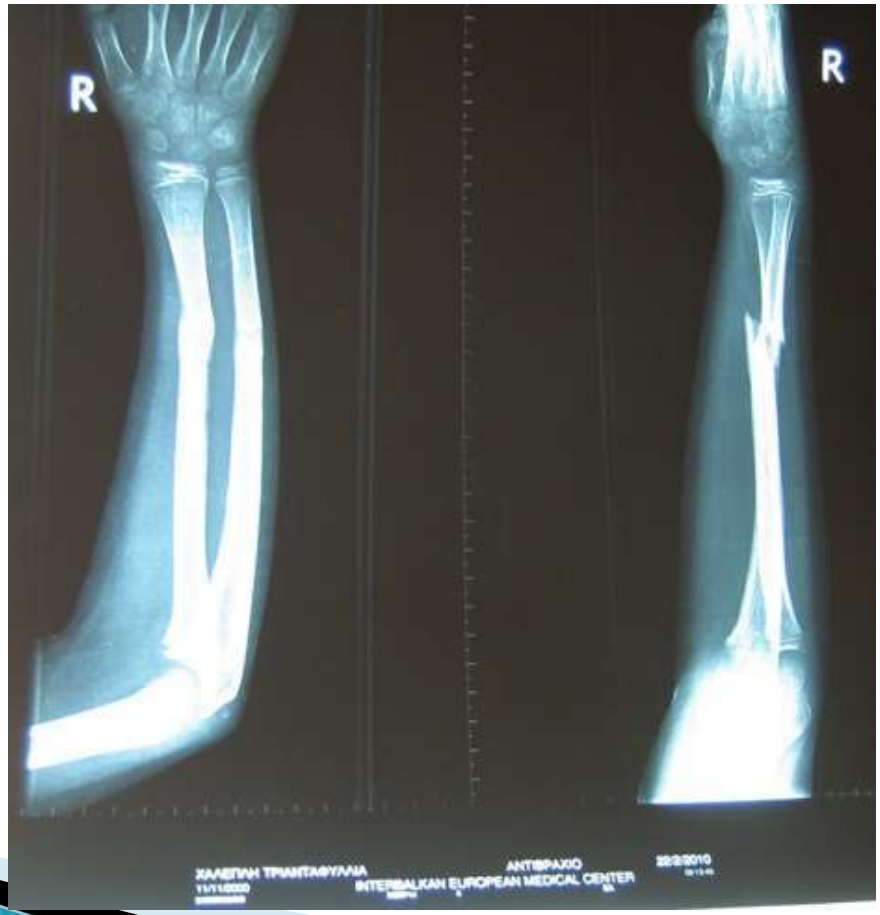






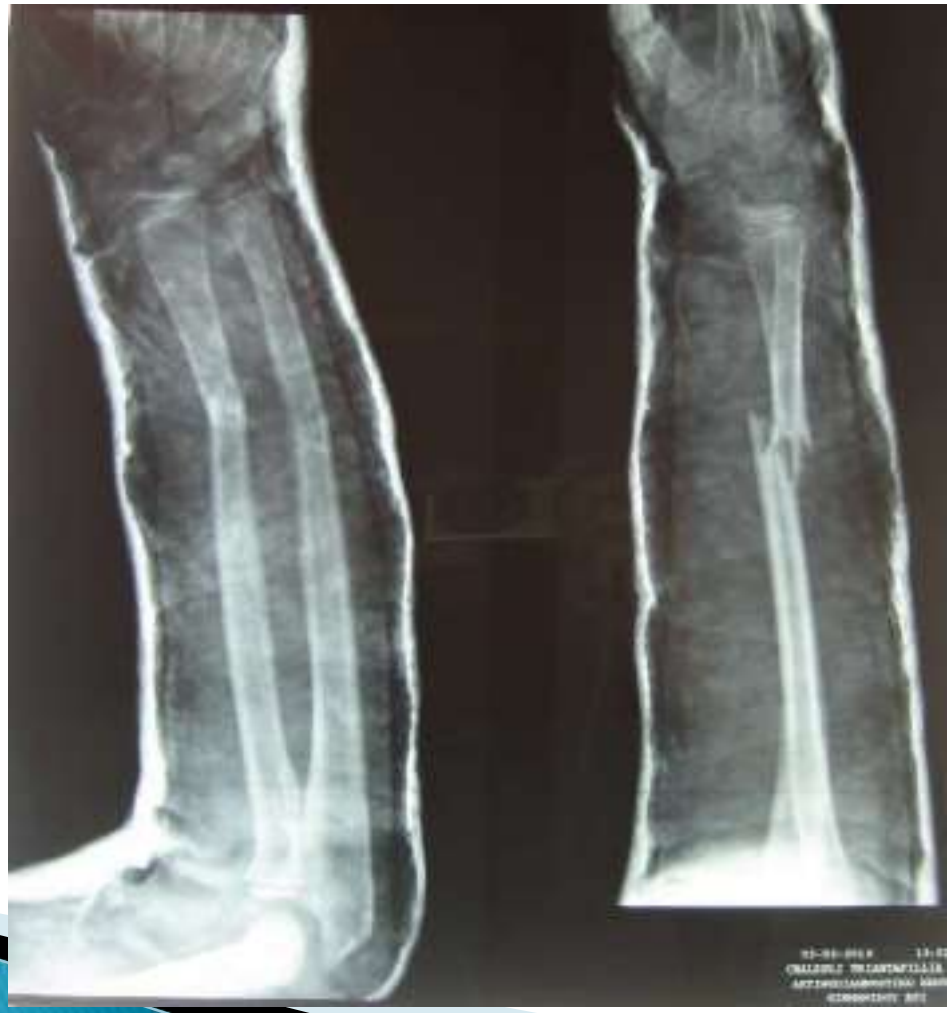
Fractures of the shaft radius ulna

- What is the next step ?



