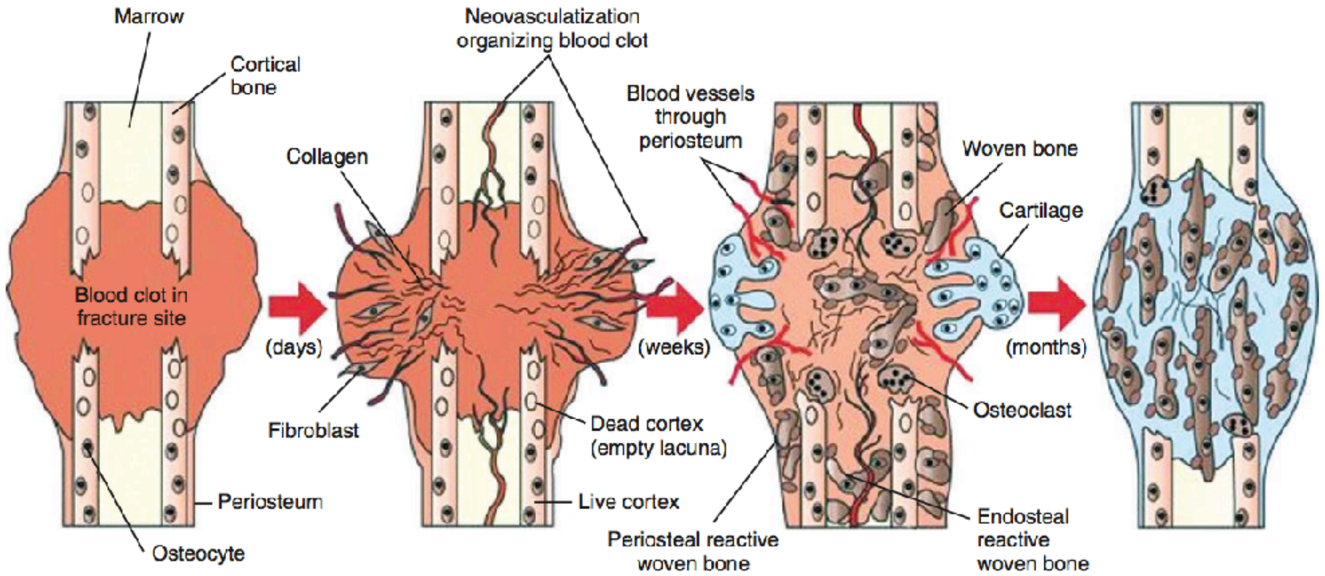
Minimally invasive plate osteosynthesis (MIPO)

I do not have a fluoroscope.Now what?

Dr. Vladislav Zlatinov, DVM
Central veterinary Clinic- Sofia, Bulgaria

Bone healing

A complex, highly regulated process with consecutive phases of inflammation, repair and remodeling.

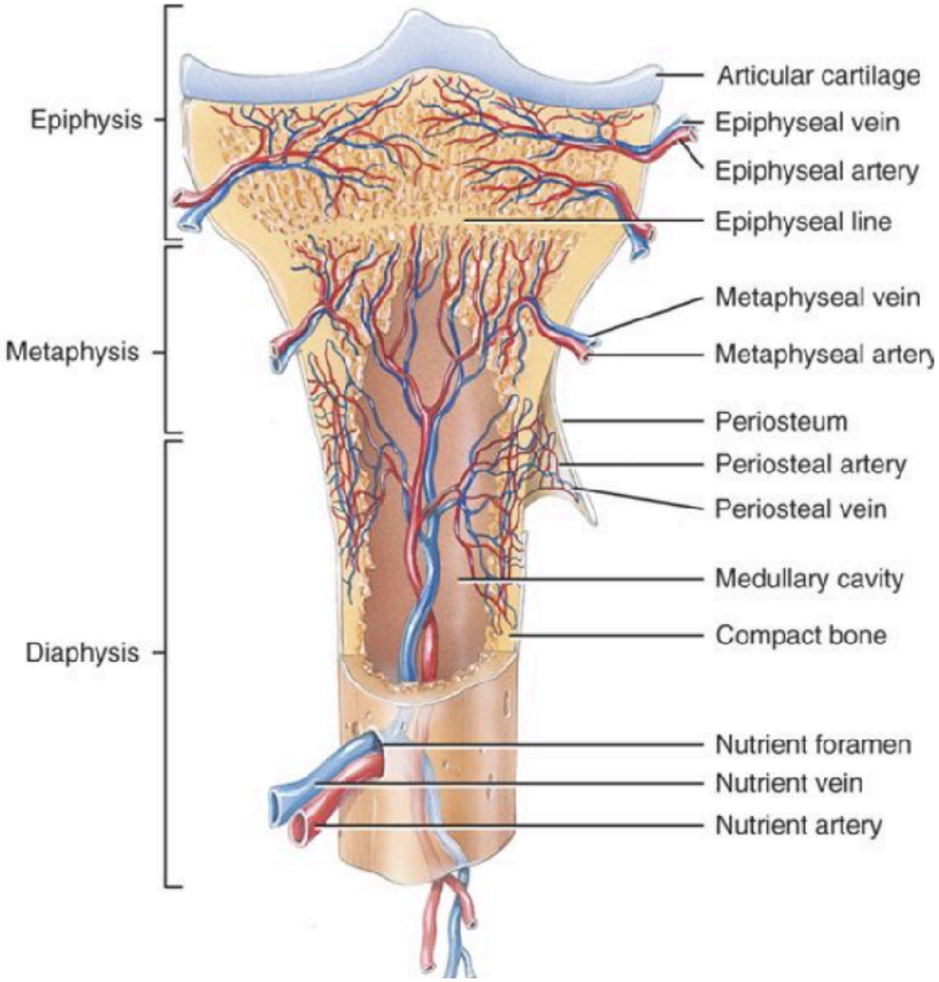


Bone blood supply

- **Afferent system** – supplying metaphyseal and periosteal arteries.

