TERZO CONVEGNO DI TRAUMATOLOGIA CLINICA E FORENSE

10° Corso di Ortopedia, Traumatologia e Medicina Legale

LE COMPLICANZE IN ORTOPEDIA E TRAUMATOLOGIA

PROBLEMATICHE CLINICHE, CONSIDERAZIONI MEDICO LEGALI E CONTROVERSIE GIURIDICHE

23 - 24 Novembre 2012

Terme Zoja – Salsomaggiore Terme (PR)

'Le complicanze delle fratture dell'arto superiore in età pediatrica'

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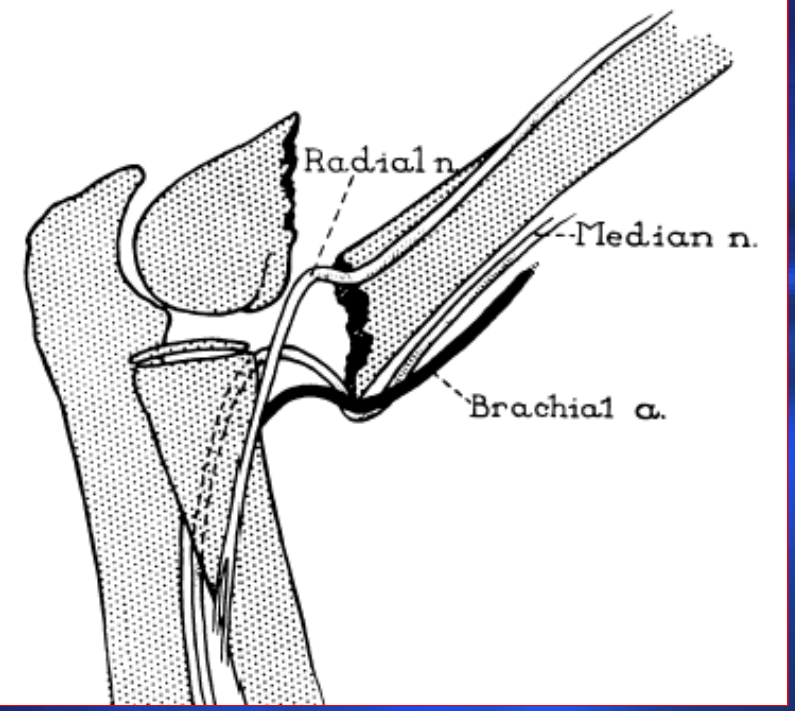
The supracondylar fracture of the humerus in children is a common childhood injury:

- 3-7% of all fractures
- 55-80% of all elbow fractures in children

Taco Gosens a,., Karst J. Bongers b Neurovascular complications and functional outcome in displaced supracondylar fractures of the humerus in children Injury, Int. J. Care Injured 34 (2003) 267–273



Watson-Jones lists supracondylar fractures of the humerus:

- 1st in the causes of palsy of the radial nerve
- 2nd as a cause of palsy of the median nerve
- 4th as a cause of palsy of the ulnar nerve

He also pointed out that most of the recorded instances of Volkmann's contracture were in the upper extremity and were due to involvement of the brachial artery at the level of a supracondylar fracture of the humerus.

Paul R. Lipscomb and R. Joe Burleson VASCULAR AND NEURAL COMPLICATIONS IN SUPRACONDYLAR FRACTURES OF THE HUMERUS IN CHILDREN 1955;37:487-492. *J Bone Joint Surg Am.*

The mechanism of supracondylar fracture predisposes to neural and vascular injuries

The commonest type is the extension fracture,in which the condylar complex shifts posteromedially or posterolaterally after a fall on the outstretched arm.

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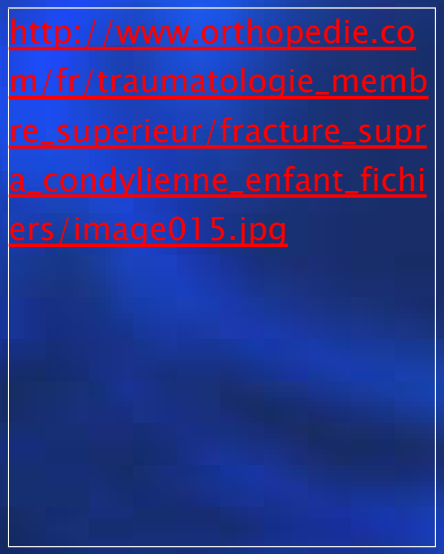
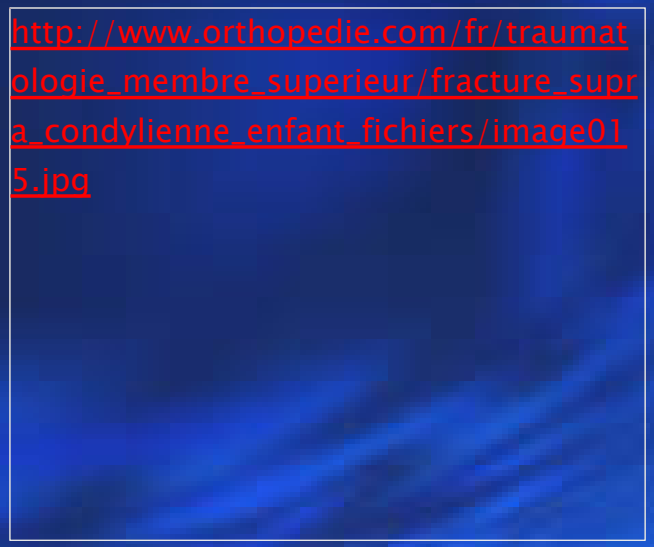
The mechanism of supracondylar fracture predisposes to neural and vascular injuries