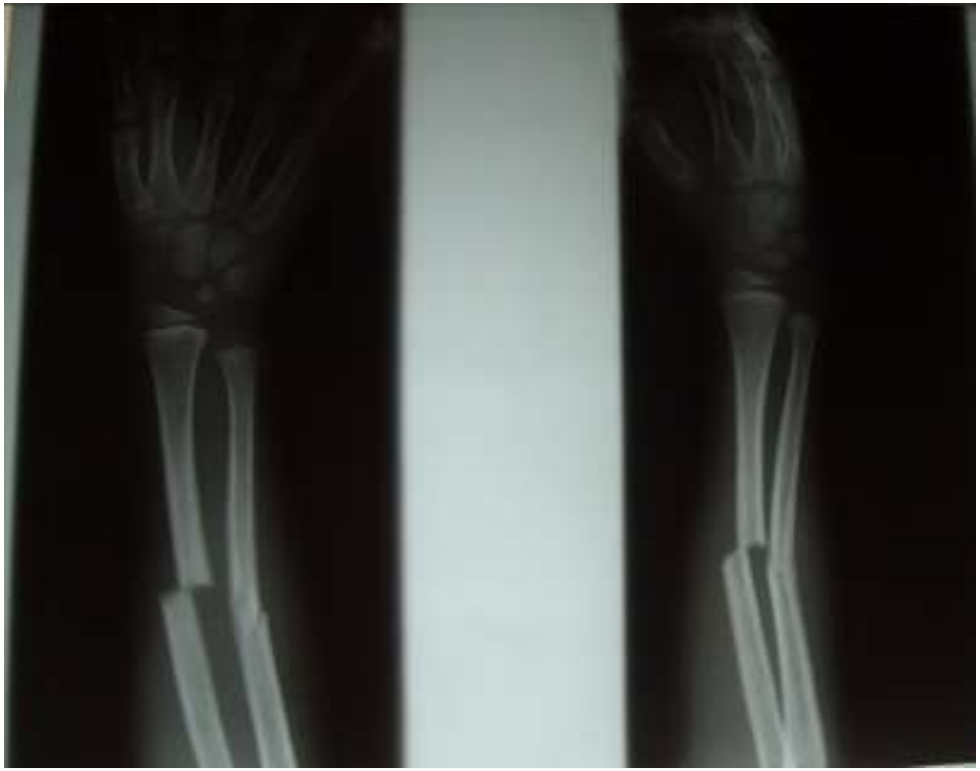
Fractures of the shaft radius ulna

- Choosing appropriate management



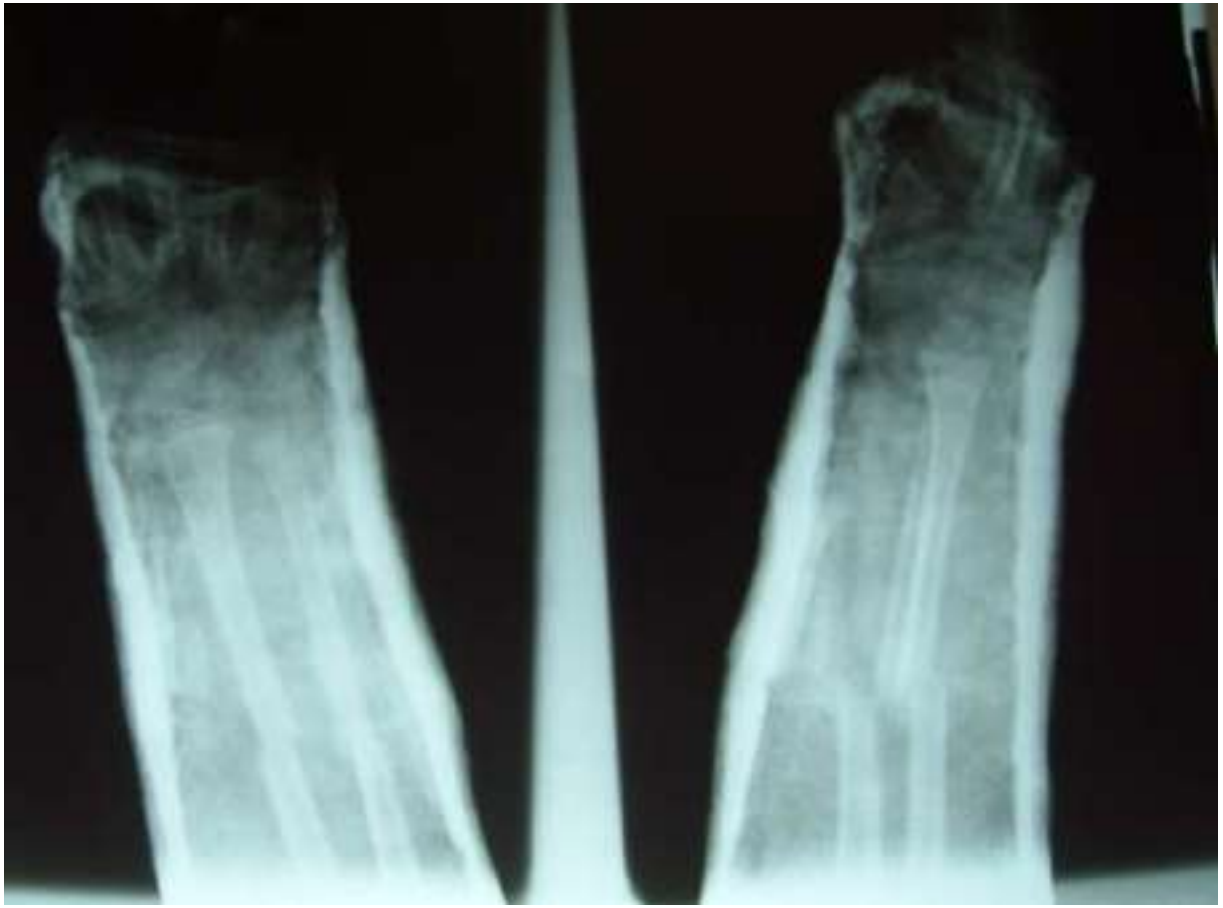
Fractures of the shaft radius ulna

initial picture Π Γ



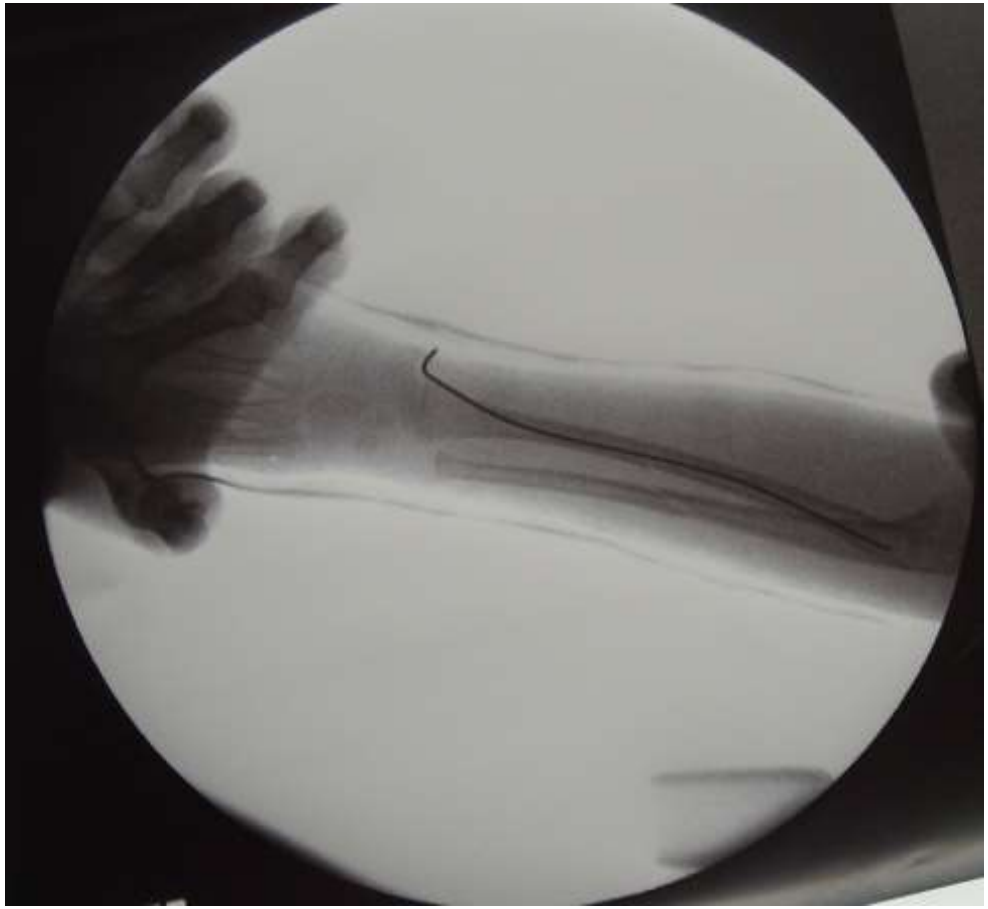
Fractures of the shaft radius ulna

reduction П Г



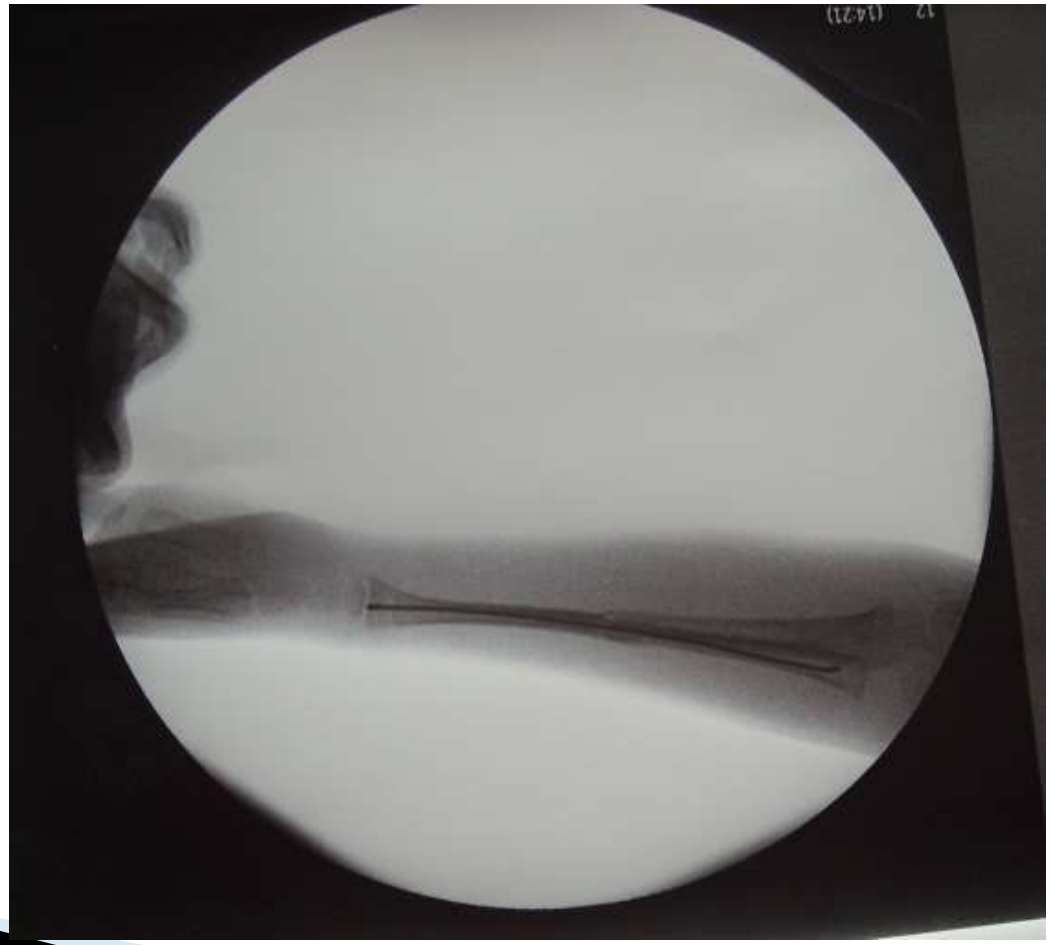
Fractures of the shaft radius ulna

management П Г 1



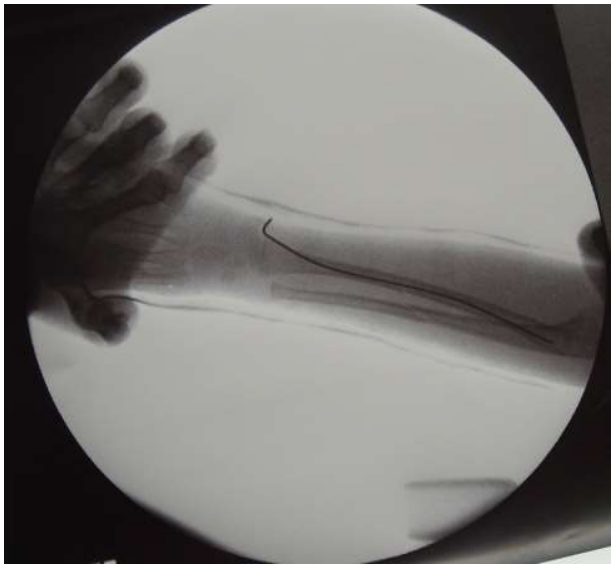
Fractures of the shaft radius ulna

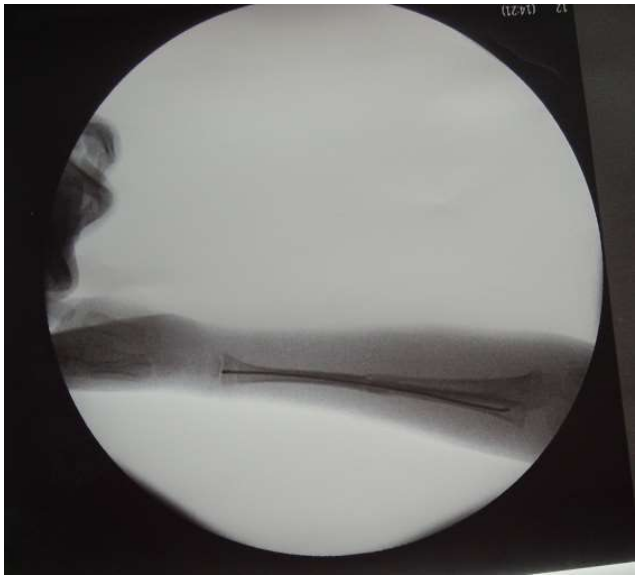
management П Г 2



Fractures of the shaft radius ulna

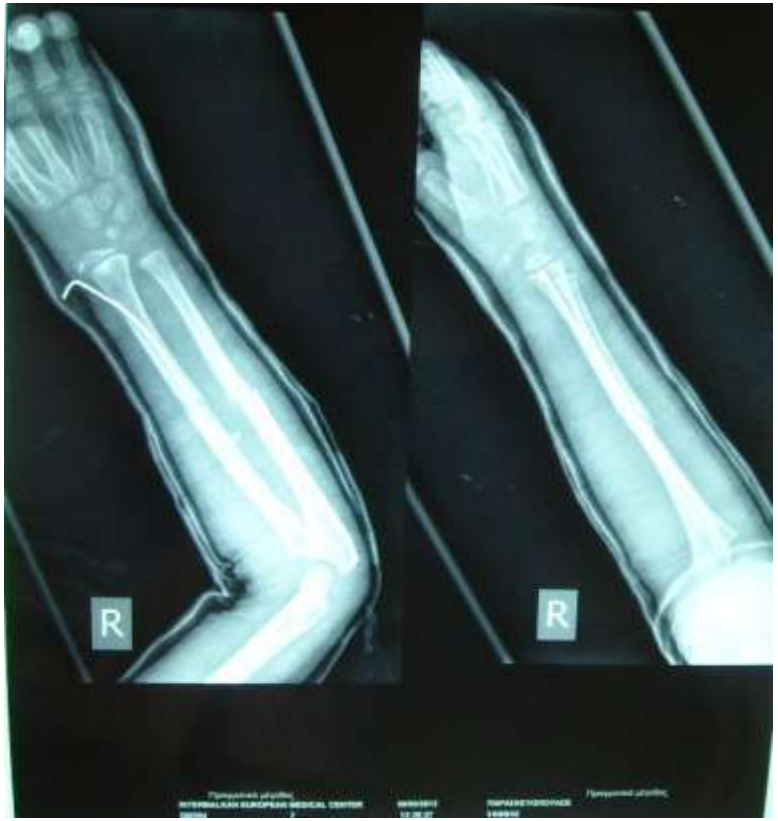
management П Г 3





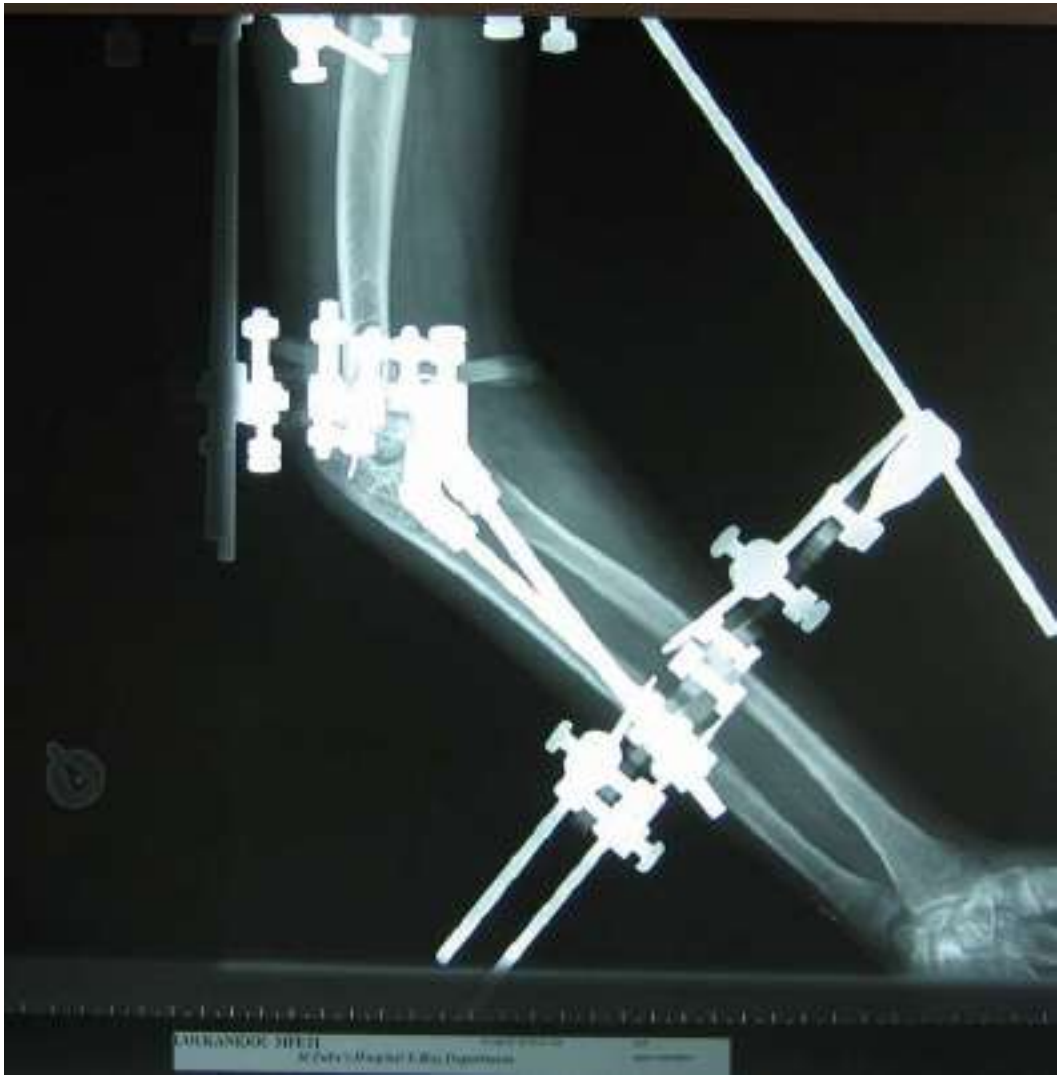
Fractures of the shaft radius ulna

final П Г

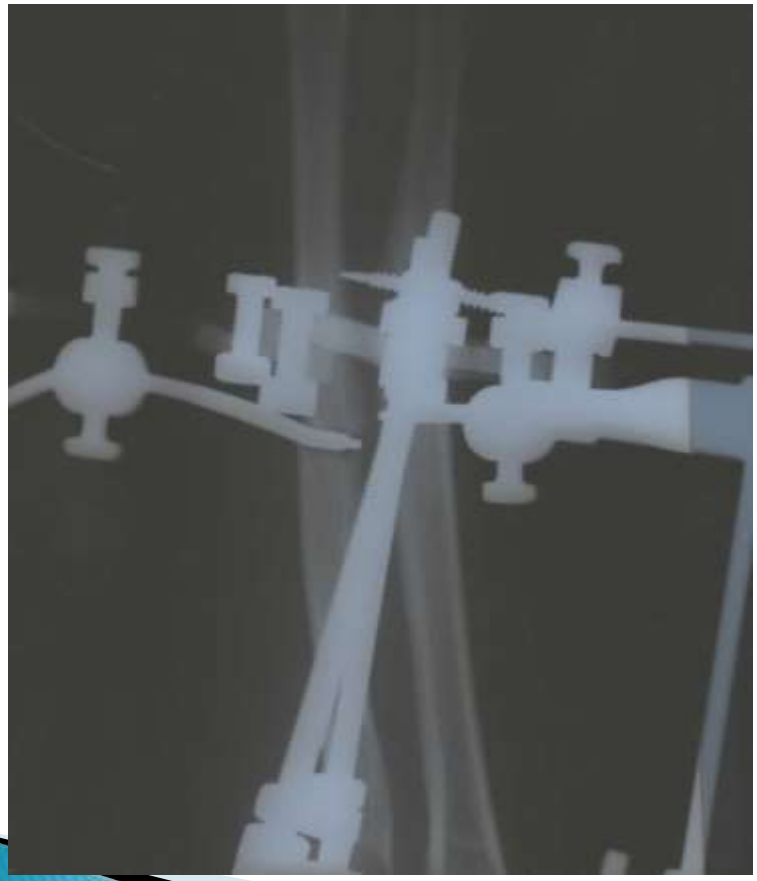


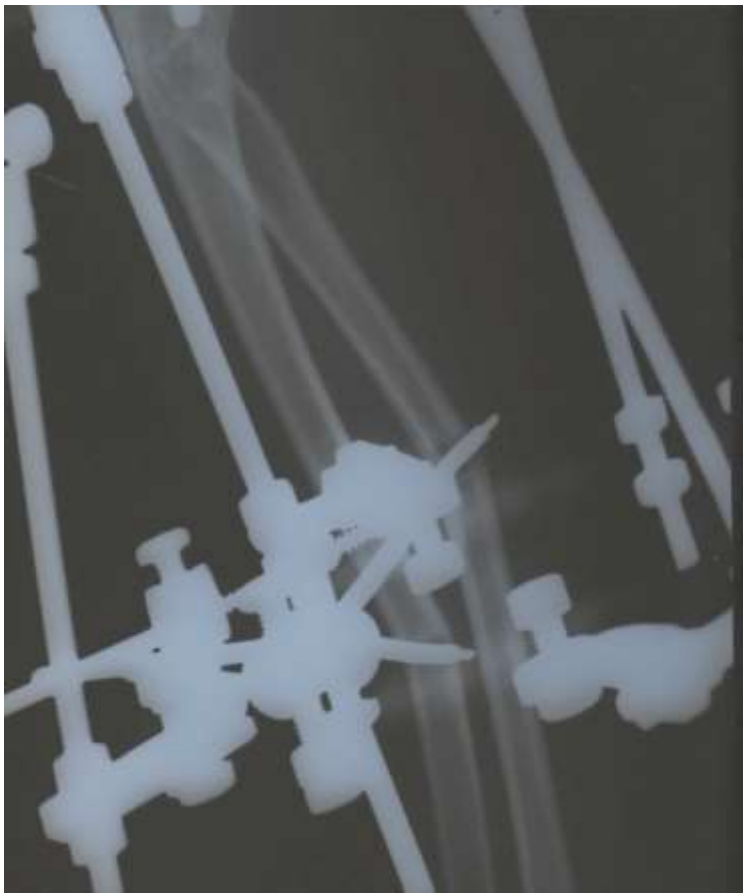
Elbow angylosis

- Application of Ilizarov device
- Proximal ring with half pins
- Distal ring with half pins
- Medial ring with wires

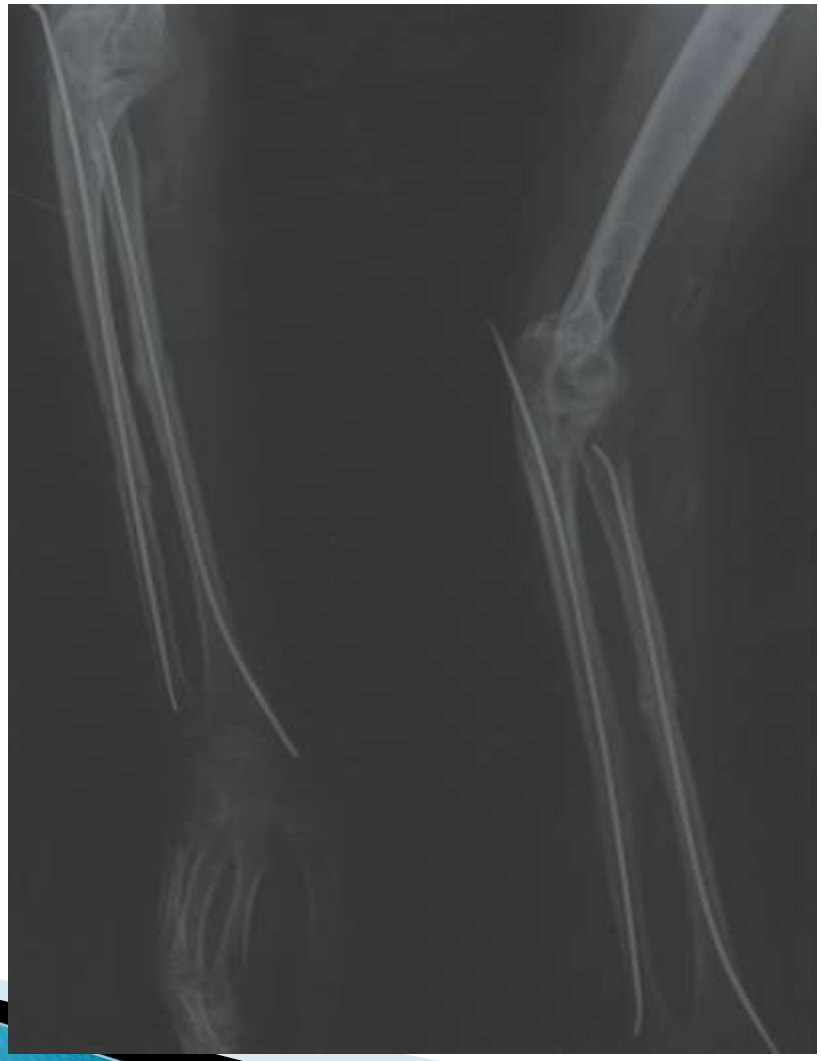


Celebration for the procedure RTA (motor bike)