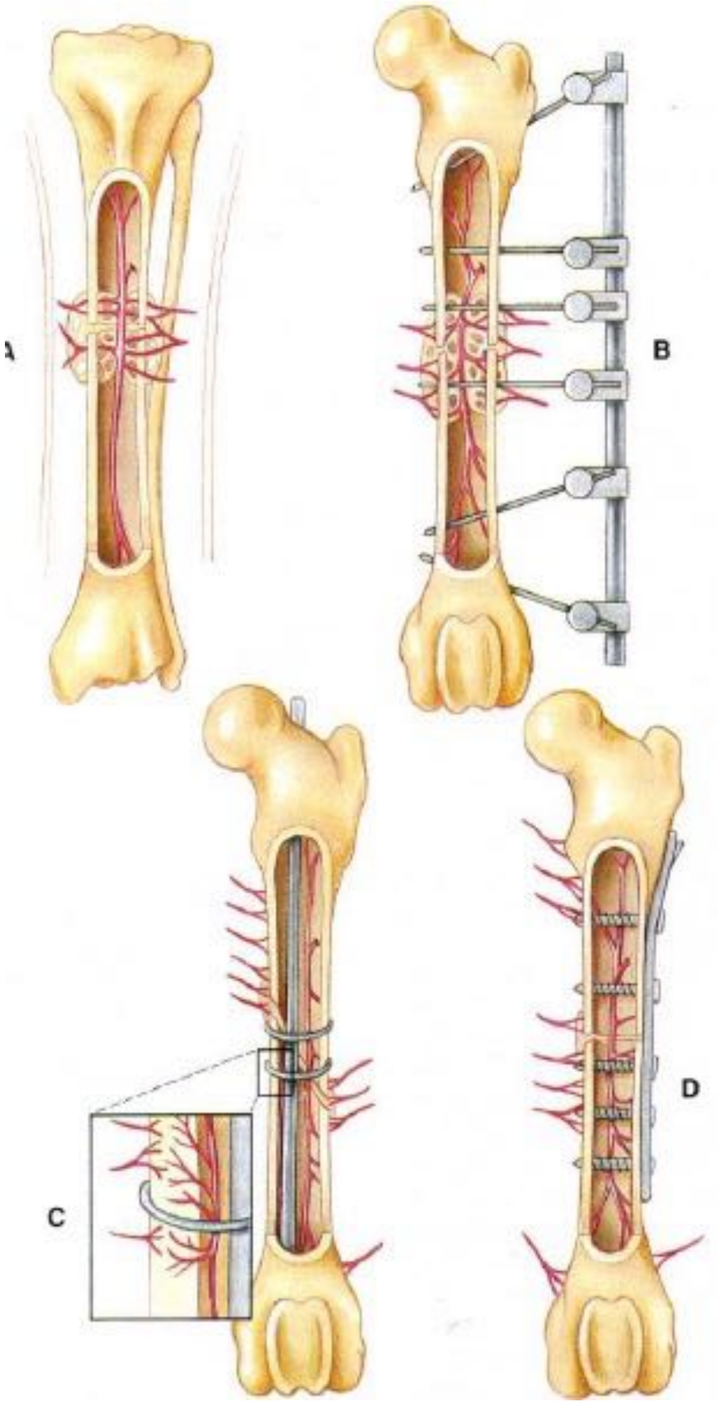
- **Vascular net** of the compact bone.

- **Efferent system**- <u>venous</u> drainage of the periosteum.