In 2% the condylar complex shifts anterolaterally: the flexion type fracture





PRIMARY COMPLICATIONS

In extension type fractures, posterolateral displacement fractures have a predilection of injury to the median nerve and/or the brachial artery and posteromedial displacement fractures are more likely to injure the radial nerve.

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The ulnar nerve is more frequently damaged in a flexion type fracture

The reported rate of primary nerve injury in displaced supracondylar fractures is up to 20%
The rate of iatrogenic nerve injury has been reported to be 2-3%

It can be difficult to quantify disturbances in sensory and motor function preoperatively, especially in the younger child for whom this is a very painful and stressful event

‘SUPRACONDYLAR HUMERUS FRACTURES IN CHILDREN: A COMPARISON OF EXPERIENCES’

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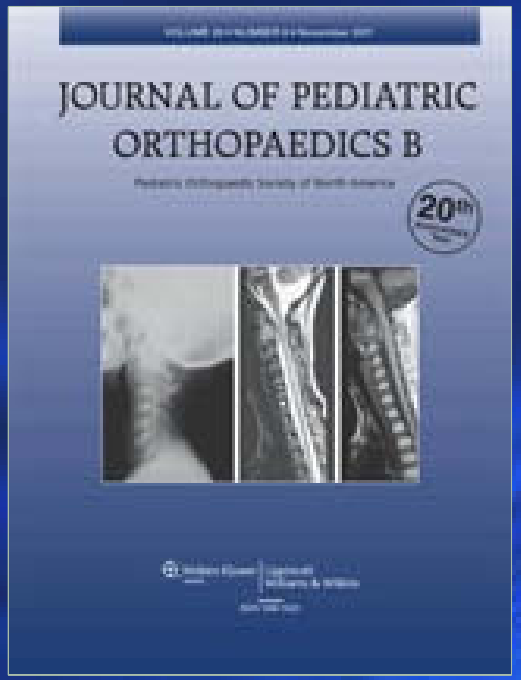


Dysfunction of nerves can also exist because of swelling of the tissues around the elbow irrespective of the treatment

ALWAYS transolecranic traction

To prevent ulnar nerve injury different methods have been reported or using mini incision over the medial epicondyle or by placing two parallel lateral pins instead of cross-pinning, but lateral pinning is associated with increased rotational instability

…or playing a correct pin insertion

SECONDARY COMPLICATIONS

1. During manipulation of the fracture the nerves and/or vessels can be stretched or entrapped between the fracture ends

3. Treatment in hyperflexion position (used when only closed reduction is performed) can compromise the vascularity of the forearm

Volkmann's contracture

The blood infiltrates the antecubital fossa

It is evident that the nerves in this regioni might be contused, compressed, restricted by scar, or lacerated. Likewise, the vessels may be compressed, contused, thrombosed, perforated, or even severed.

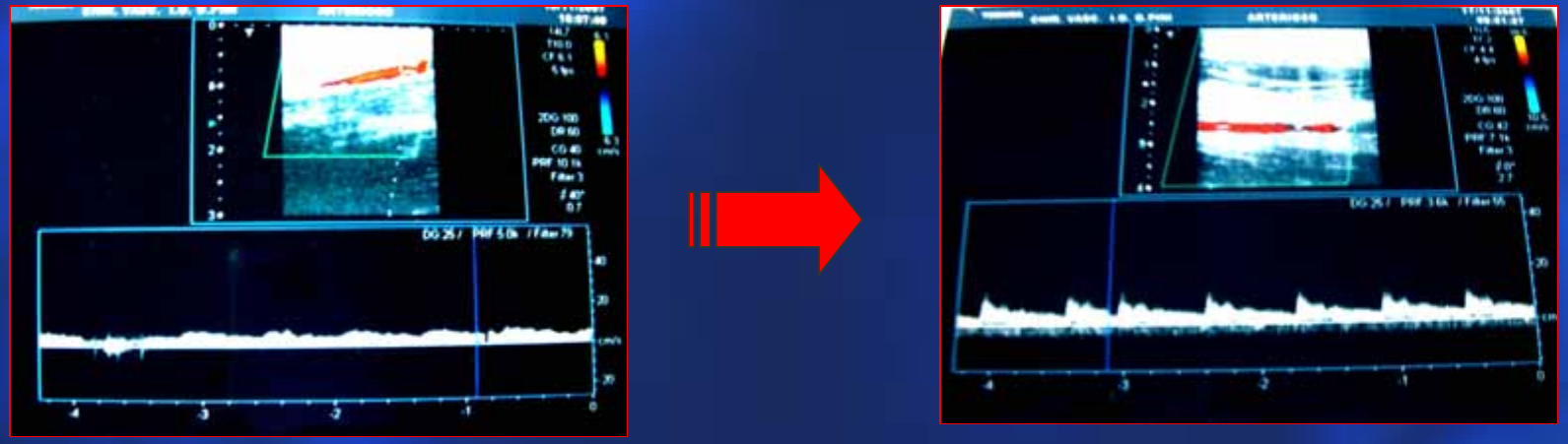
The use of arteriography in cases of vascular injury is controversial

2. Freidman and Jupiter suggested that it could be used to localize and define the nature of a suspected vascular injury.
3. Shaw et al., however, favoured exploration without proceeding to angiography.
4. Copley et al. showed that no further information is obtained from angiography to help define or locate the vascular injury.