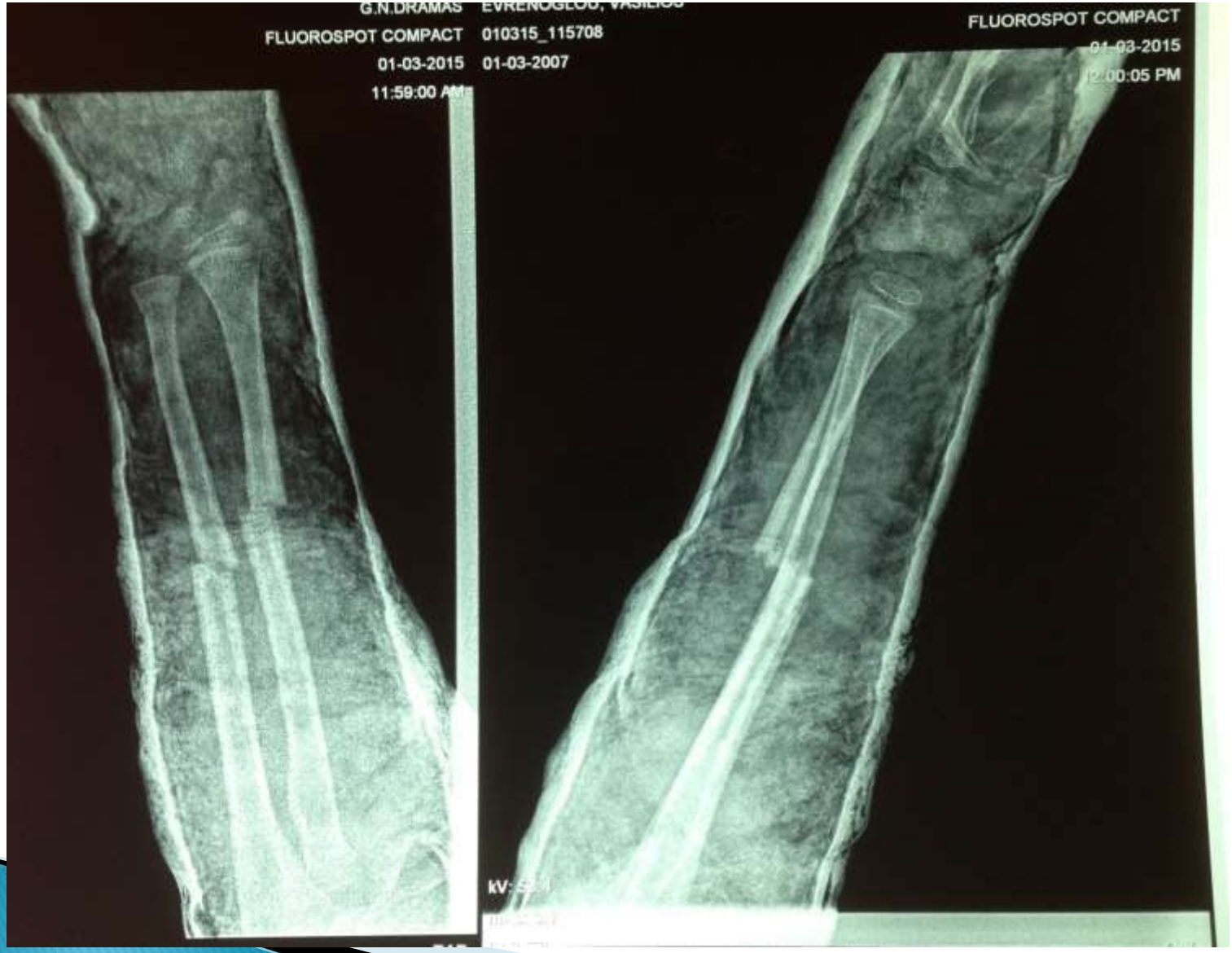




Union of the fracture

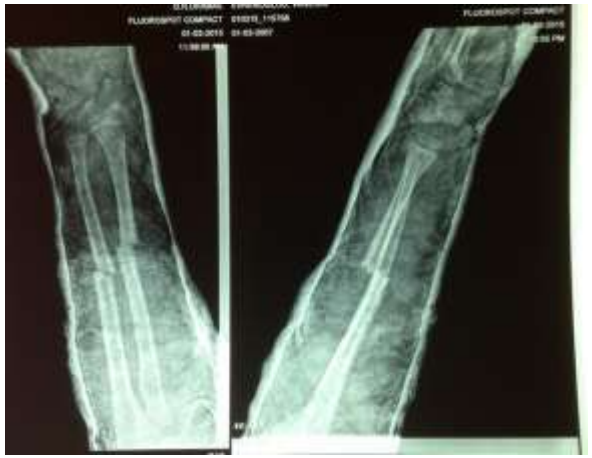


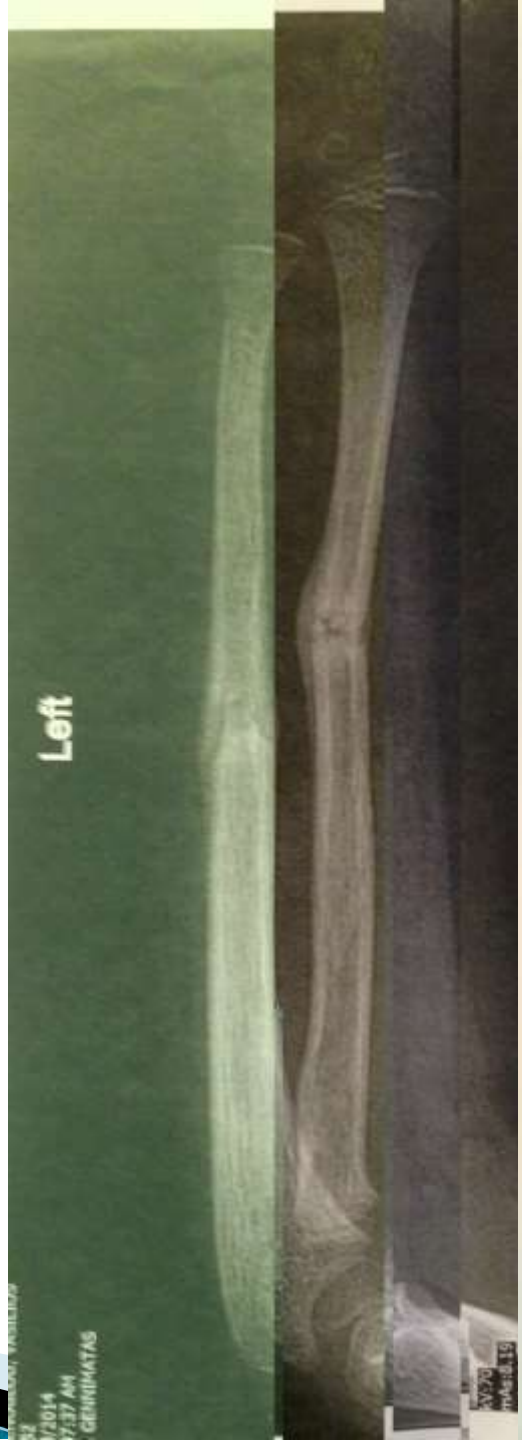
Fractures of the shaft radius ulna acceptable ? 1a

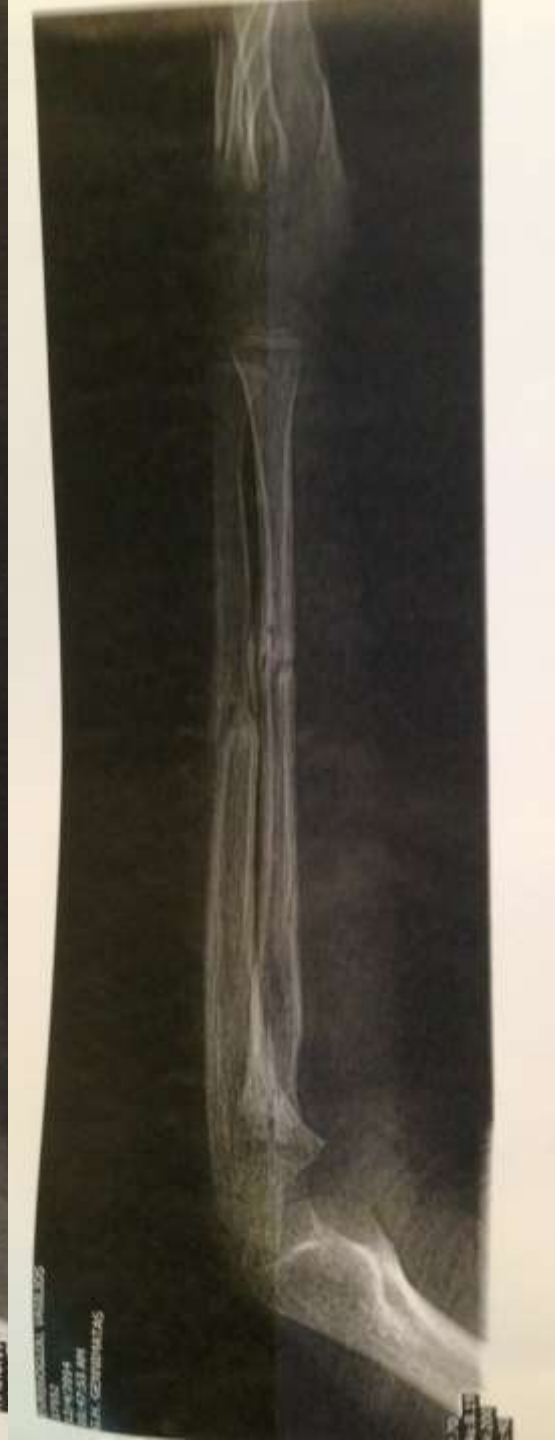


Fractures of the shaft radius ulna

final 1b

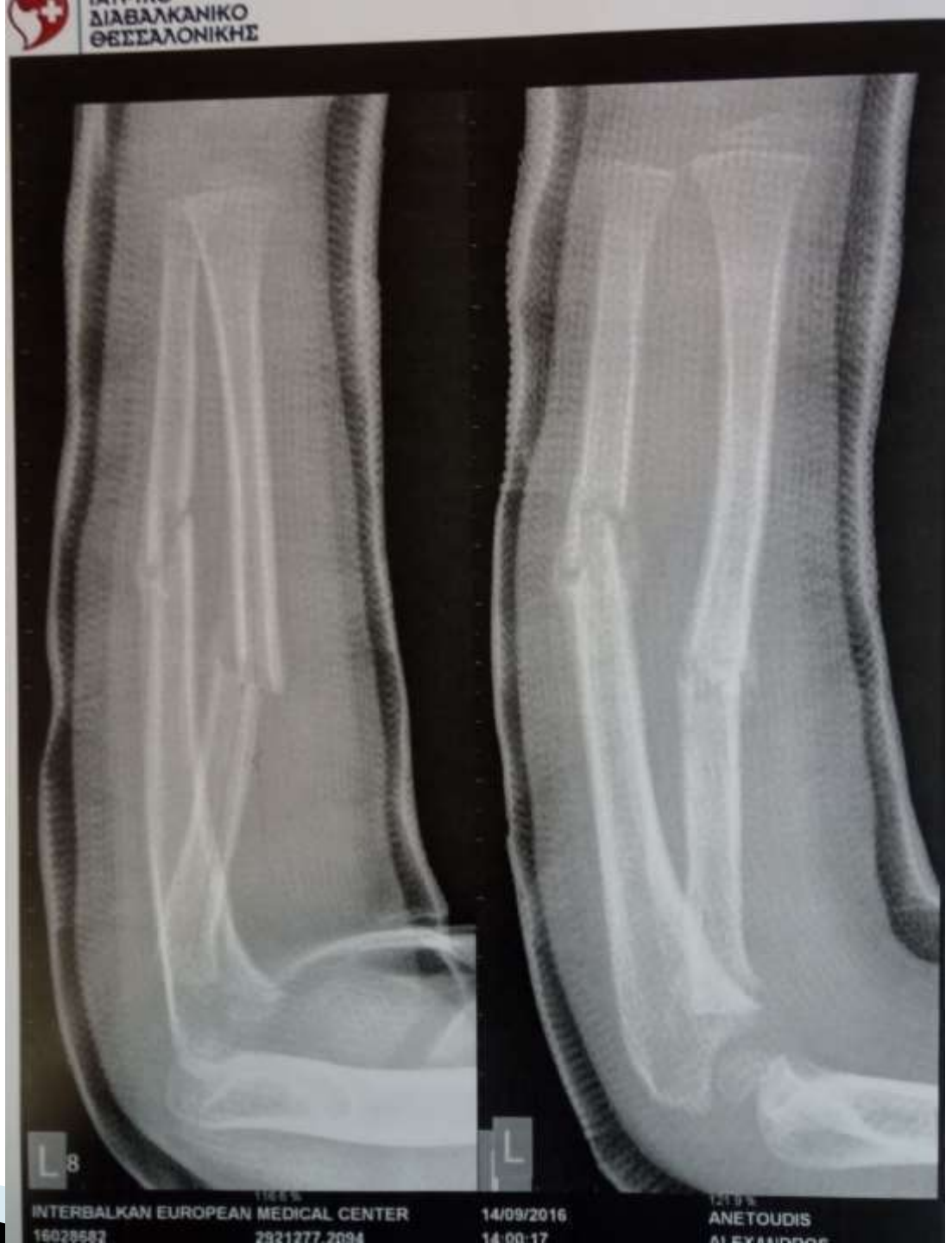






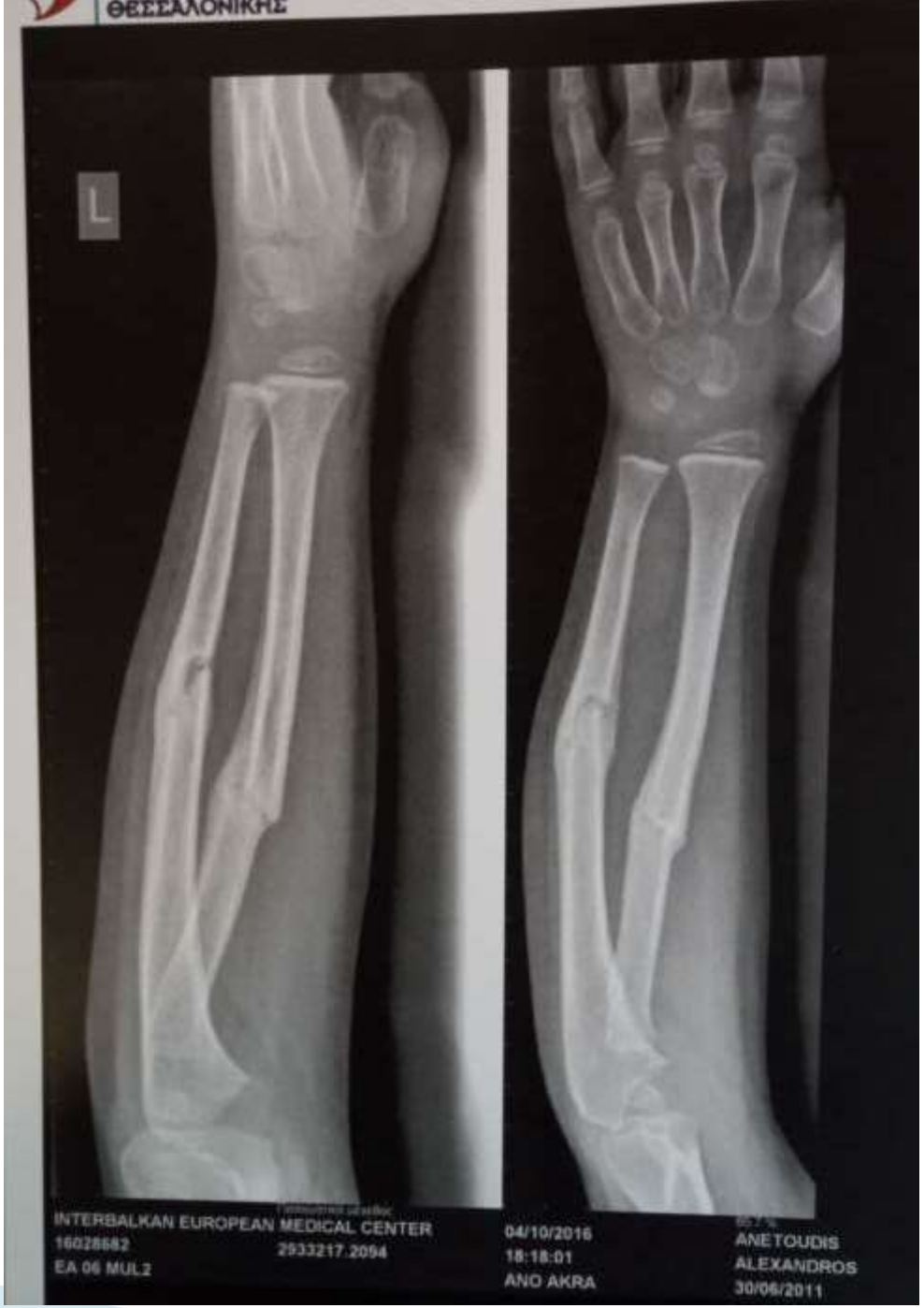
Choosing appropriate treatment

- Age
- Contact of bones
- Axis
- Interosseous distance



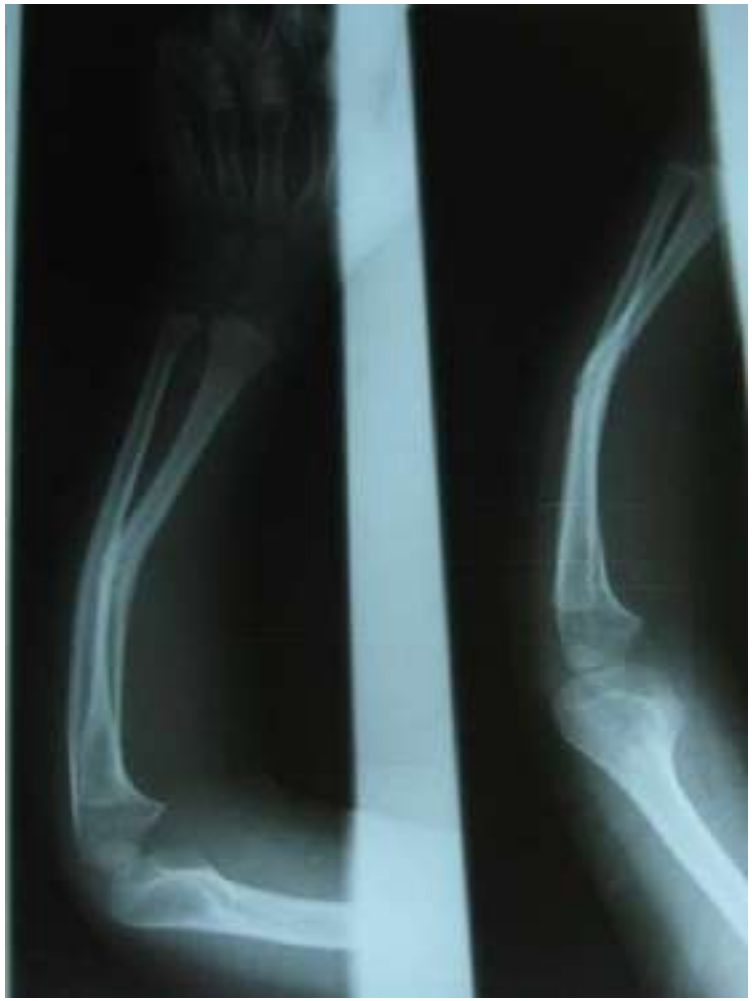
Axial deviation ?