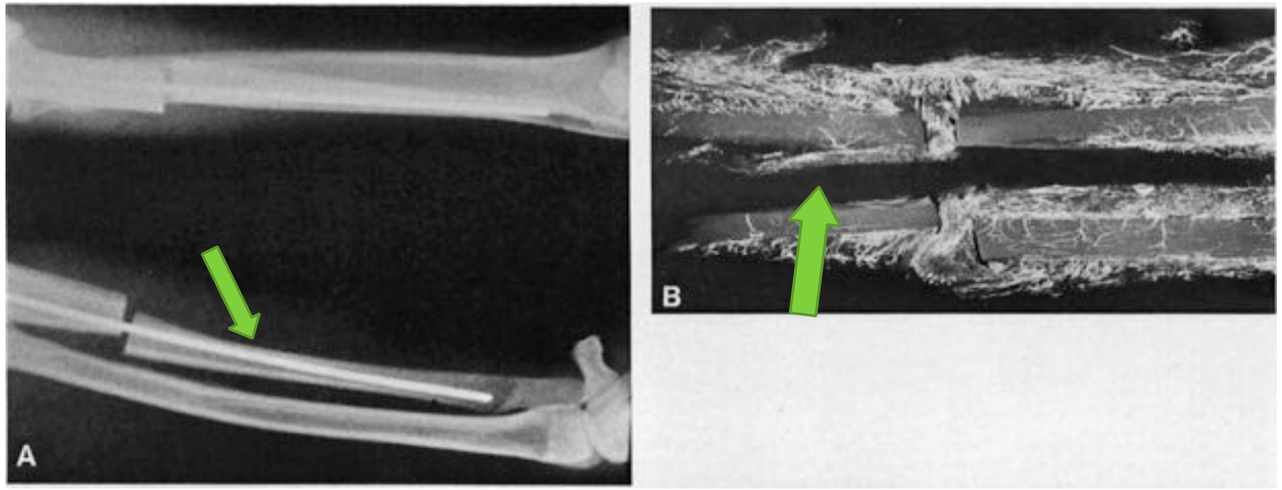


Intra- osseous blood supply

Implants imprint

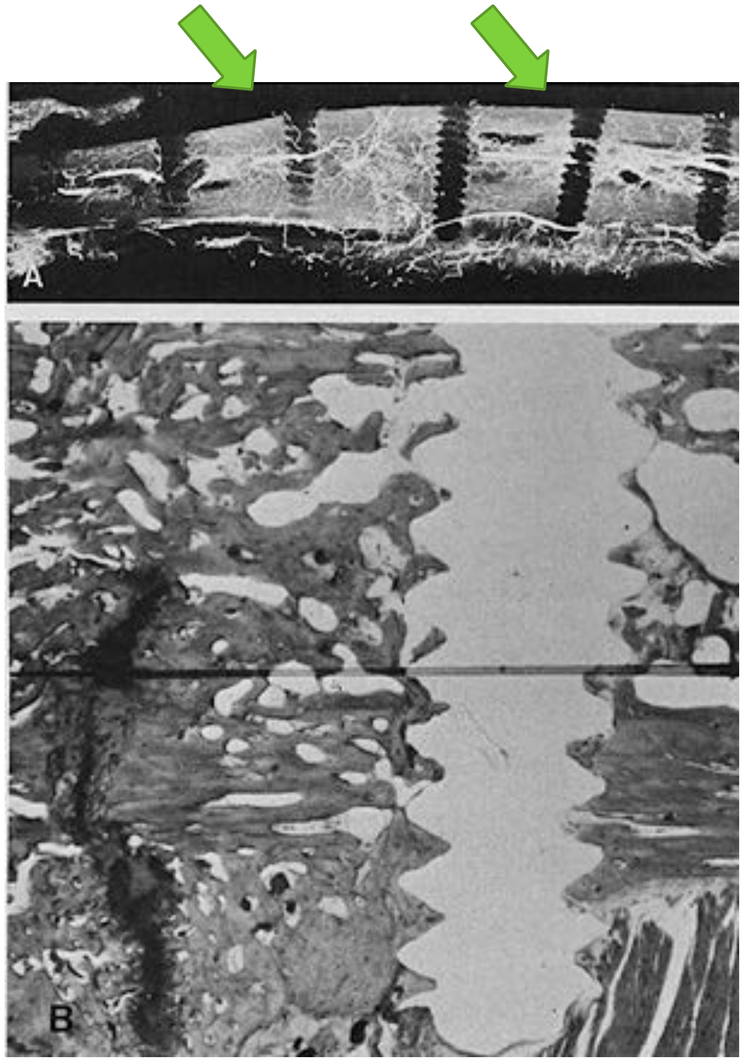


IM pins



Unstable ulnar fracture

Plates

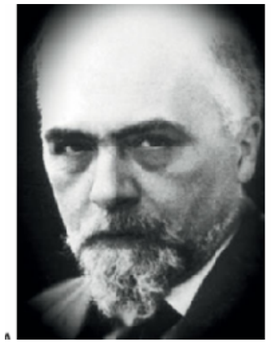


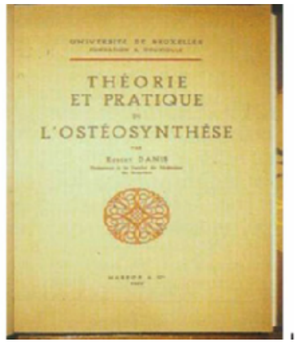
6 w post DCP osteosynthesis

Plate osteosynthesis

The pioneer

- **Robert Danis**- the father of the plate osteosytntheis.
- 1938- first axial compression plate.
- 1949- the theory and practice of osteosynthesis.

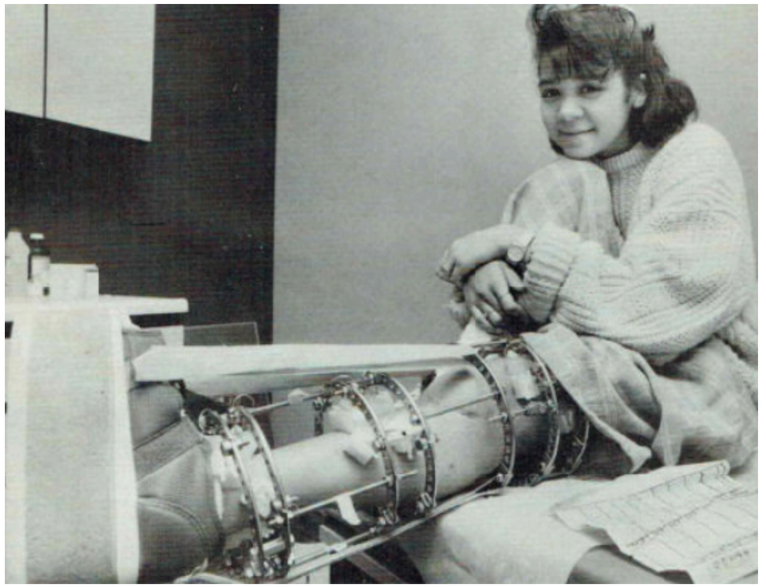




1950- External skeletal fixation

Gavril Abramovich Ilizarov (1921-1992)

Circular external fixator- 1950
Distraction osteogenesis



AO Group

"Association for the Study of Internal Fixation"

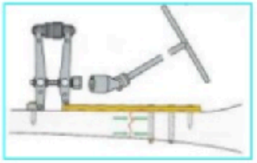
AO 1958

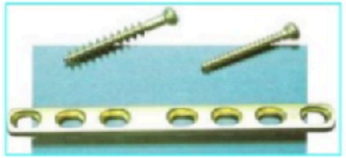
ARBEITSGEMEINSCHAFT FÜR OSTEOSYNTHESEFRAGEN

STUDY GROUP FOR OPERATIVE FRACTURE TREATMENT

AO (ASIF) 1958

Functional rehabilitation
Anatomical reduction
Mechanically Stable Fixation
Interfragmentary Compression
No external splints - Early mobilization