Shaw B A, Kasser JR, EMans JB, Rand FF Management of Vascular Injuries in displaced Supracondylar Humeral Fractures without Arteriography. J. Orthop. Trauma 1990, 4:25-9

Ottolenghi CE. Acute Ischemic Syndrome. Its treatment, prophylaxis of Volkmans Syndrome. Am J Orthop. 1960, 2:312-16.

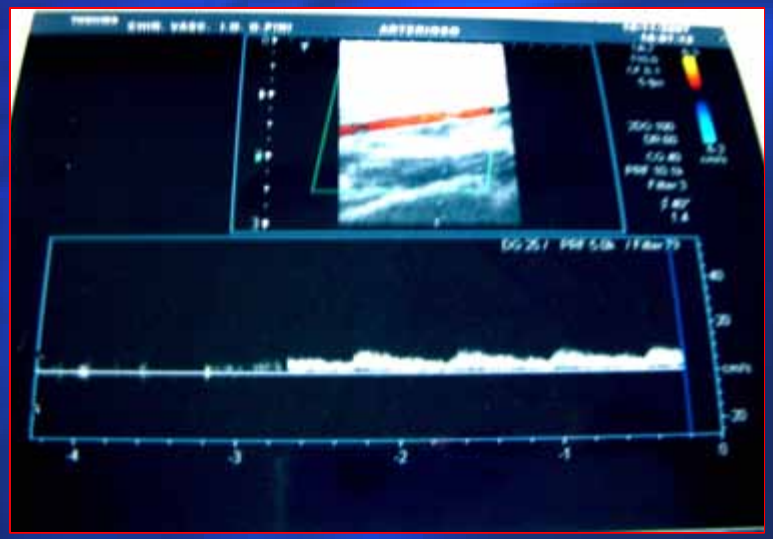
Our policy is to check for vascular status at frequent intervals by physical examination and Doppler Sonography before going in for more invasive procedures as exploration or arteriography

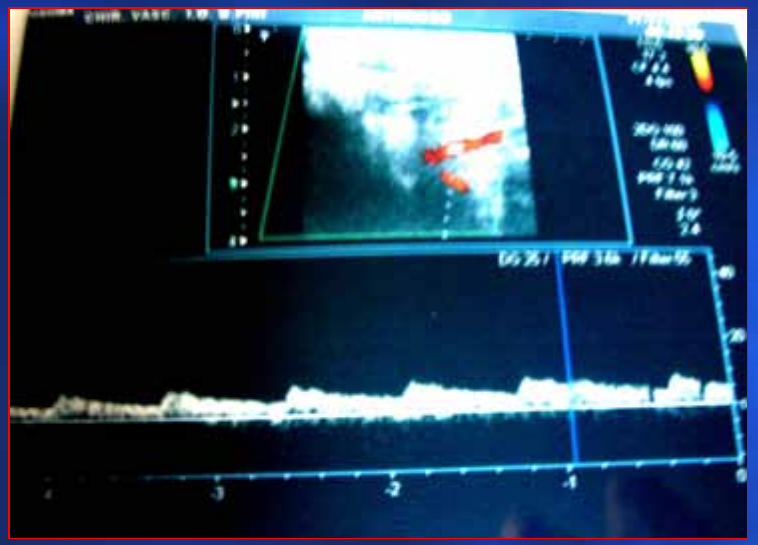


Befor and after reduction and stabilization

However prompt stabilization in displaced supracondylar fractures associated with cold hand can avoid dreaded vascular related complications

The radial pulse is reported to be absent before reduction in 7–12% of all fractures and up to 19% in displaced fractures. After reduction the pulse is restored in 80% of the cases.





SECONDARY COMPLICATIONS

- Inadequate reduction (Baumann's angle >10.) of the fracture when reviewing the postoperative X-ray.
- Wound infection

Baumann's Angle:

- humeral capitellar angle: angle between long axis of humeral shaft & growth plate of lateral condyle, will reliably predict final carrying angle after reduction;
- increases in Bauman's angle will occur in residual VARUS and internal rotation deformities

LATE COMPLICATIONS

- Impairment of extension or flexion function
- Cubitus varus or valgus

The cubitus varus is due to medial tilting of the distal fragment combined with rotation and not to physical injury. It does not remodel with growth and is not progressive

In 1994, Davids et al, presented a review of lateral condyle fractures of the humerus due to malunion of supracondylar humerus fractures as well as varus as a result of overgrowth of a lateral condyle fracture. This complication results in decreased range of motion of the elbow, and can predispose to a fracture of the lateral condyle