- Age
- Contact of bones
- Axis
- Interosseous distance

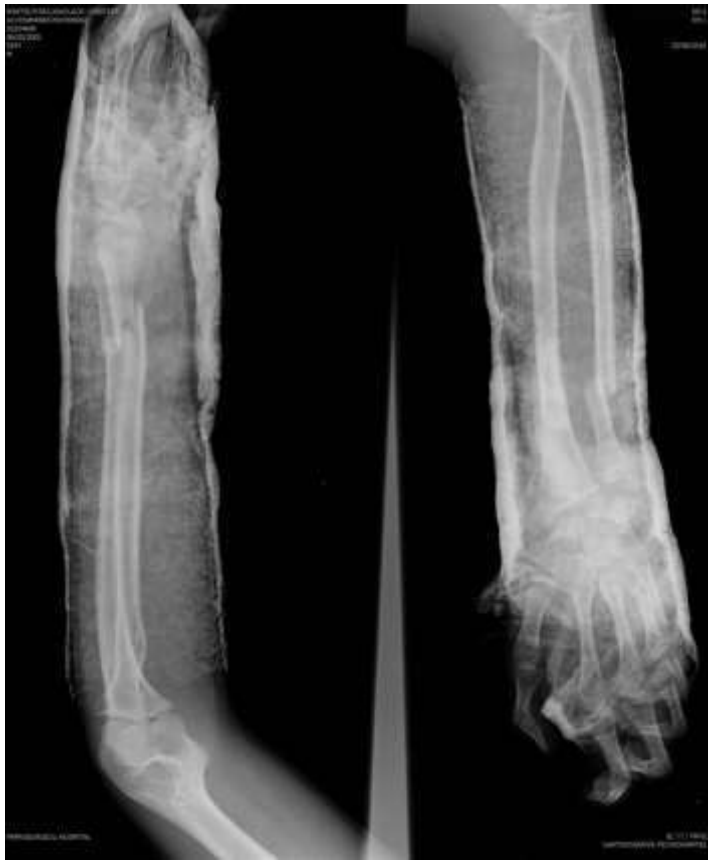


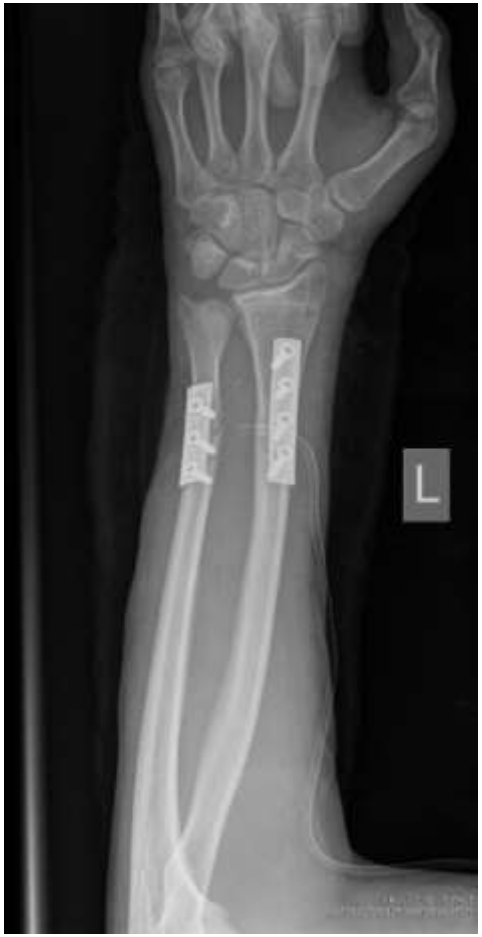
Plastic deformation

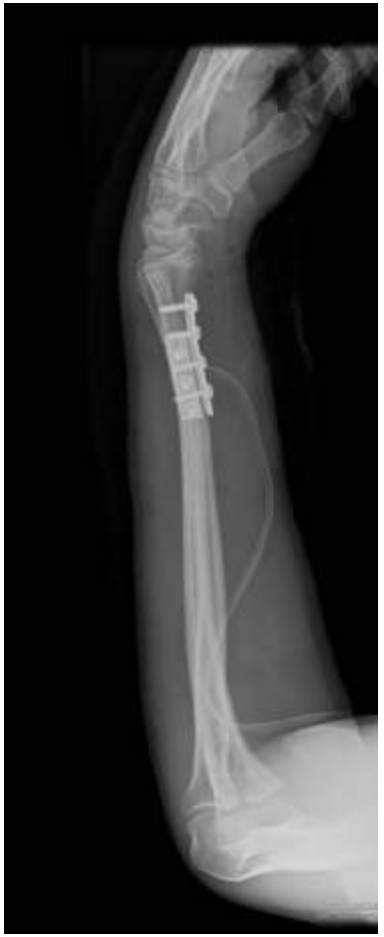
- Main complaint is the ulnar prominence



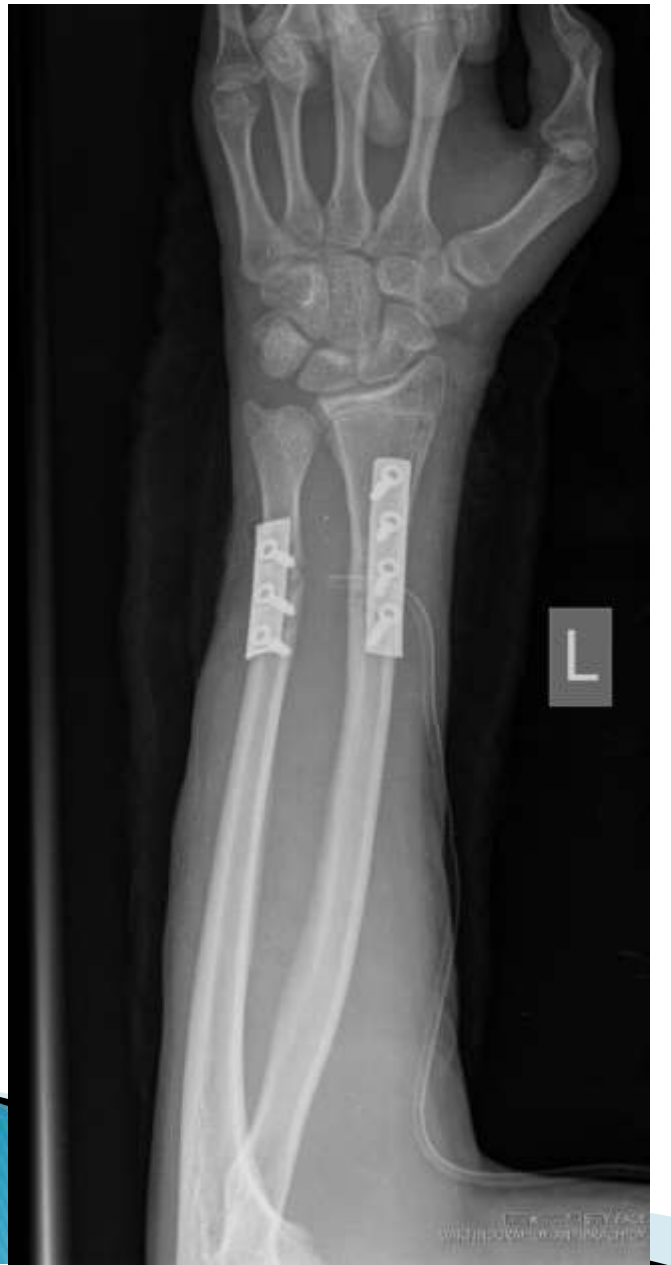
Plating for fractures of radius and ulna 1

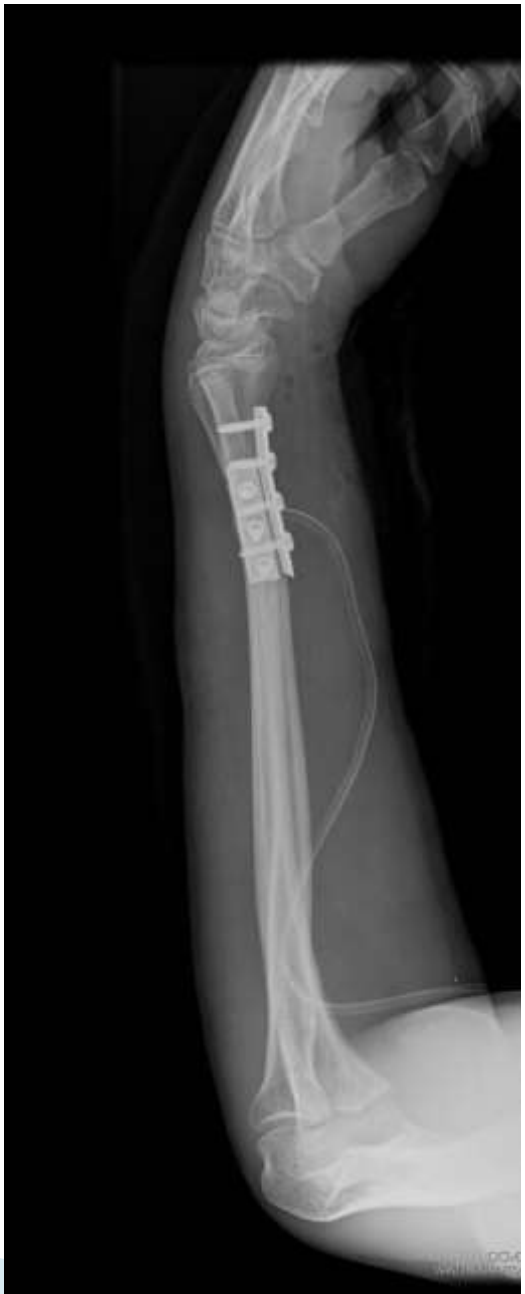




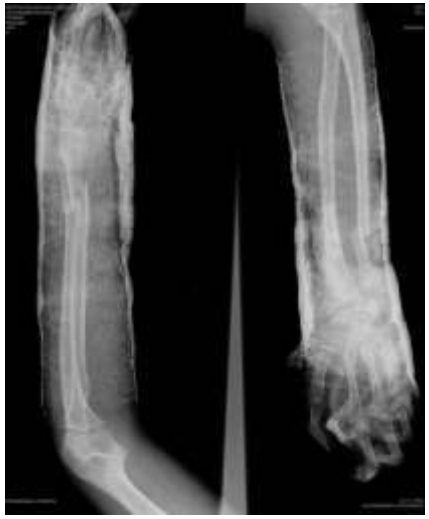


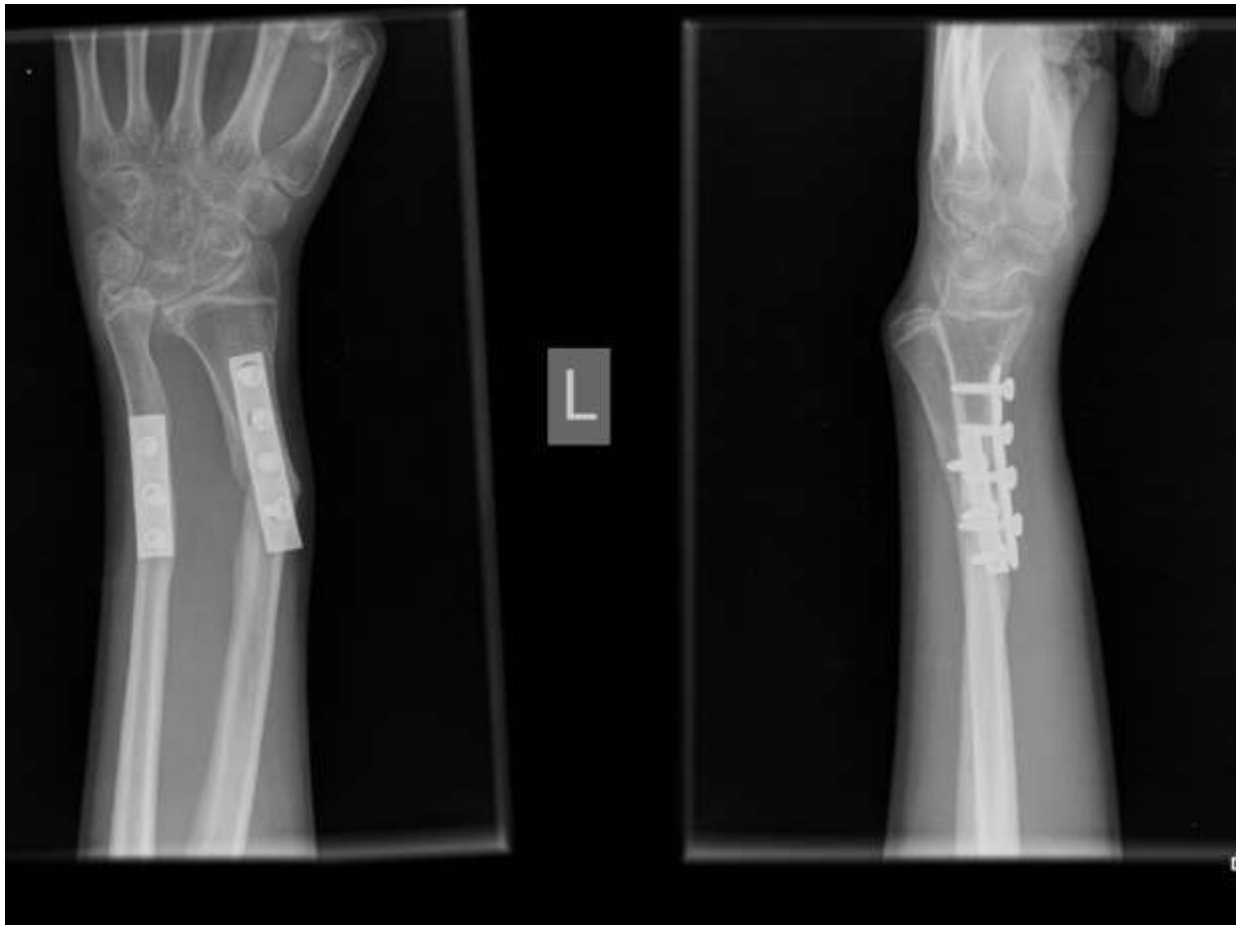
Plating for fractures of radius and ulna 2