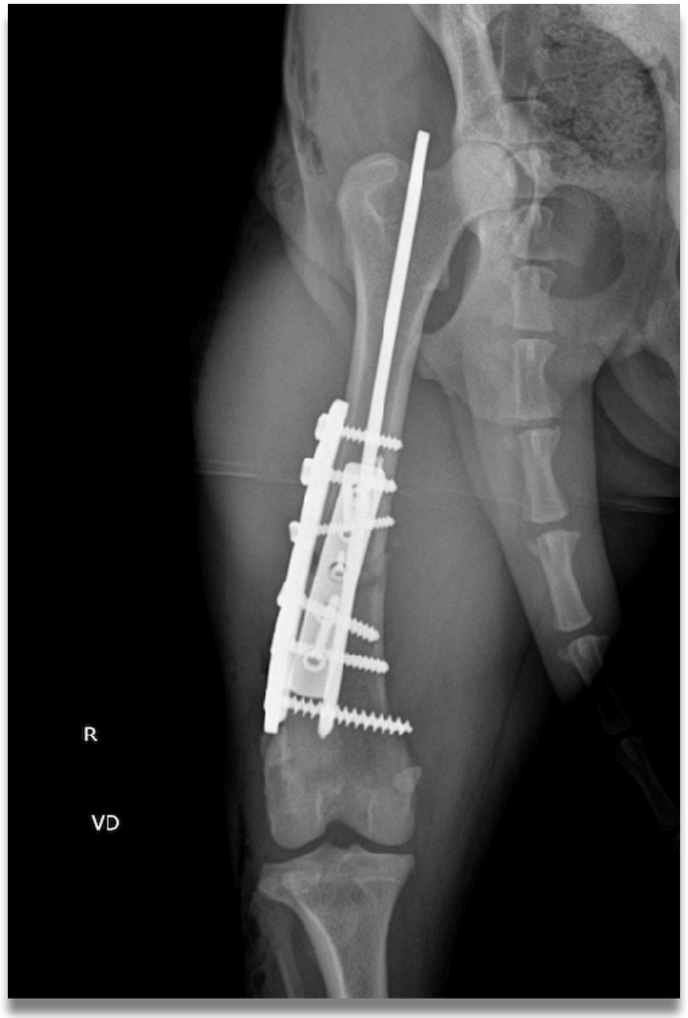


Dynamic Compression Plate (DCP) 1963 + 1969

- 1958
- ORIF results investigation
- **Emphasis**- rigid fracture stabilization with plates.

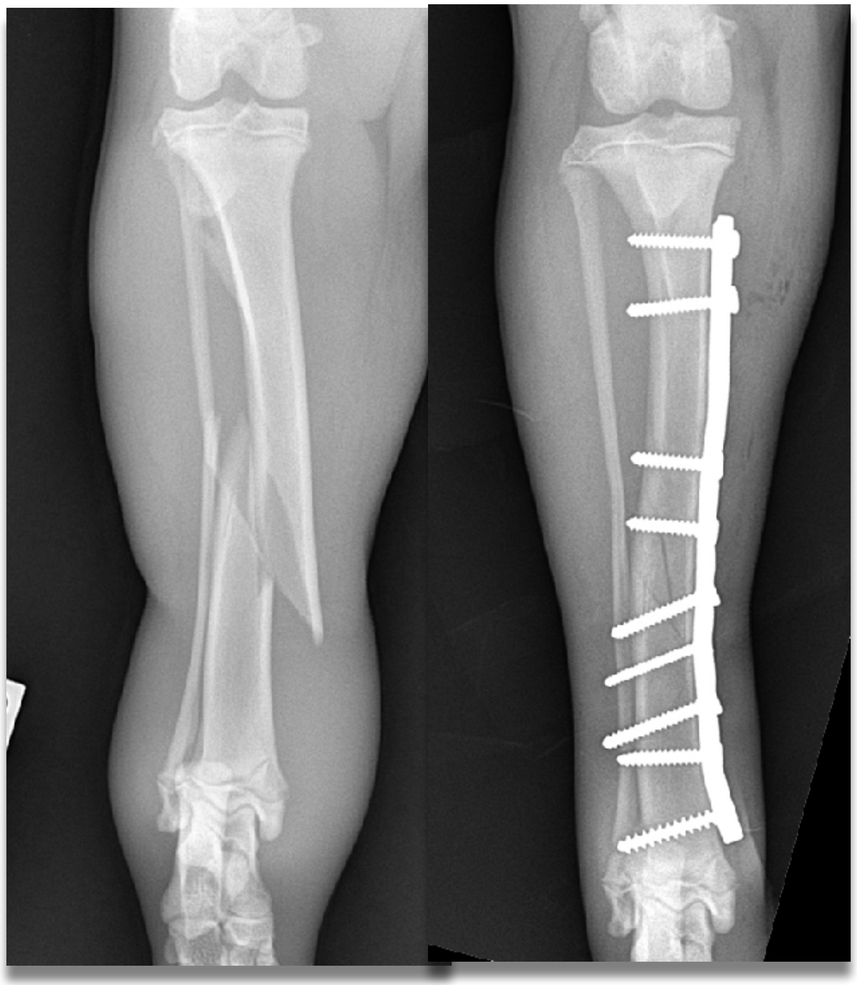
AO Principles (1960)