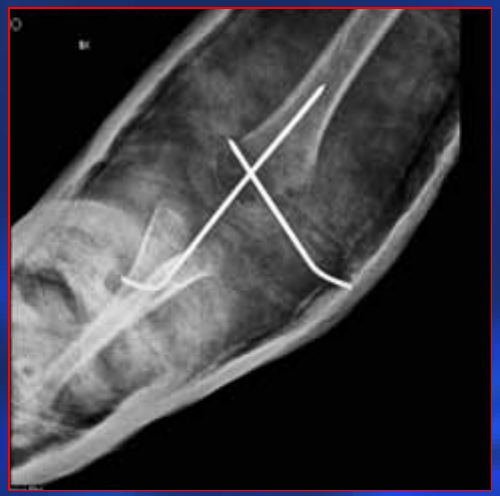
Davids JR, Maguire MF, Mubarak SJ, Wenger DR. Lateral Condyle Fracture of the Humerus Following Post-traumatic Cubitus Varus. *Journal of Pediatric Orthopaedics*. 1994;14:466-470

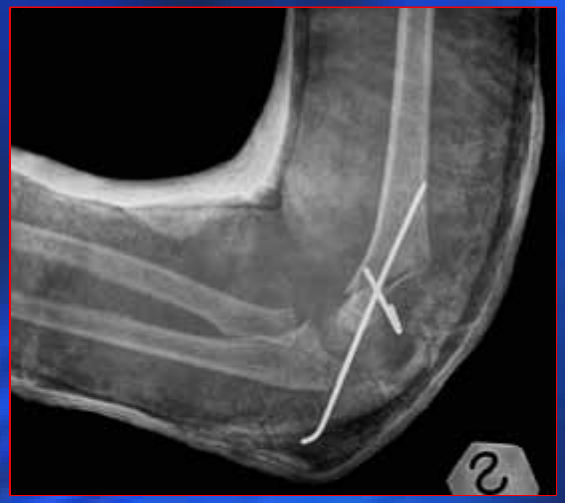
Their findings suggest that the physis and epiphysis tend to be more prone to re-injury than the metaphysis of the distal humerus in children after a supracondylar fracture. They implied that the healed supracondylar humerus fractures result in a thickened metaphysis protecting the area from further injury. Conversely, the growth plate becomes more vulnerable, especially in cases of varus positioning

Takahara M, Sasaki I, Kimura T, Kato H, Minami A, Ogino T. Second Fracture of the Distal Humerus after Varus Malunion of a Supracondylar Fracture in Children. *Journal of Bone and Joint Surgery*. 1988;80-B(5):791-797

It is essential to recognize the importance of possible neural and vascular injuries in all patients who sustain supracondylar fractures of the humerus. A thorough sensory, motor, and circulatory evaluation must be carried out at the initial examination. An absent radial pulse may return after careful closed manipulation of the fracture or reduction by traction.

We conclude that a good functional result can be obtained in perfectly reduced fractures, but fractures that heal in malrotation can give rise to a reduced function and cosmetic appearance of the elbow.





1 . Supracondylar fractures of the humerus in children may be associated with injuries to nerves or blood vessels which are much more serious than the fracture.
2. The early recognition of such complications is imperative.
3. Early and adequate treatment of acute vascular complications is necessary, even though it means surgical exploration of the antecubital fossa and resection of the injured segment of the brachial artery.

4. Adequate and early treatment of acute vascular injuries usually ensures a good prognosis, but delay may lead to serious and permanent disability.