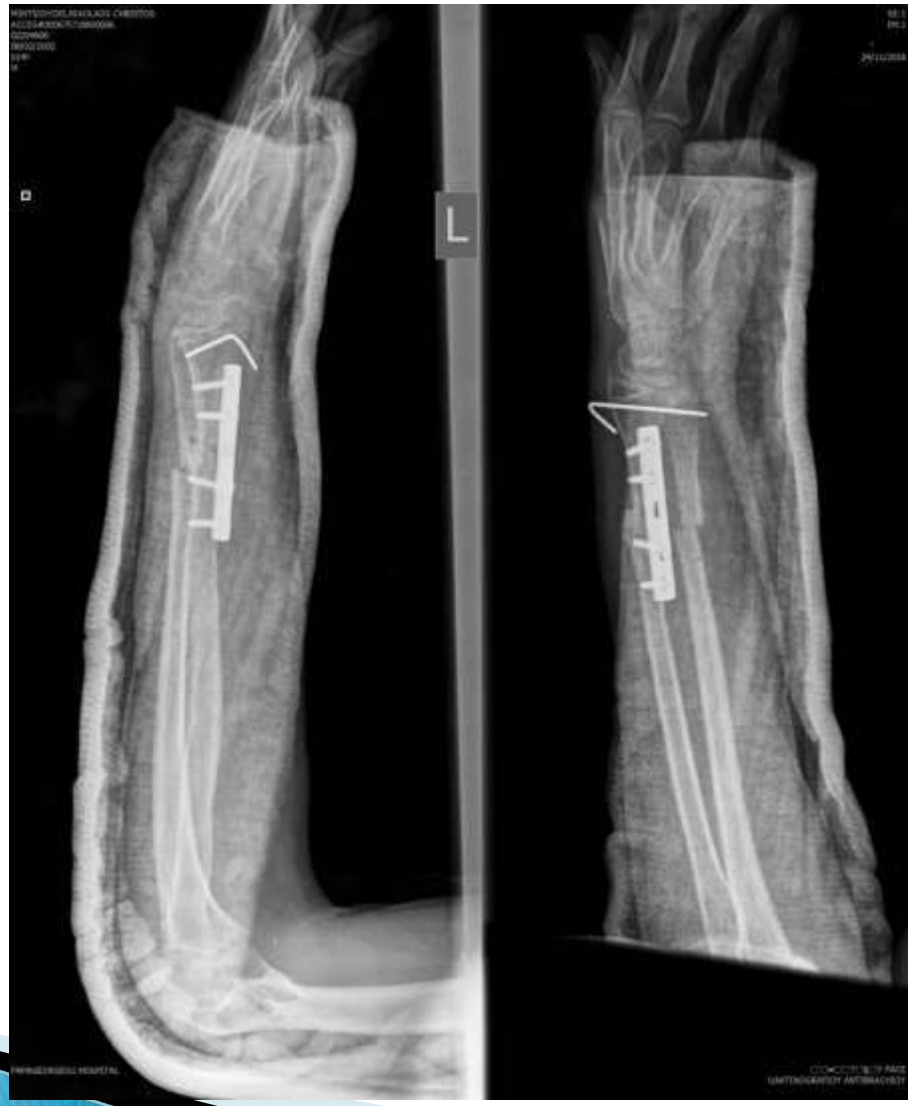


Plating for fractures of radius and ulna 3

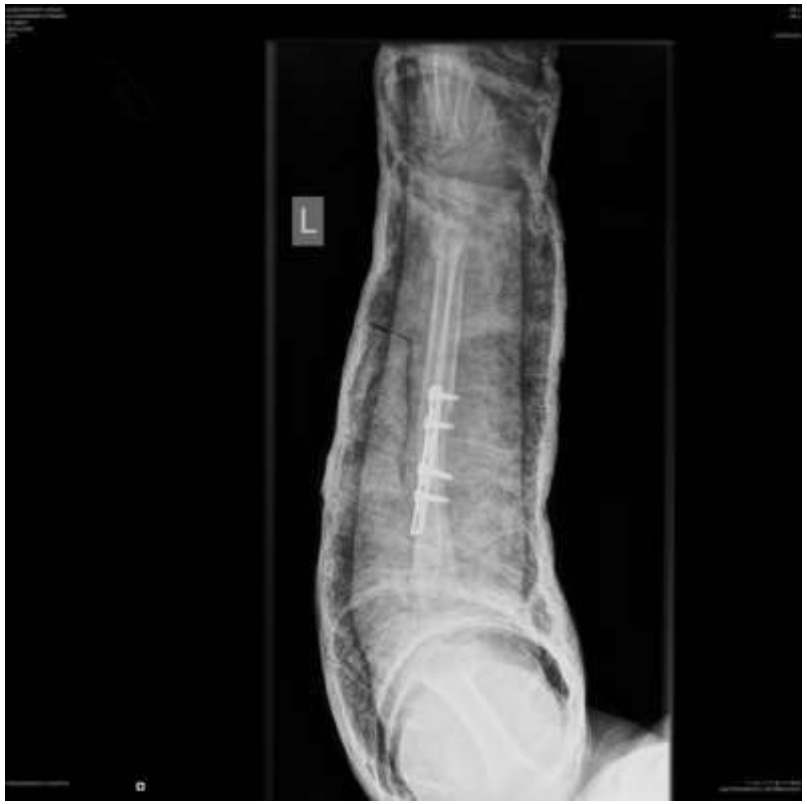


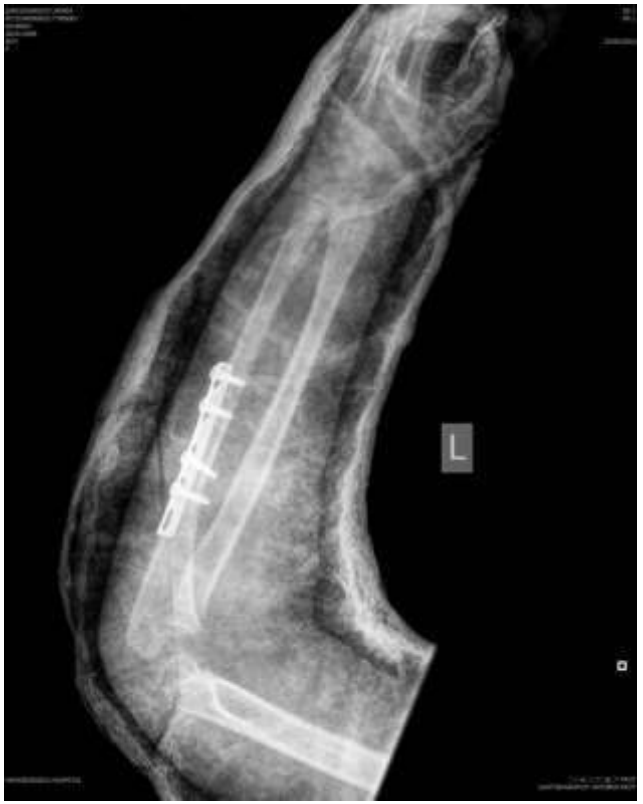


Plating for fractures of radius and ulna 4

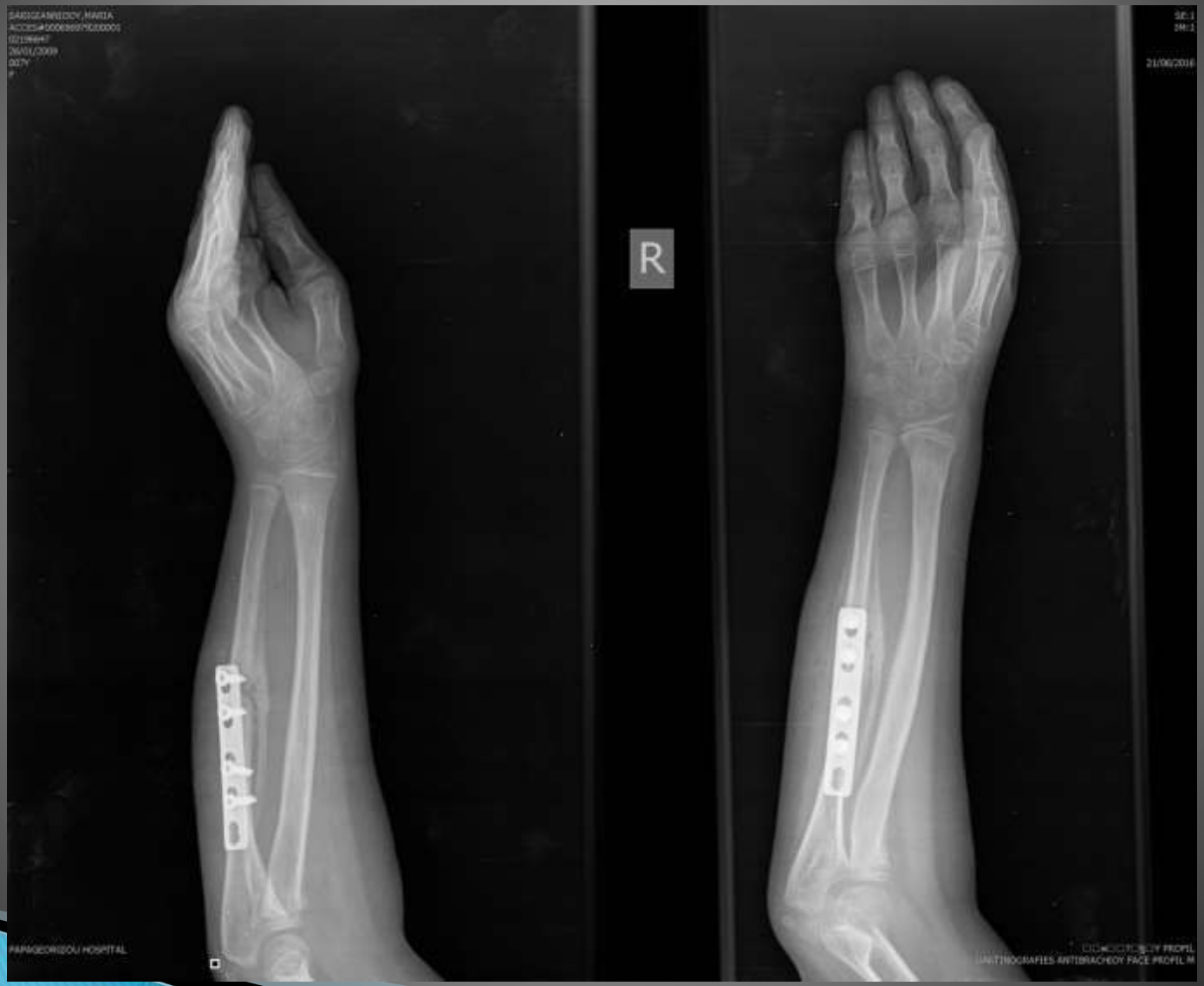


Plating one bone





Plating one bone



Surgical treatment for fractures of the shaft radius ulna

- Plates
- **ESIN**
- One bone or bilateral fixation
- K wires are the EXCEPTION
- Remodelling is LESS compared with distal fractures

- Orthop Rev (Pavia). 2014 Apr 22; 6(2): 5325.
- **Treatment of Diaphyseal Forearm Fractures in Children**
- Matthew L. Vopat,[1] Patrick M. Kane,[2] Melissa A. Christino,[2] Jeremy Truntzer,[2] Philip McClure,[2] Julia Katarincic,[2] and Bryan G. Vopat[2]
- Generally, these fractures can be successfully managed with closed reduction and casting, however operative fixation may also be required. The optimal method of fixation has not been clearly established. Currently, the most common operative interventions are open reduction with plate fixation *versus* closed or open reduction with intramedullary fixation.

- Injury. 2014 Aug;45(8):1135-43. doi: 10.1016/j.injury.2014.04.020. Epub 2014 May 2.
- **Systematic review: functional outcomes and complications of intramedullary nailing versus plate fixation for both-bone diaphyseal forearm fractures in children.**
- Patel A[1], Li L[2], Anand A[1]
- There were no statistically significant differences in functional outcome or time to fracture union between plating and IM nailing. No consistent difference was found in complication rate, fracture angulation, shortening or rotation. Better cosmesis and shorter duration of surgery was noted in the IM nailing group. Post-operative radial bow was significantly abnormal in the IM nailing groups, but did not affect forearm movement

ESIN

- J Pediatr Orthop B. 2009 Nov;18(6):289-95..
- **Nonunion of forearm shaft fractures in children after intramedullary nailing.**
- Fernandez FF[1], Eberhardt O, Langendörfer M, Wirth TZ

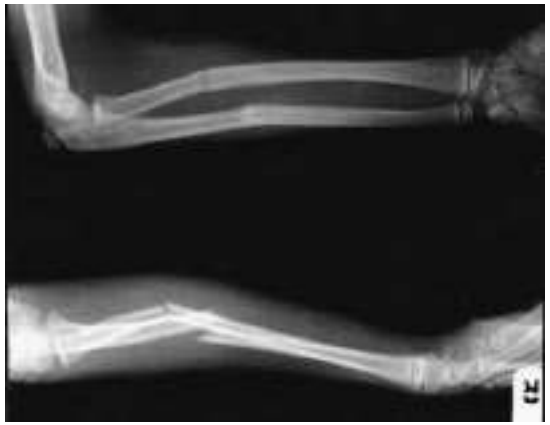
- Orthop Unfall. 2013 Aug;151(4):364-70
- **[Pseudarthrosis following surgically treated forearm fractures in children and adolescents].**
- Fernandez Fernandez F[1], Langendörfer M, Wirth T, Eberhardt O.

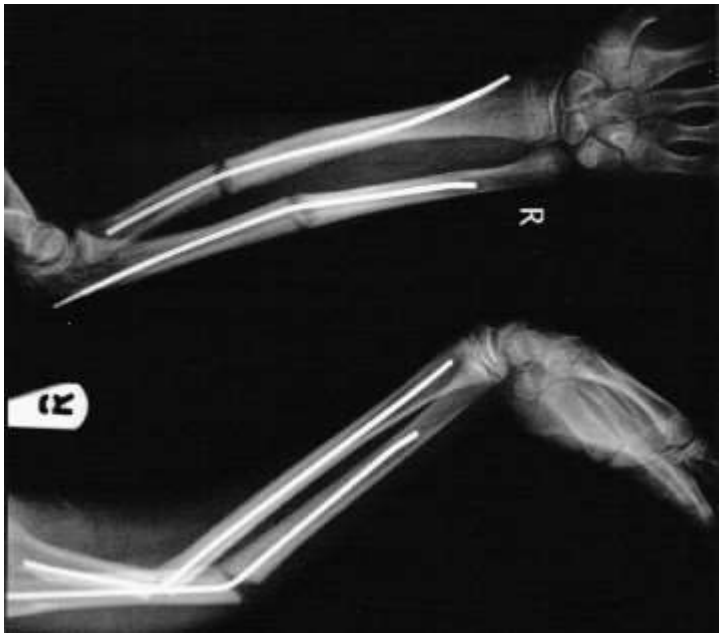
CASE REPORT

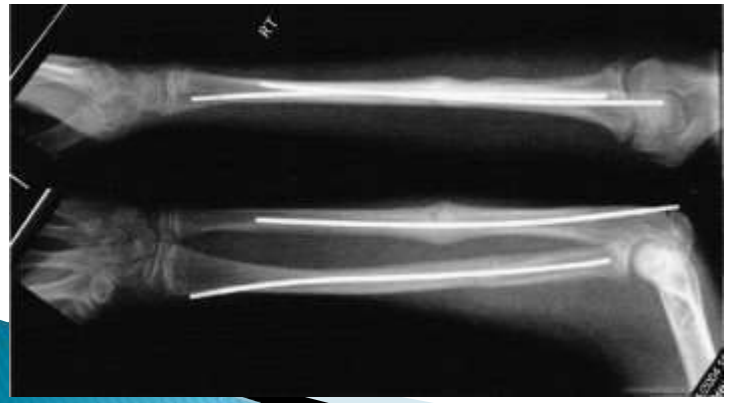
Use of ESIN in forearm fractures in children: Does keeping the nail in situ longer prevent refractures?