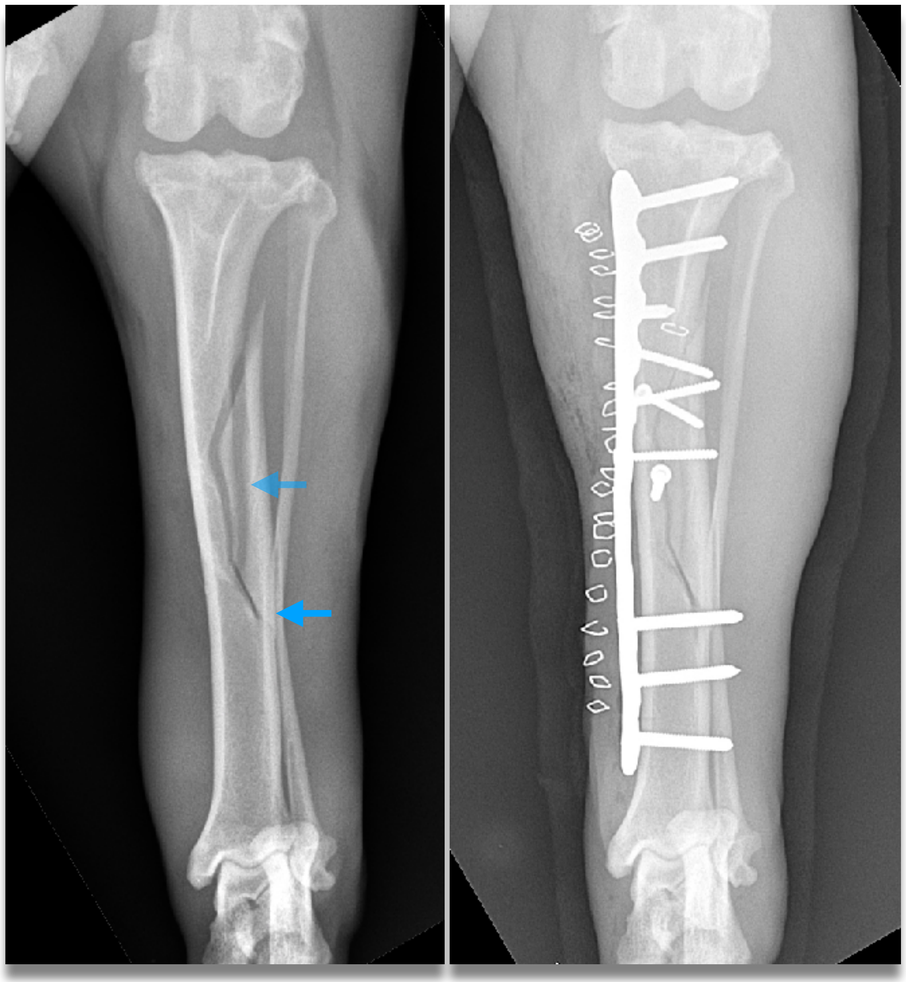
- Anatomical reduction
- Rigid internal fixation
- Preservation blood supply
- Early mobilisation



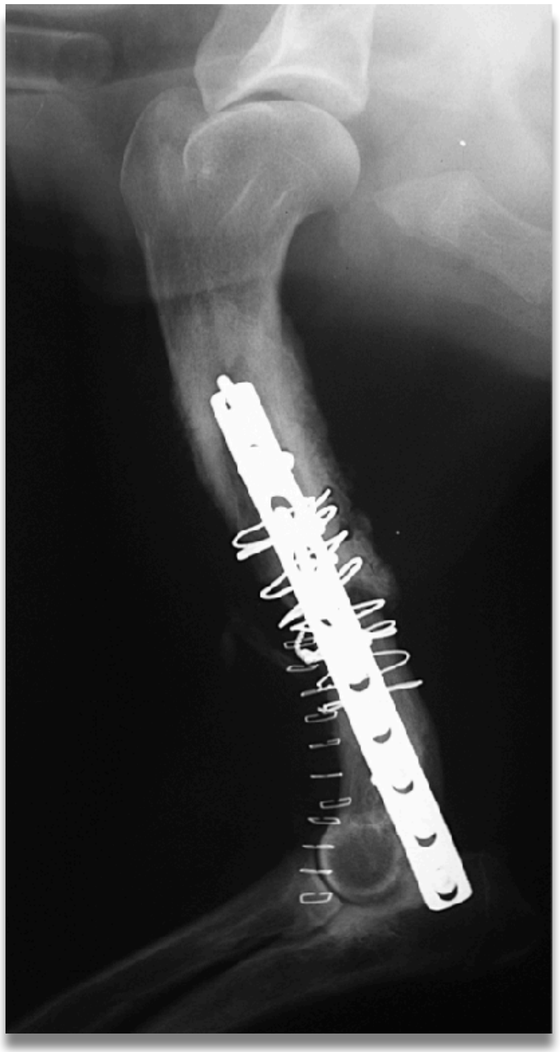
Principle of absolute stability and primary bone healing