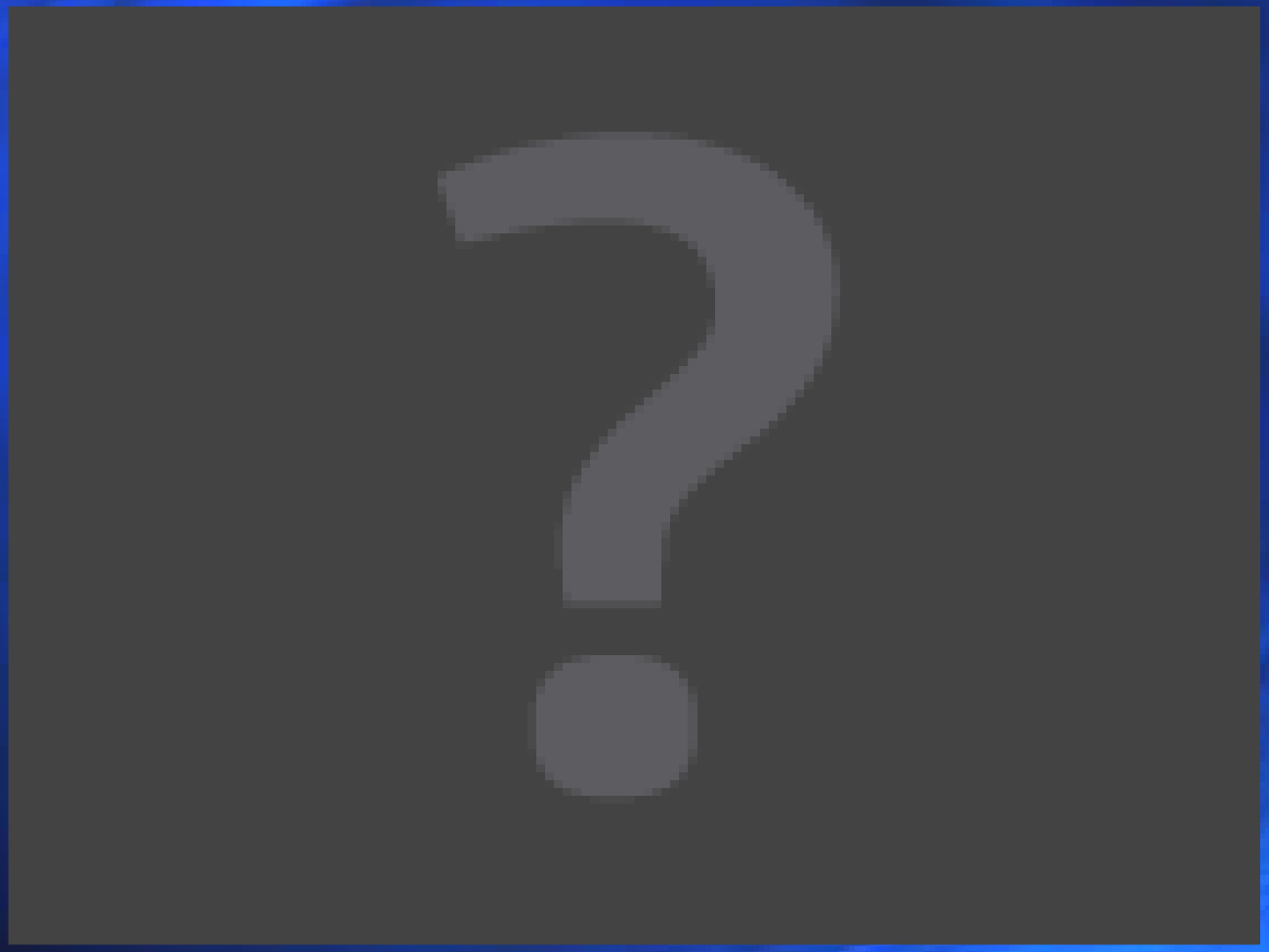
5. Palsies of nerves should be observed for a few weeks after adequate reduction of the fracture. If no improvement has taken place in function of the nerve or nerves in question after this period, surgical exploration is advisable.

ATTENTION !!!

Results are not always related to a successful treatment…

Bad reduction…

Great clinical and functional result…



Great reduction…

Bad clinical and functional result…

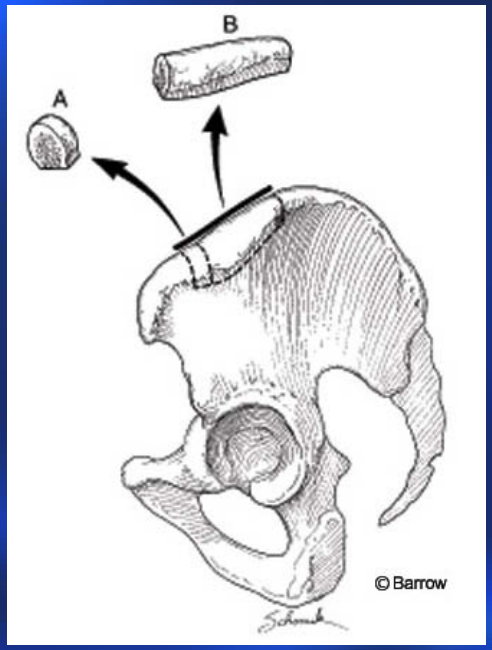
FOREARM POSTTRAUMATIC NONUNIONS

Nonunion is one of the most dangerous complication of forearm fractures, it happens either for anatomical causes, such as the relative thickness of cortical bones or to the smallness of the medullary and the precarious ulnar vascularization and either for mechanical reasons

- 1. Praemer A, Furner S, Rice DP. Musculoskeletal conditions in the United States. Park Ridge, IL: American Academy of Orthopaedic Surgeons; 1992.
- 2. Marsh J, Buckwalter J, Evarts C. Delayed Union, Nonunion, Malunion, and Avascular Necrosis. In: Epps CH, eds. Complications in Orthopaedic Surgery. Philadelphia, JB: Lippincott; 1993:183–211.
- 3. Papagelopoulos P, Morrey B. Treatment of nonunion of olecranon fractures. J Bone Joint Surg Br. 1994;76:627–635.
- 4. Cabanela M, Morrey B. Fractures of the Olecranon. In: Morrey BF, eds. The Elbow and Its Disorders. Philadelphia, WB: Saunders C; 1993:365–379.

A number of strategies about this subject have been devised and, at the end, the use of a combined approaches is likely to produce the best clinical outcome

Traditionally, the problems that are related to fracture-healing have been treated with operative intervention which often involves the use of an autologous bone graft .