Manish Changulani , Neeraj Garg, Colin E. Bruce

Injury Extra
Volume 37, Issue 4, April 2006, Pages 151-15







Fractures of shaft of radius and ulna
displacement angulation

- Up to 10d in the frontal and lateral
- Overriding of fragments NOT accepted

- Price and Scott JPO 1990

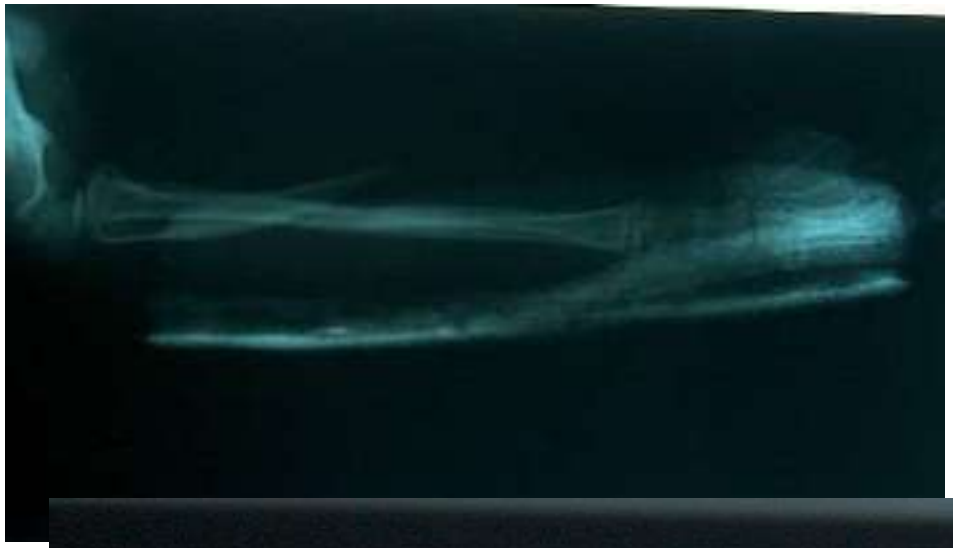
Functional impairment following malunion

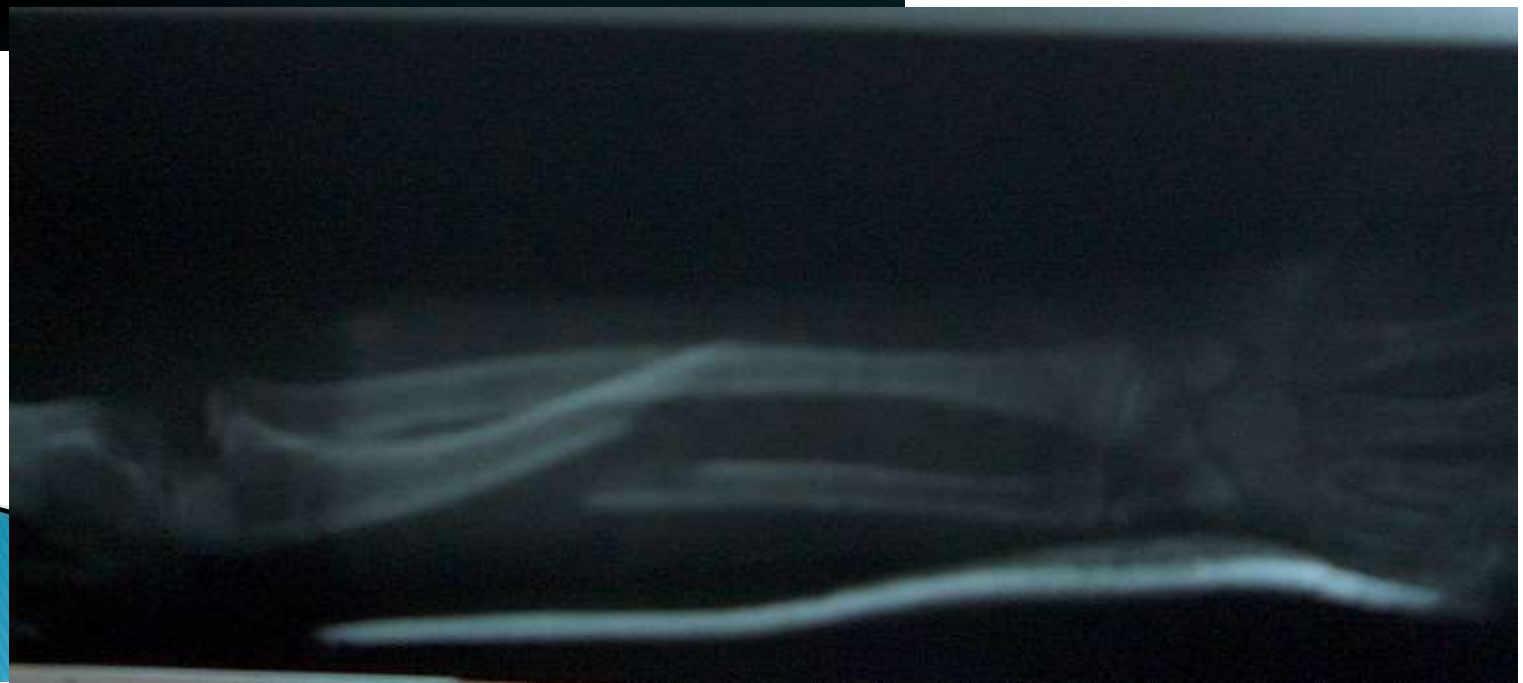
- Malunion does not correlate with functional deficit
- Few children are treated for malunion

- Price

- Acta Orthop. 2017 Feb; 88(1): 101–108.
- Published online 2016 Nov 14.
  doi: 10.1080/17453674.2016.1255784
- PMCID: PMC5251255
- **Predictive factors for re-displacement in diaphyseal forearm fractures in children—role of radiographic indices**
- Shadi Asadollahi,[1] Masoumeh Pourali,[2] and Kamran Heidari
- Our results suggested that fractures with a higher degree of initial angulation and non-anatomical reduction more often result in re-displacement. Moreover, the casting quality examined with the radiographic indices played an important role in the success of a non-operative management.