Conventional approach- absolute stability

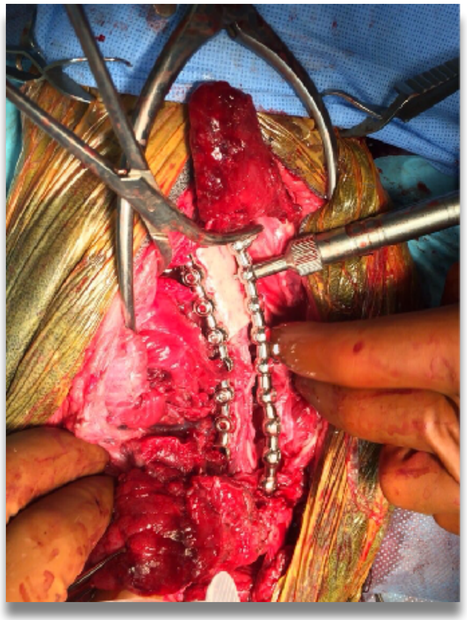


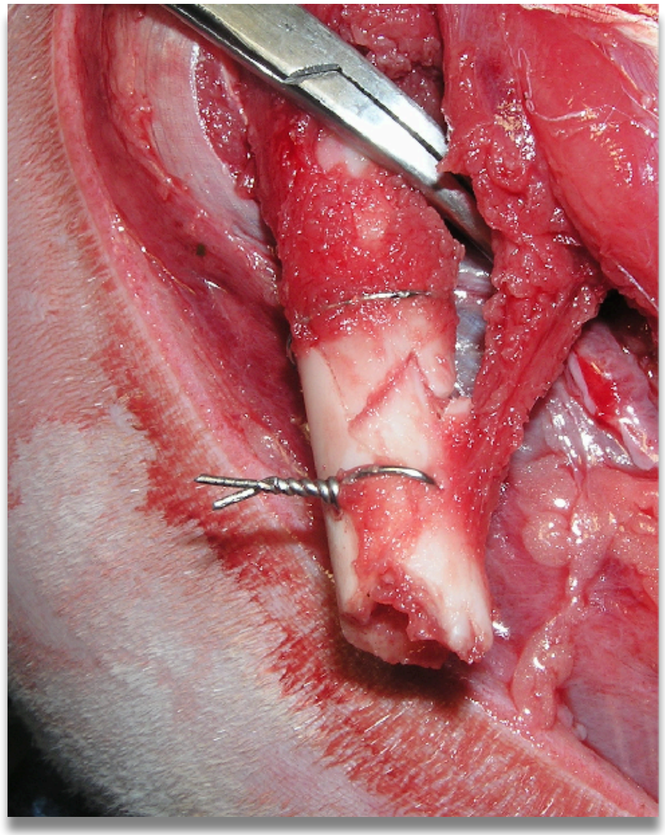


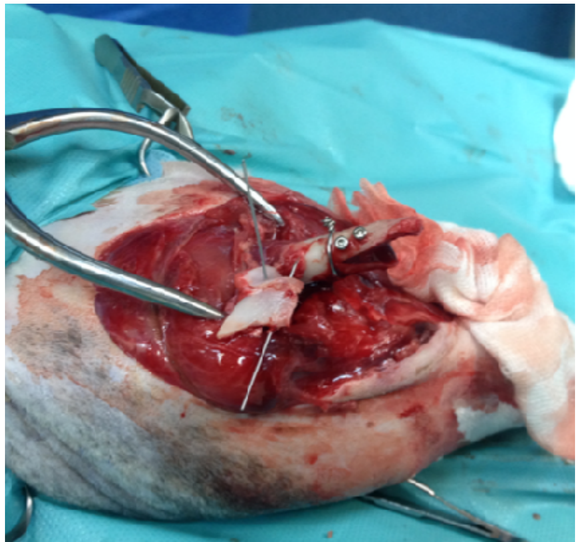
Too much emphasis on biomechanics..



Respect of soft tissues?







A predictable result...

A predictable result...

- Lack of respect of the **soft tissue environment**

Open but do not touch

OBDNT- the first step towards biology

Evolution AO Principles (1990)

- Anatomical reduction
- Rigid internal fixation
- *Preservation blood supply*
- Early mobilisation

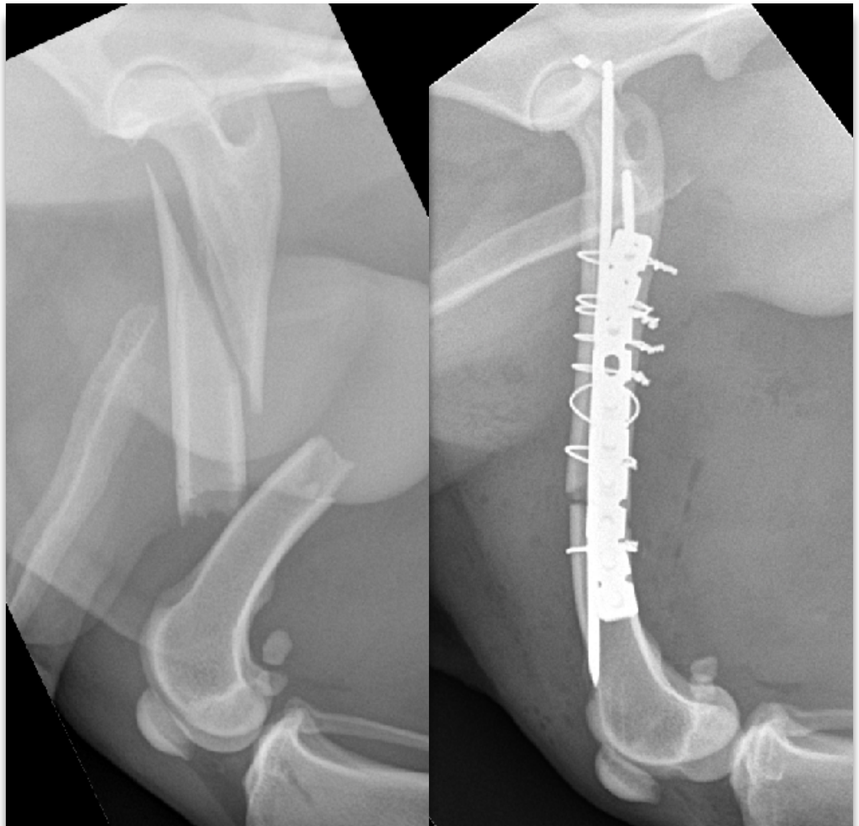
- **Functional** reduction
- **Stable** internal fixation
- *Preservation blood supply*
- Early mobilisation

The concept of Biological Osteosynthesis

- **Functional** reduction
- Stable internal fixation
- **Preservation blood supply**
- Early mobilisation