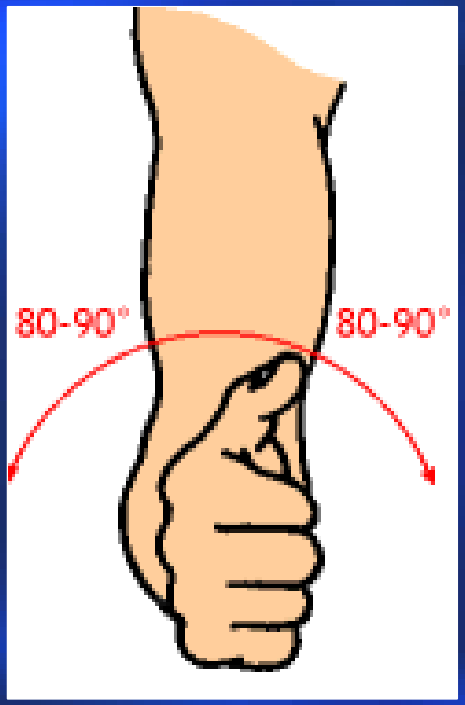


- Calori G, D'Avino M, Tagliabue L, et al. An ongoing research for evaluation of treatment with BMPs or AGFs in long bone non-union: Protocol description and preliminary results. Injury. 2006;37S:43-50.
- Gupta DK, Kumar G. Gap nonunion of forearm bones treated by modified Nicoll's technique.Indian J Orthop. 2010 Jan;44(1):84-8.
- Krzykawski R, Król R, The results of locked intramedullary nailing for non-union of forearm bones.Kamiński AOrtop Traumatol Rehabil. 2008 Jan-Feb;10(1):35-43.

the rate of non-union in forearm fractures is less than 2% when proper technique is used in compliant patients but the rate of non-union after ulnar lesions is considerably higher .

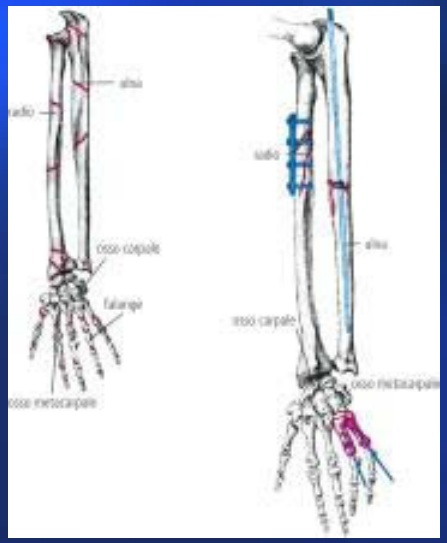
- Chapman MW, Gordon JE, Zissimos AG. Compression plate fixation of acute fractures of the diaphysis of the radius and ulna. J Bone Joint Surg Am. 1989;71:159–169.
- Biyani A, Olscamp AJ, Ebraheim NA. Complications in the management of complex Monteggia-equivalent fractures in Adults. Am J Orthop. 2000;29:115–118.
- Poigenfürst J, Vogt W. Osteosynthesis of ulna pseudarthrosis after Monteggia equivalents. Unfallchirurg. 1994;97:127–131.

Biomechanical investigations showed that ulna is mainly responsible for stabilizing the forearm in respect to axial and torsional bending



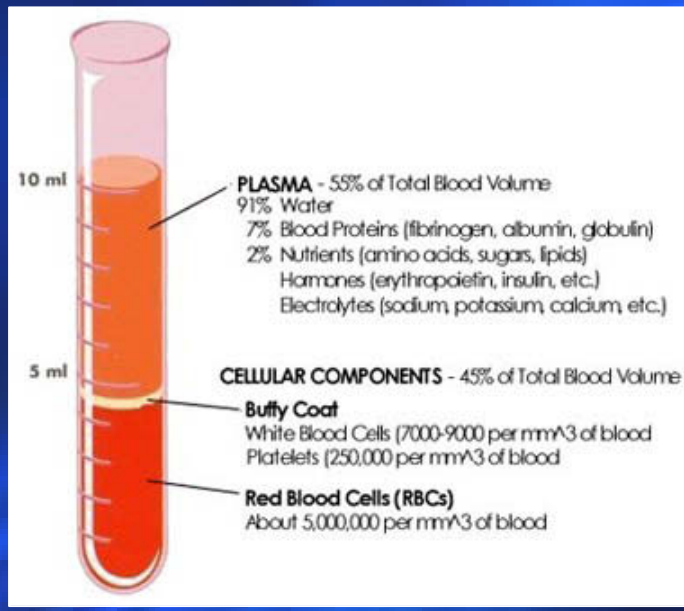
- Jones DJ, Henley MB, Schemitsch EH, et al. A biomechanical comparison of two methods of fixation of fractures of the forearm. J Orthop Trauma 1995;9:198–206

Treatment usually consists in an osteosynthesis of the ulnar or the radial non-union with the use of a dynamic compression plate or an intramedullary nail and an autologous cancellous bone-graft



- Gupta DK, Kumar G. Gap nonunion of forearm bones treated by modified Nicoll's technique.Indian J Orthop. 2010 Jan;44(1):84-8.
- Kulenkampff HA, Rustemeier M. Fractured Monteggia pseudarthrosis: an unusual case. Unfallchirurg. 1990;93:32–34.
- Rotini R., Antonioli D., Marinelli A., Katusic D. Surgical Treatment of Proximal Ulna Nonunion. Chir Organi Mov. 2008 Feb;91(2):65
- Mückley T, Hierholzer C, Berger A, et al. Compression nailing of ulnar nonunion after Monteggia lesion. J trauma. 2005;59:249-253.