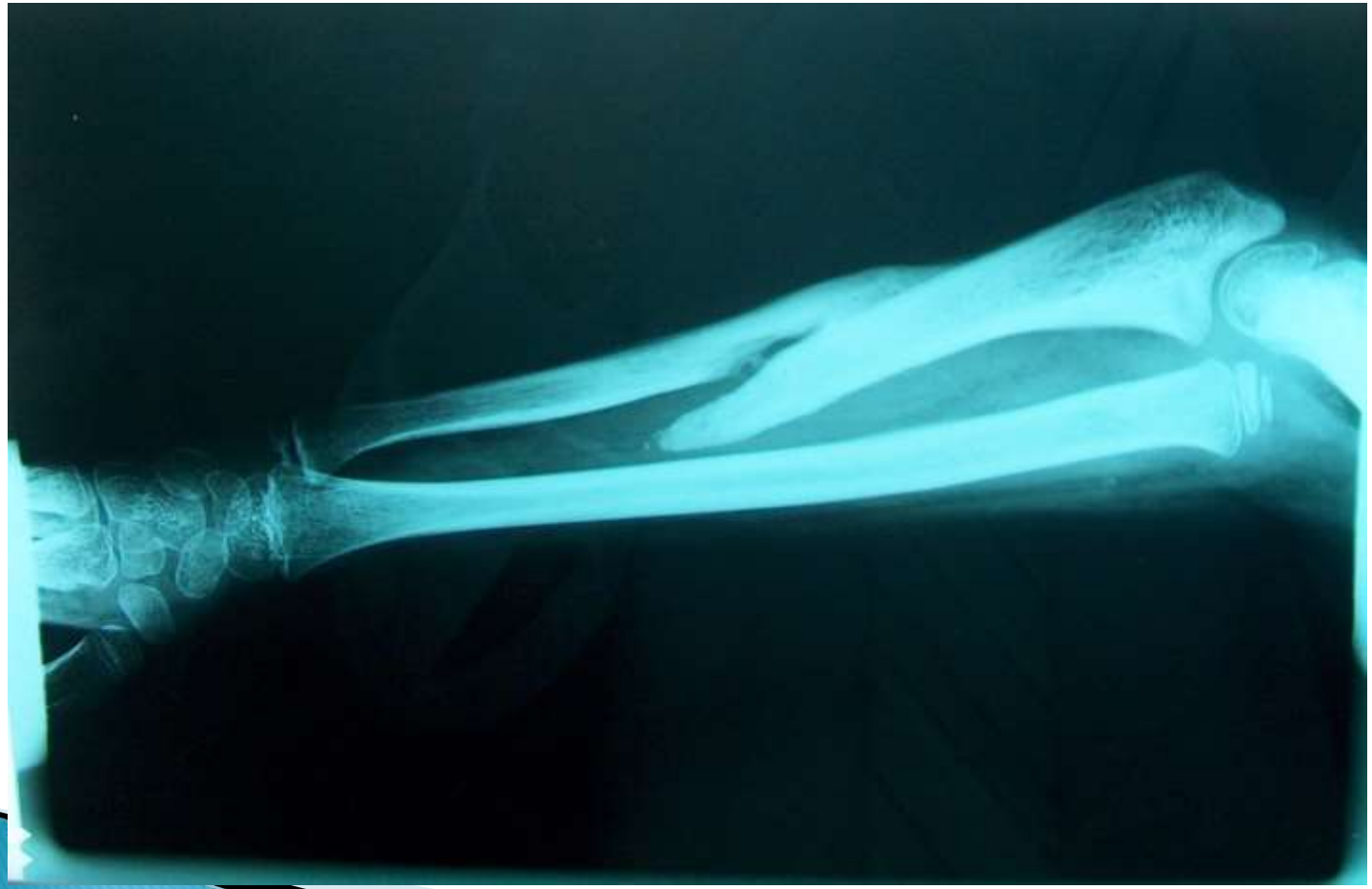
Fracture and displacement of the ulna



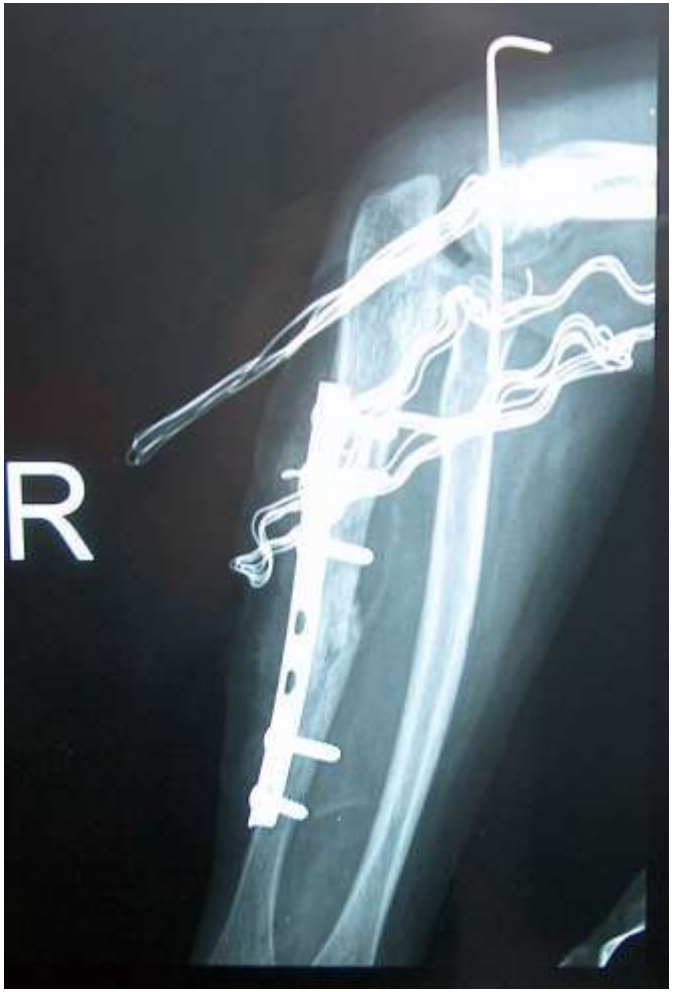


- Elbow examination

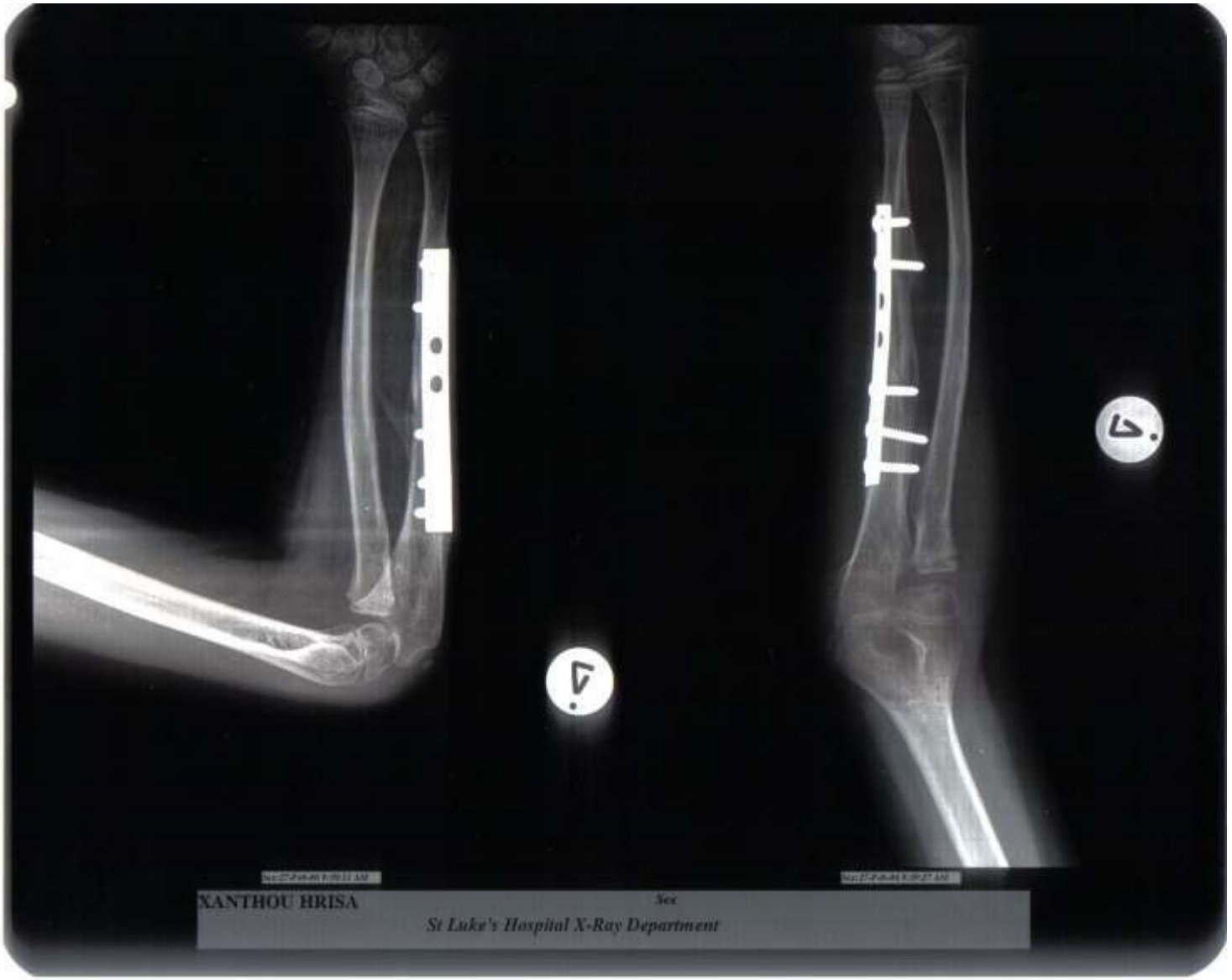
Radial head dislocation
Monteggia



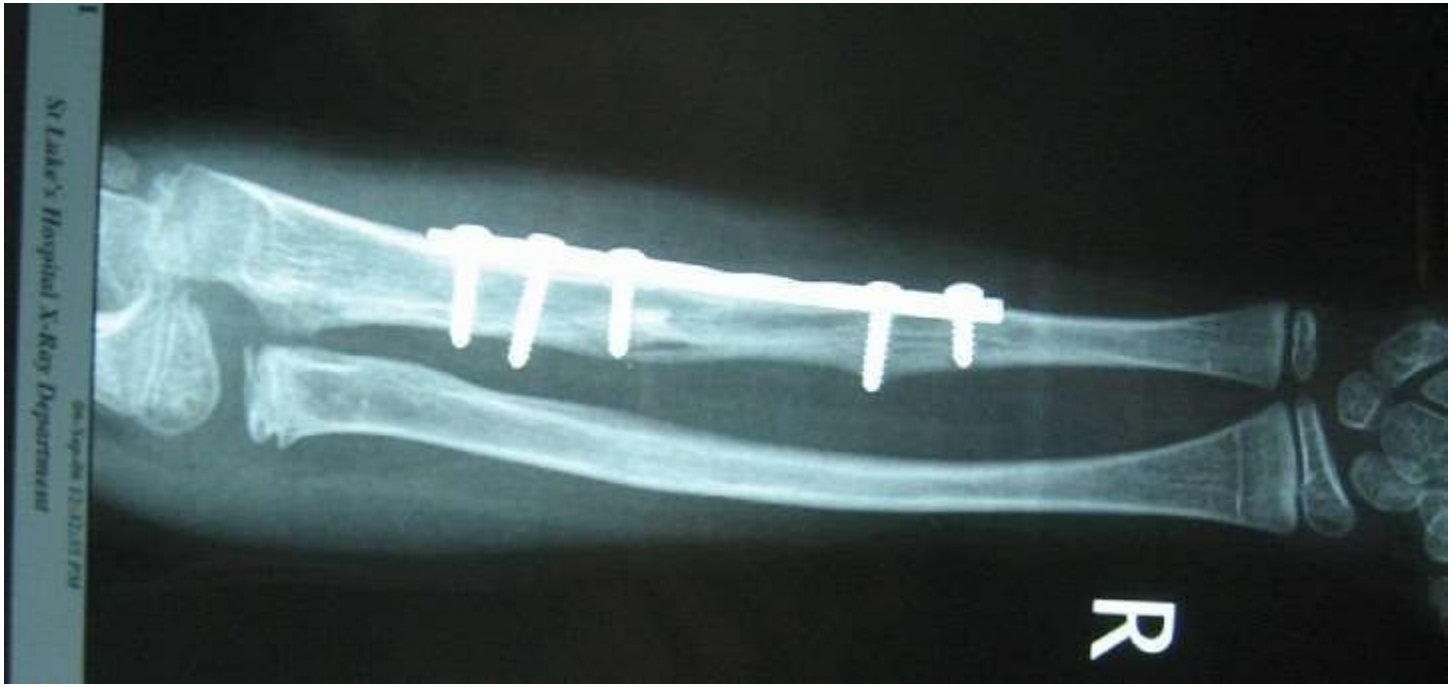
Εξάρθρημα κεφαλής κερκίδος



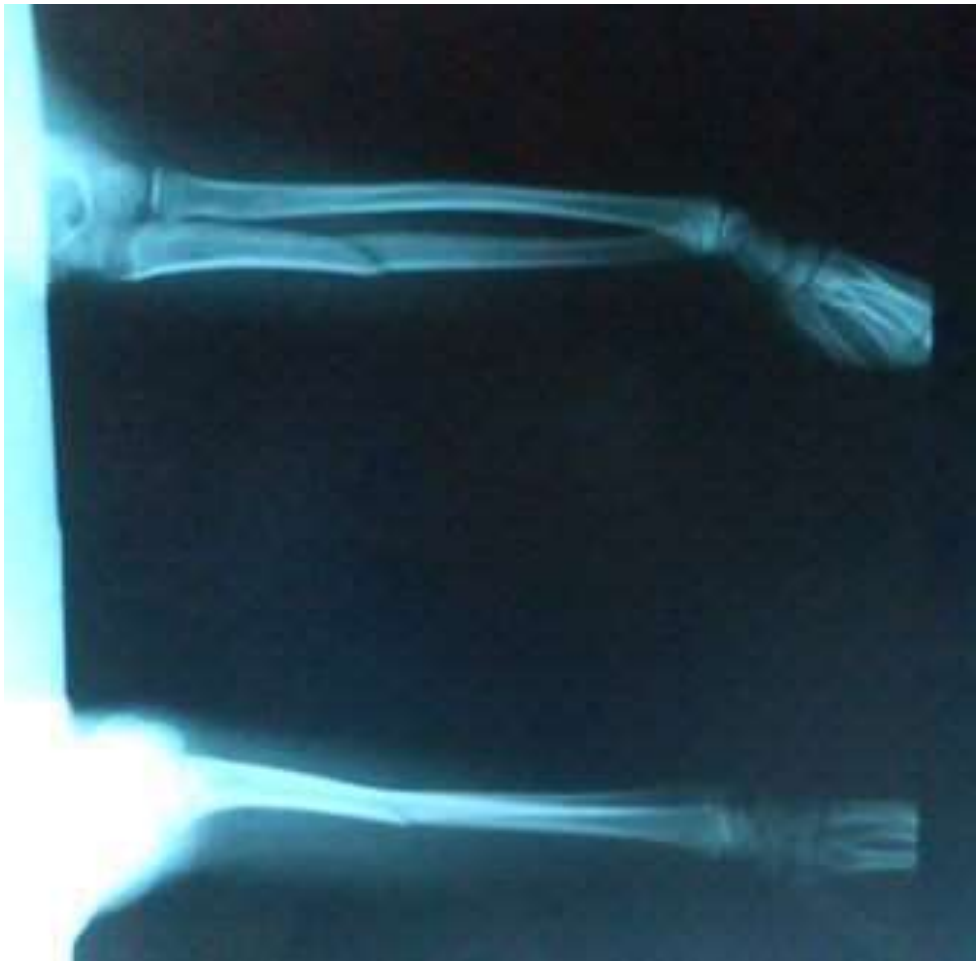
Monteggia fracture



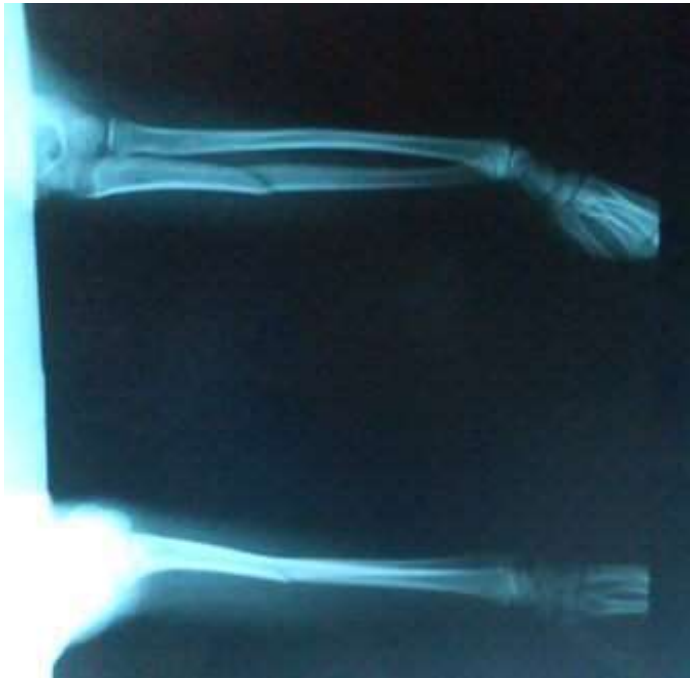
Monteggia fracture

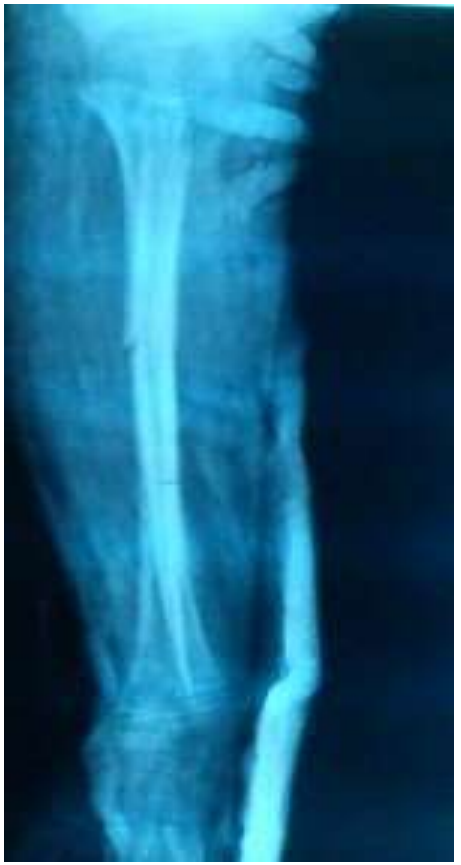


Κάταγμα ωλένης
ulnar fracture

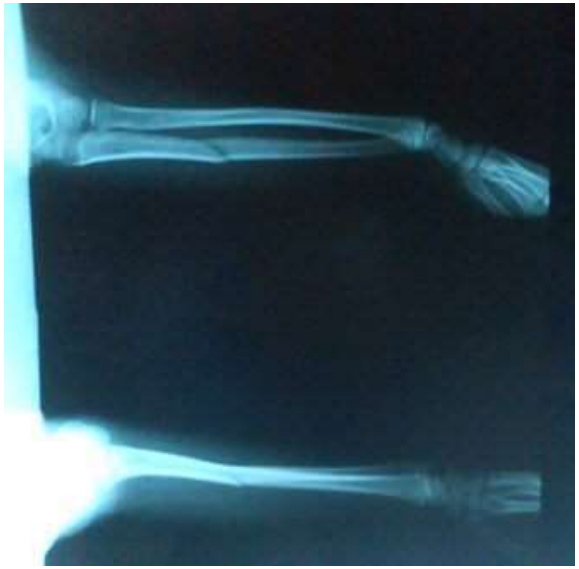


Κάταγμα ωλένης αντιμετώπιση
ulnar fracture management?

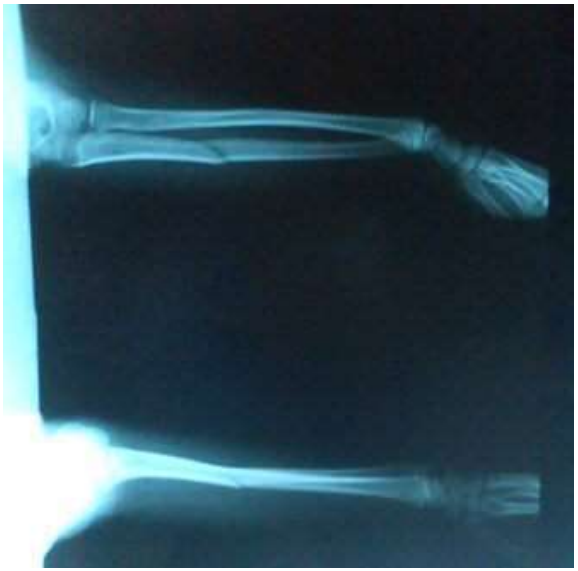


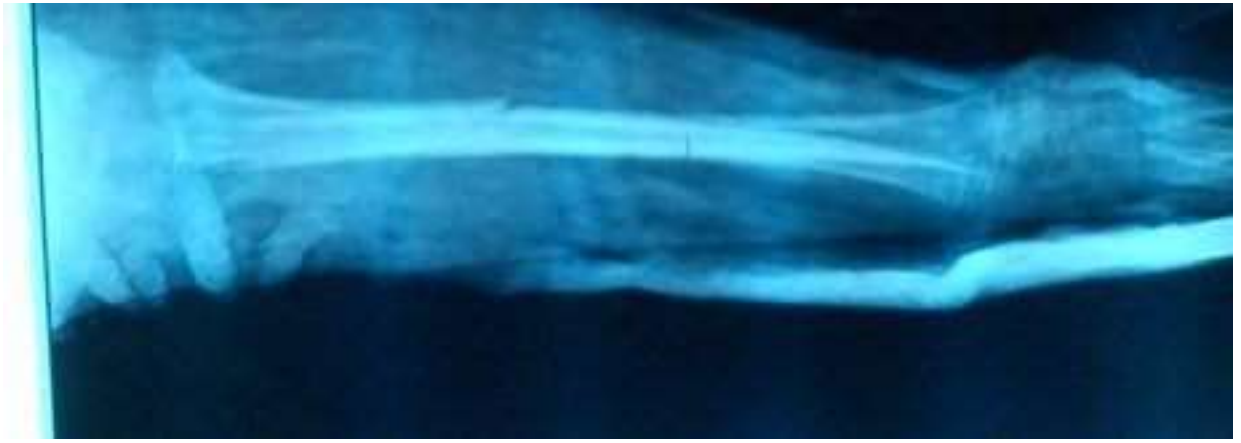


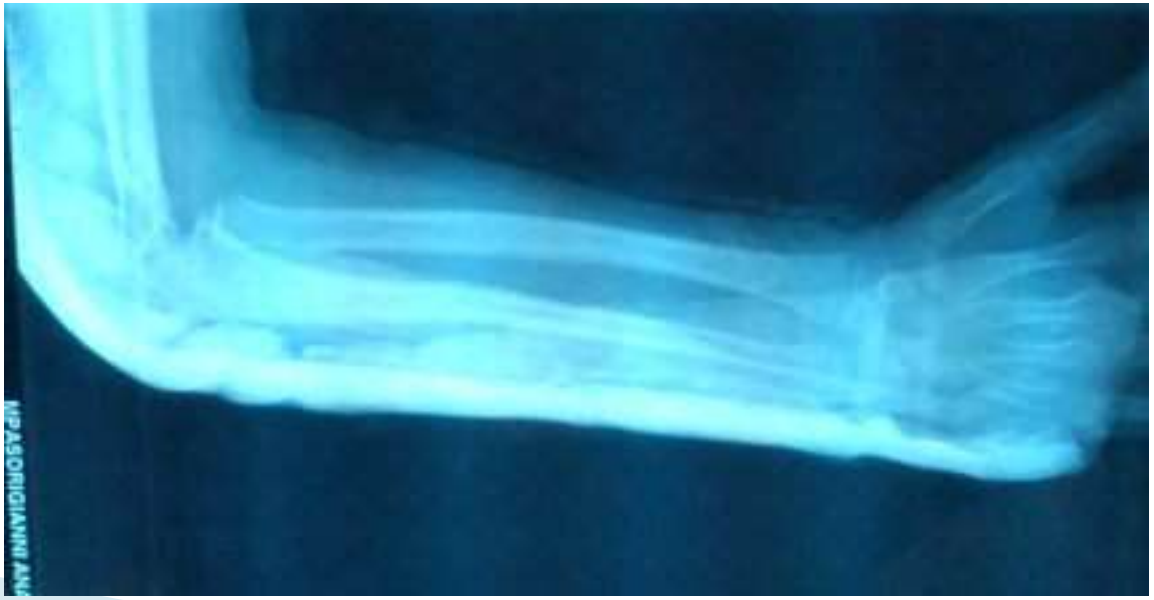
Κάταγμα ωλένης αποτέλεσμα ?
Ulnar fracture result