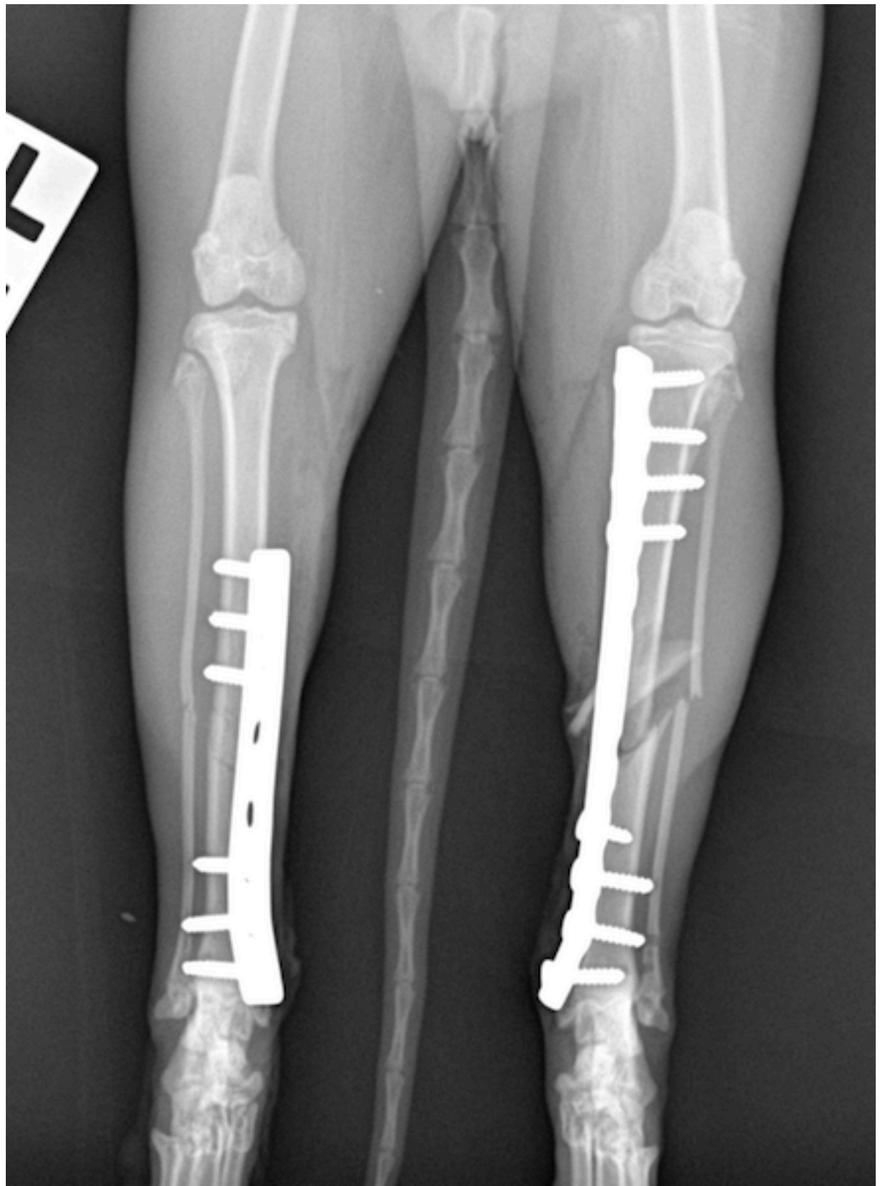
Concept Verdict

Reducible vs non reducible



Concept Verdict

Absolute vs Relative



Human femoral fractures

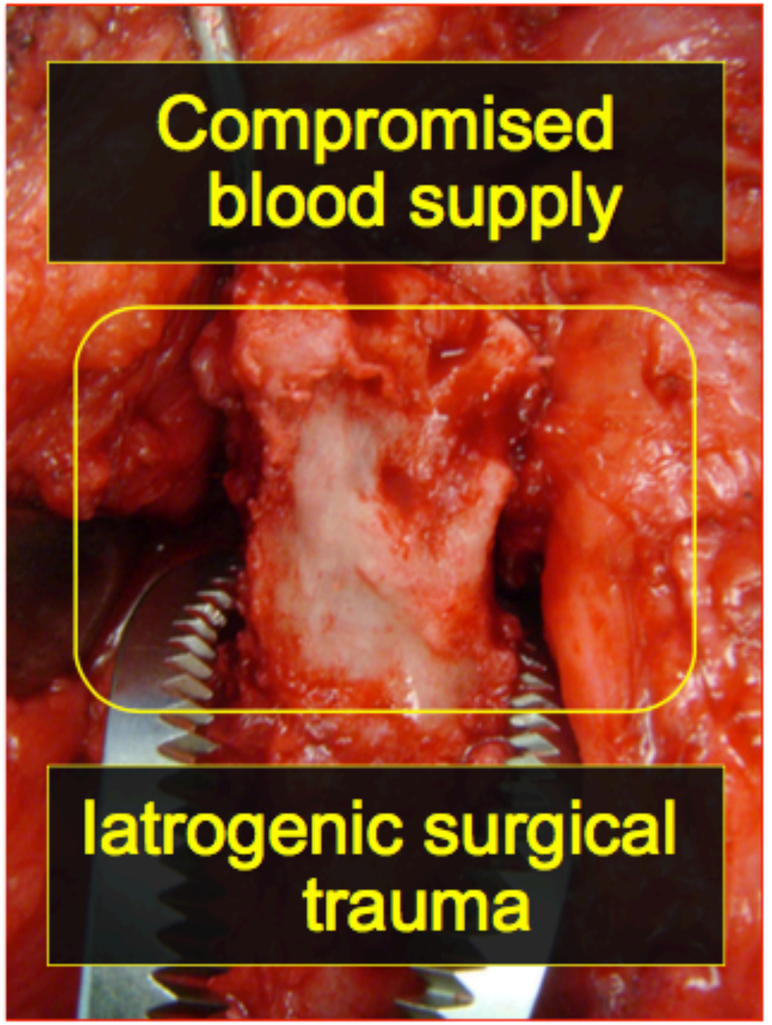
Variable	Group I (1970's)	Group 2 (1980's)	Group 3(1990's)
Implants failures	19%	10%	4%
Non-unions	10%	3%	4%
Mal-unions	10%	7%	0%
Re-operations	43%	31%	13%
Clinical unions (months)	5	5	3
Success rate	**62%**	**83%**	**87%**