The novelty of our treatment is the combination of a particular unreamed locked intramedullary nail (the "Acumed ulnar or radial rod" or 'Thalon elastic nail') associated with the use of autologous platelet-rich plasma (PRP).



According to us the use of a locked unrimed nail ensures rotational stability and PRP preparation enhances the healing of non-union avoiding the utilization of autologus bone graft; Prp preparation just need a sample of periferical blood instead of more invasive procedures utilized for bone-grafting.

- Bühren V. Intramedullary compression nailing of long tubular bones. Unfallchirurg. 2000;103:708–720.
- Gonschorek O, Hofmann GO, Bühren V. Interlocking compression nailing: a report on 402 applications. Arch Orthop Trauma Surg. 1998;117:430–437.

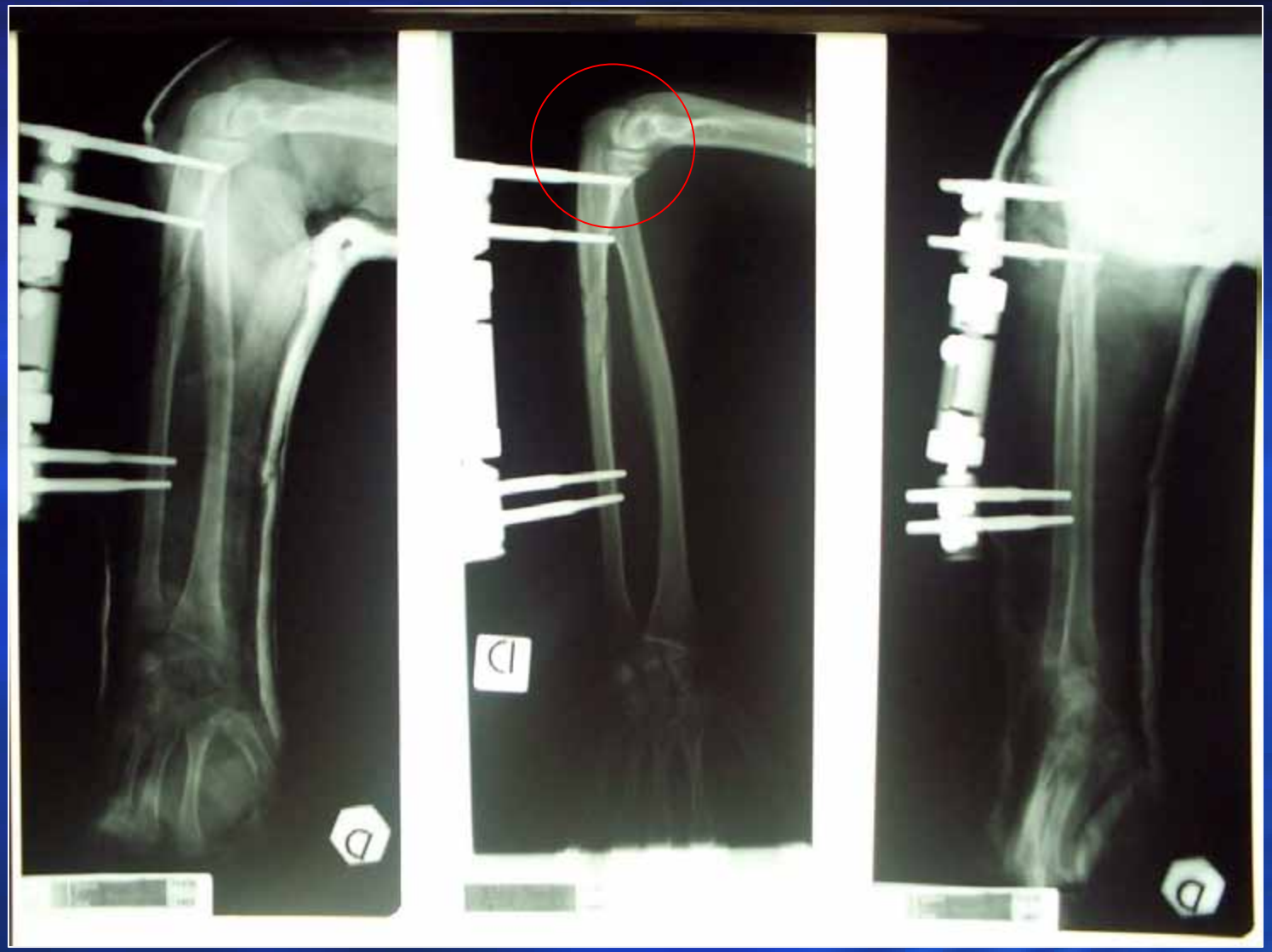
Patient 1

radial + ulnar nonunion after removal of 2 Kirschen wires (one ulnar + 1 radial) used to treat a previous forearm combined fracture.

implantation Acumed ulnar rod nail and acumed radial rod nail after the curettage of the non-union area.

X-rays taken after 9 months from surgery that shows the complete recovery of the non-union area both in the ulna and in the radius

Patient 2 : forearm EXPOSED combined fracture



First treatment with an axial external fixator

Ulnar nonunion AFTER THE REMOVAL OF THE EX. FIX.