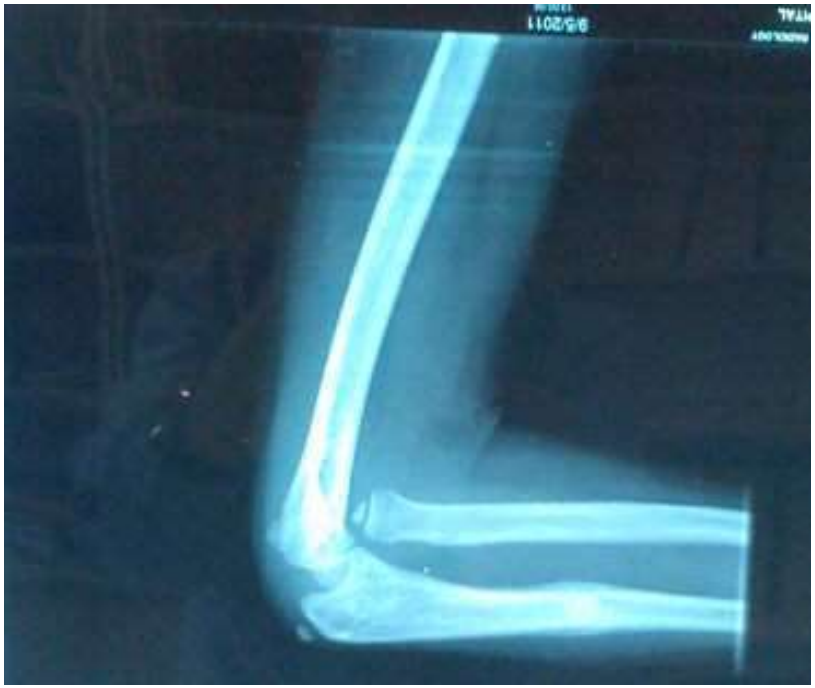
Ulnar fracture reconsider xrays

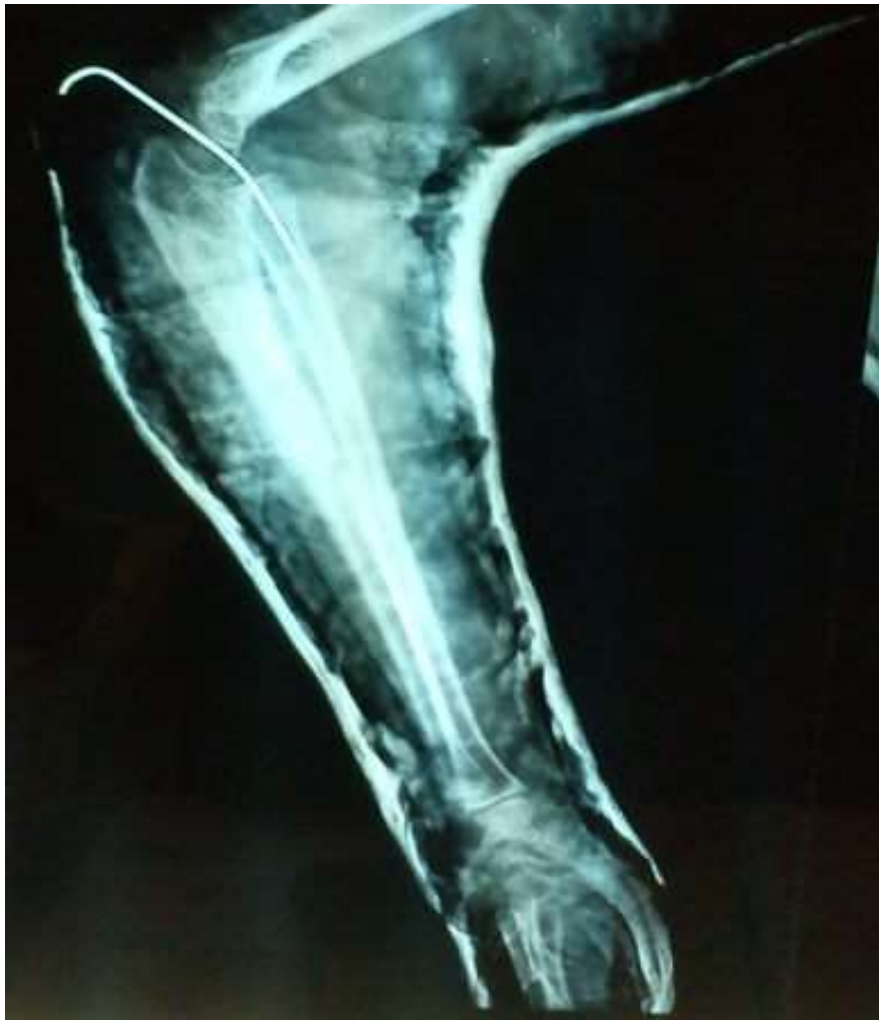




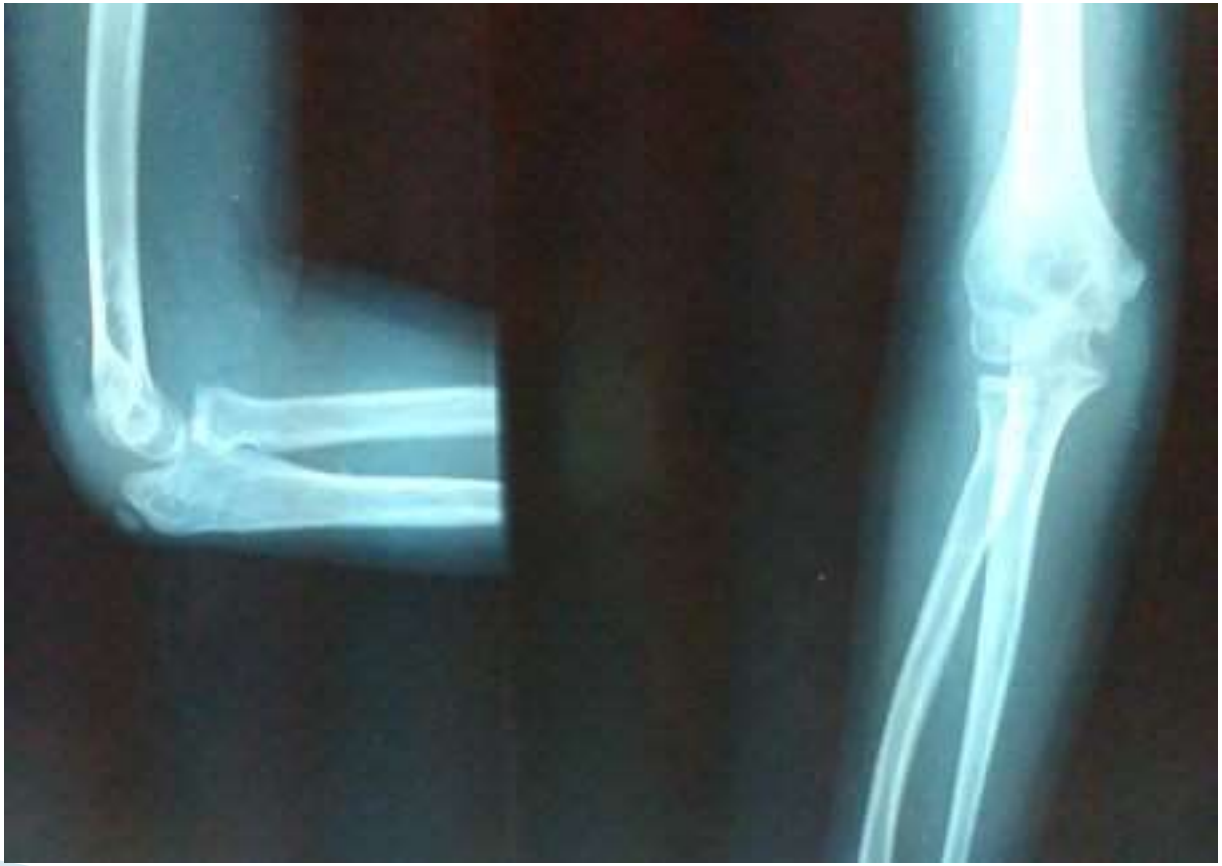


Fracture dislocation Monteggia management



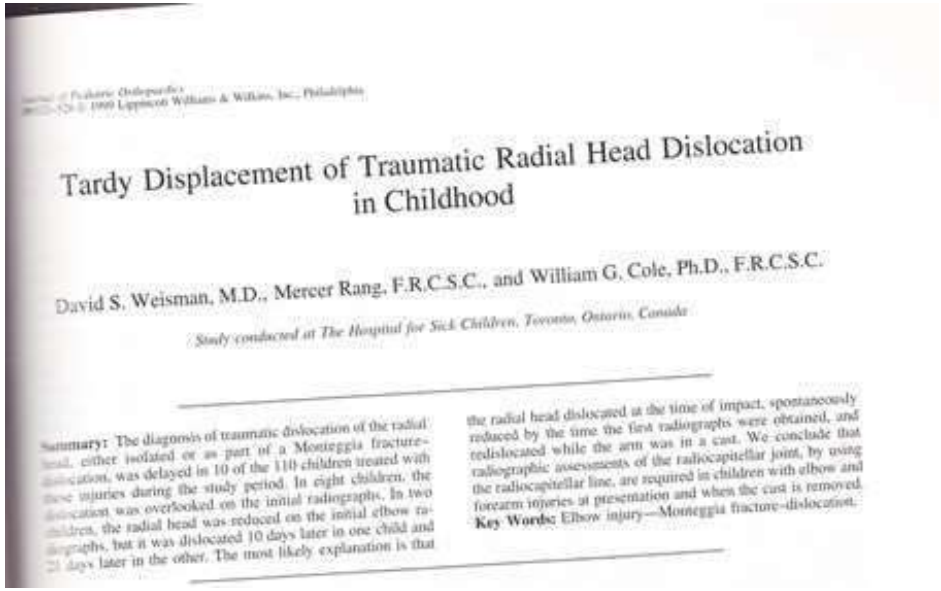


Fracture dislocation Monteggia final result



Fracture dislocation Monteggia final result

Late onset dislocation of the radial head



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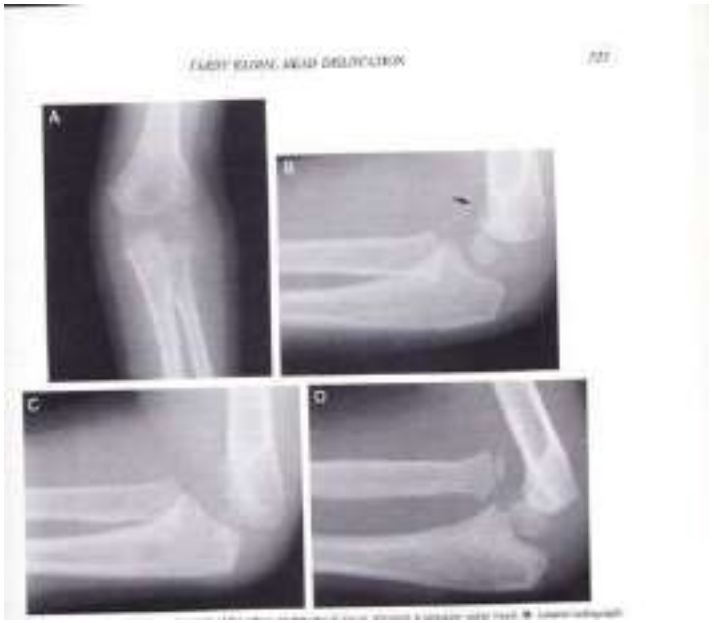
Tardy Displacement of Traumatic Radial Head Dislocation in Childhood

David S. Weisman, M.D., Mercer Rang, F.R.C.S.C., and William G. Cole, Ph.D., F.R.C.S.C.

Study conducted at The Hospital for Sick Children, Toronto, Ontario, Canada

Summary: The diagnosis of traumatic dislocation of the radial head, either isolated or as part of a Monteggia fracture-dislocation, was delayed in 10 of the 110 children treated with these injuries during the study period. In eight children, the dislocation was overlooked on the initial radiographs. In two children, the radial head was reduced on the initial elbow radiographs, but it was dislocated 10 days later in one child and 21 days later in the other. The most likely explanation is that the radial head dislocated at the time of impact, spontaneously reduced by the time the first radiographs were obtained, and redislocated while the arm was in a cast. We conclude that radiographic assessments of the radiocapitellar joint, by using the radiocapitellar line, are required in children with elbow and forearm injuries at presentation and when the cast is removed.

Key Words: Elbow injury—Monteggia fracture-dislocation.



Fracture dislocation MONTEGGIA classification

- Bado
- Letts

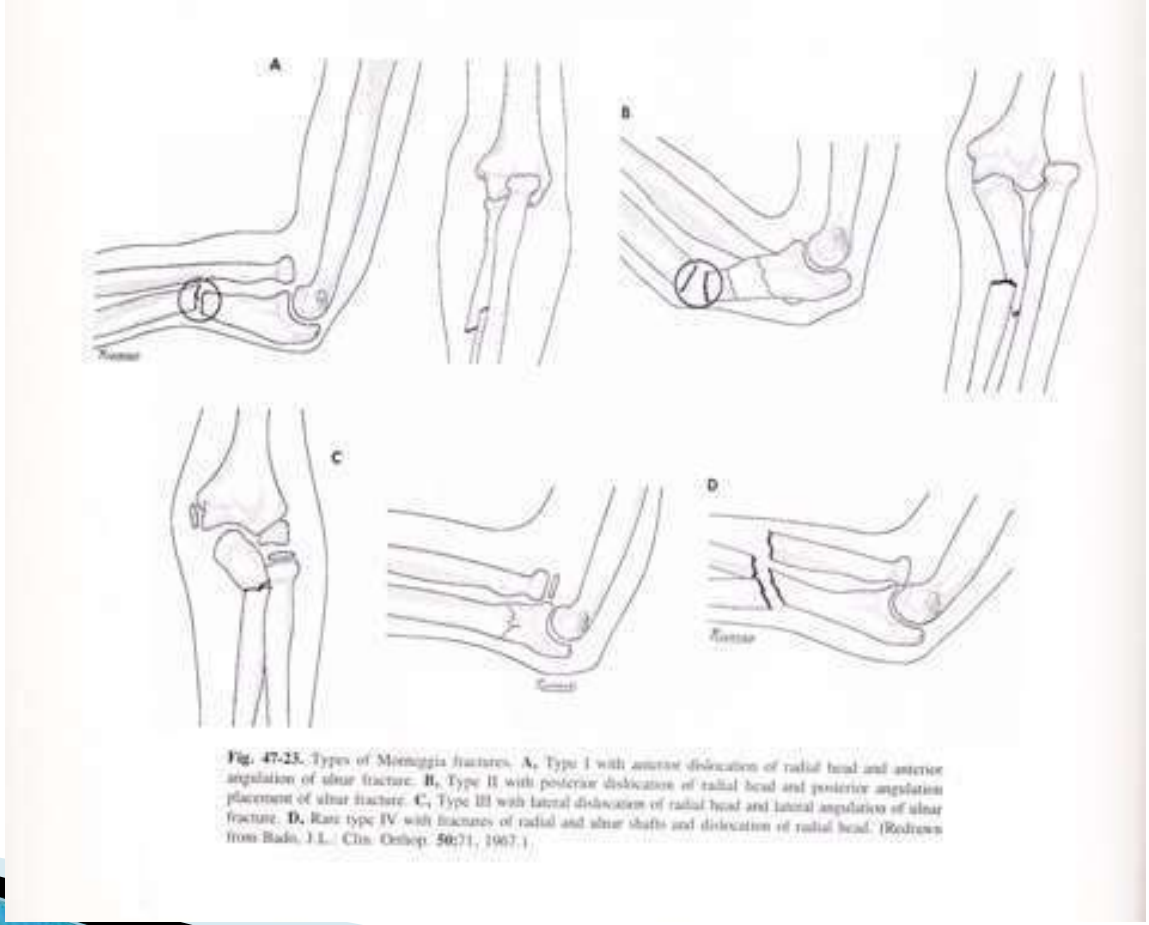


Fig. 47-23. Types of Monteggia fractures. **A,** Type I with anterior dislocation of radial head and anterior angulation of ulnar fracture. **B,** Type II with posterior dislocation of radial head and posterior angulation placement of ulnar fracture. **C,** Type III with lateral dislocation of radial head and lateral angulation of ulnar fracture. **D,** Rare type IV with fractures of radial and ulnar shafts and dislocation of radial head. (Redrawn from Bado, J.L.: Clin. Orthop. **50**:71, 1967.)

Fracture dislocation MONTEGGIA radiological assessment

- Η γραμμή του άξονα της κερκίδας διέρχεται σε όλες τις θέσεις από το κέντρο του έξω κονδύλου

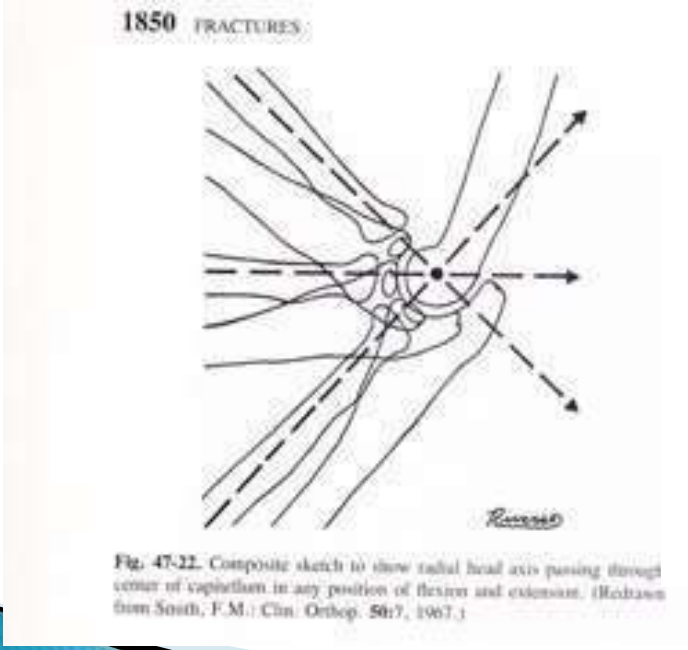


Fig. 47-22. Composite sketch to show radial head axis passing through center of capitellum in any position of flexion and extension. (Redrawn from South, F.M.: Clin. Orthop. 50:7, 1967.)

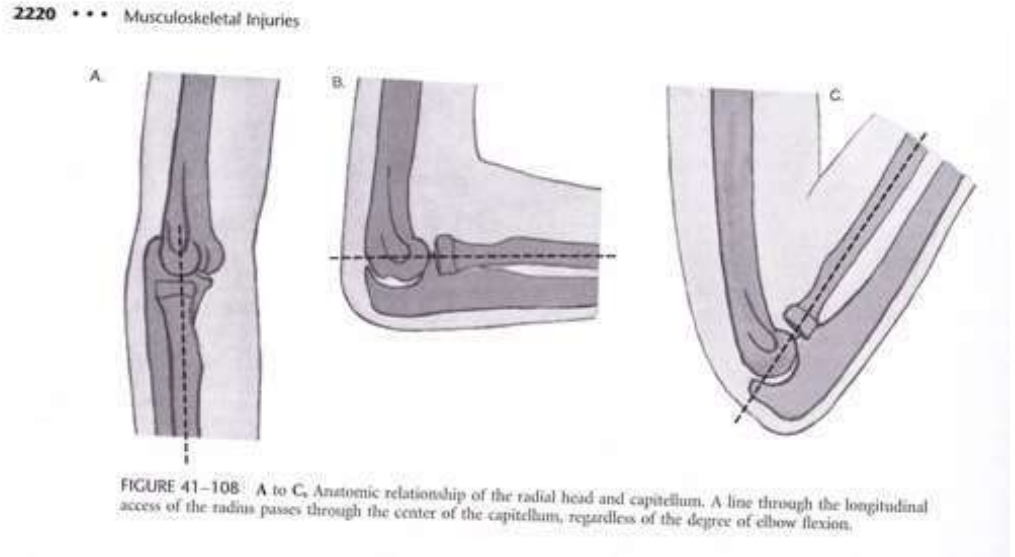
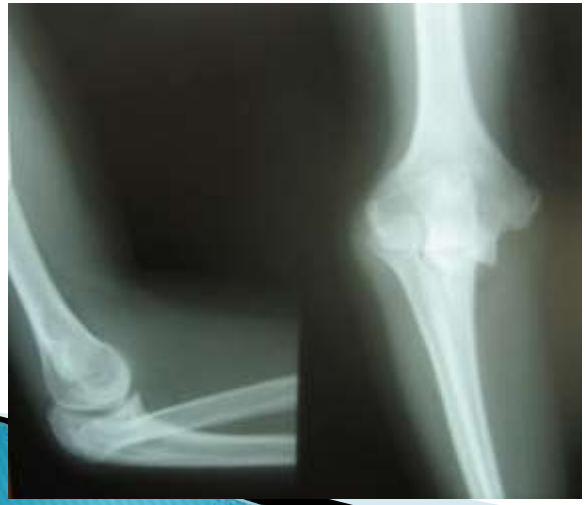
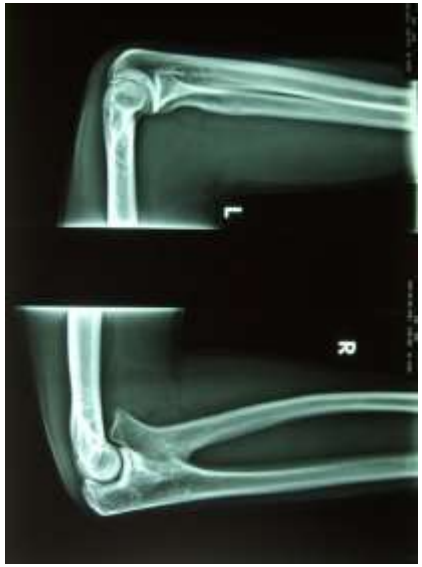


FIGURE 41–108 A to C, Anatomic relationship of the radial head and capitellum. A line through the longitudinal access of the radius passes through the center of the capitellum, regardless of the degree of elbow flexion.

ΚΑΤΑΓΜΑ ΕΞΑΡΘΡΗΜΑ MONTEGGIA
ακτινολογική διάγνωση

- Διαφορική διάγνωση από συγγενές εξάρθρημα της κεφαλής της κερκίδας
- Οπίσθιο εξάρθρημα, συνήθως αμφοτερόπλευρο
- Ευμεγέθης , ανώμαλη σε σχήμα





THANK YOU