Treatment of the nonunion area with an Acumed ulnar rod nail + PrP that lead to recovery after 28 weeks

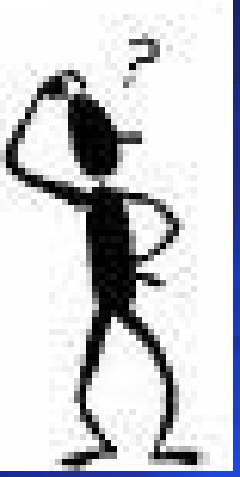
Posttraumatic Osteomyelitis

It's an important septic pathology that involves bone.

Even if usually it doesn't interest growth plates it can lead to important consequences like axial deviation or diferences in lenghts.

- *Delayed diagnosis*
- *Inadequate treatment*

Kit M. Song, J Am Acad Orthop Surg 2001; 9: 166-175



How can we treat its compliances???

EXTERNAL FIXATION

When do we treat it???

When the septic process it's over

Our experience……

Axial or Circular external fixation

G.M. 11 yo

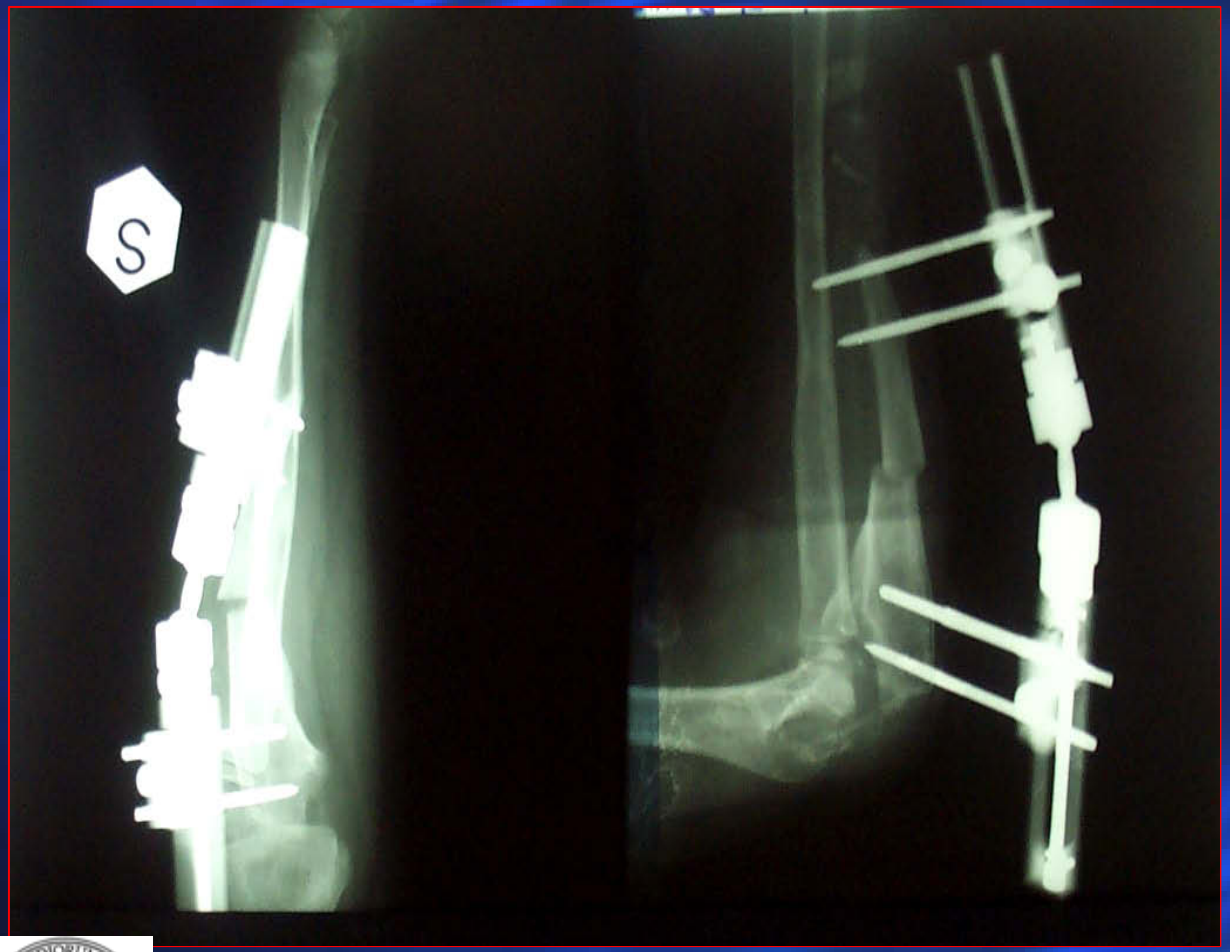
Combined fracture of ulna +radius treted with a non surgical reduction and a cast

Breaking down and sinthesis with K wires performed in another structure

Posttraumatic Osteomyelitis

Loss of substance

Application of an external axial system to stabylize and lenghten




WORLD CUP

Progression of bone healing

Recovery

The teatment of the compliances of upper limbs in pediatric patients is often difficult because of its particular way of presentation and because patients are too young to let us know what is going on!!!

Thank you