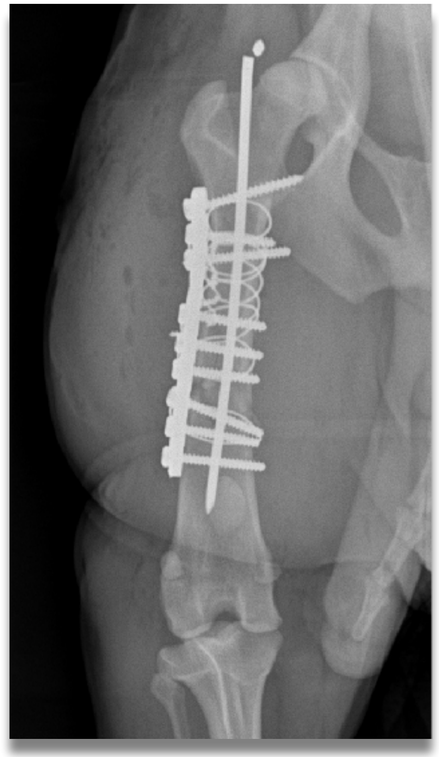
Rozbuch et al, CORR 1998

Conventional approach, femoral fracture

Complications – Plate fixation

- Slow healing (35%)
  - Nonunion
  - Delayed union
- Infection (5%)
- Implant failure (15%)
- Malalignment (20%)
  - Angulation
  - Torsion

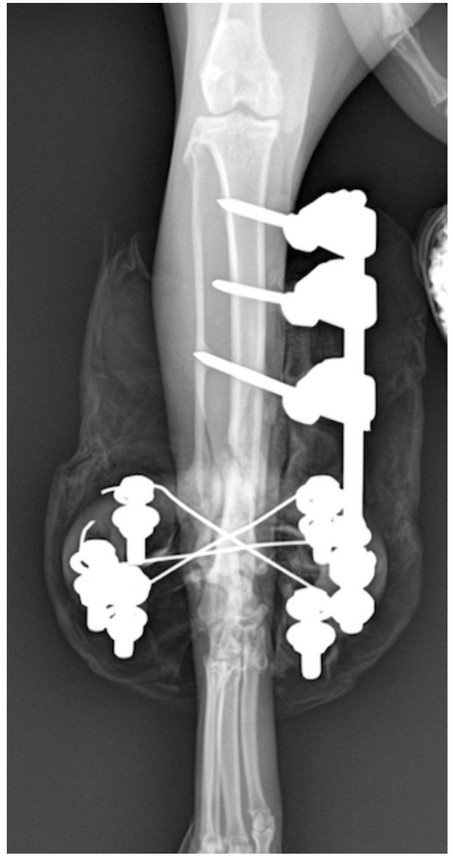




Johnson, JAVMA 1998

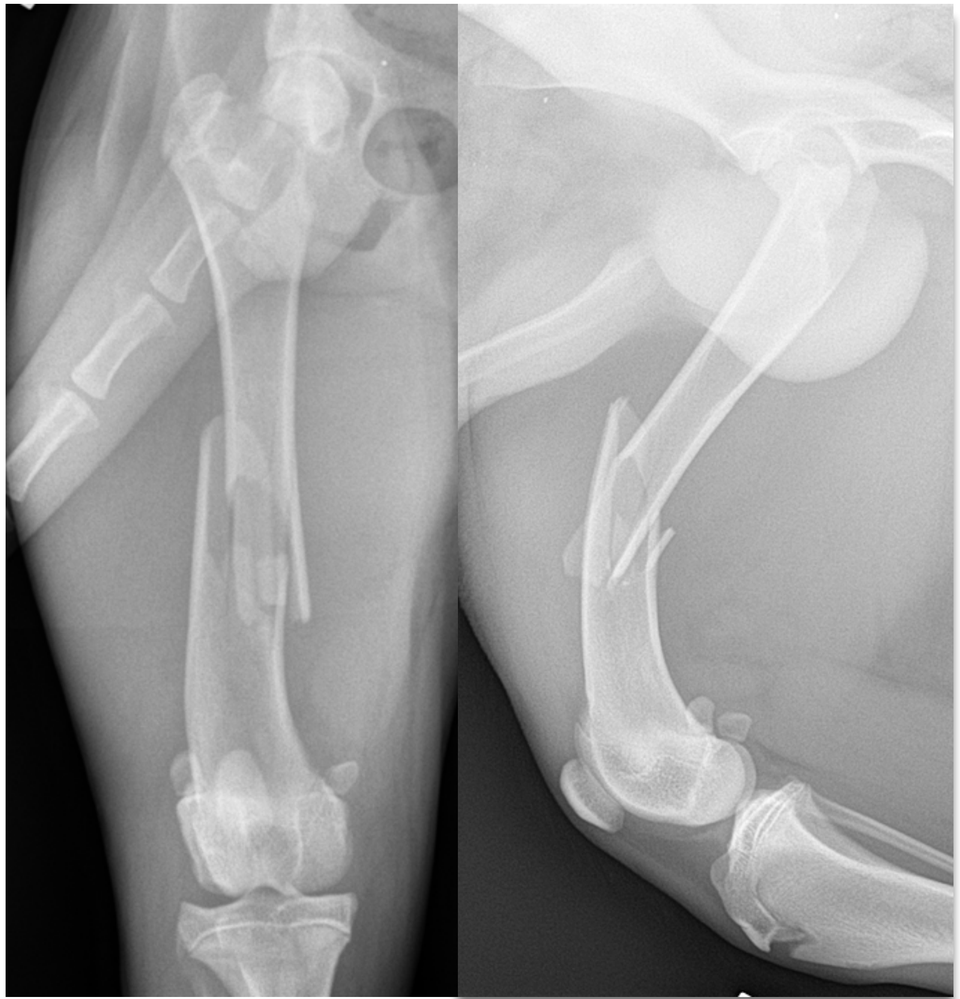
Biological Osteosinthesis with ESF- <u>relative stability</u>

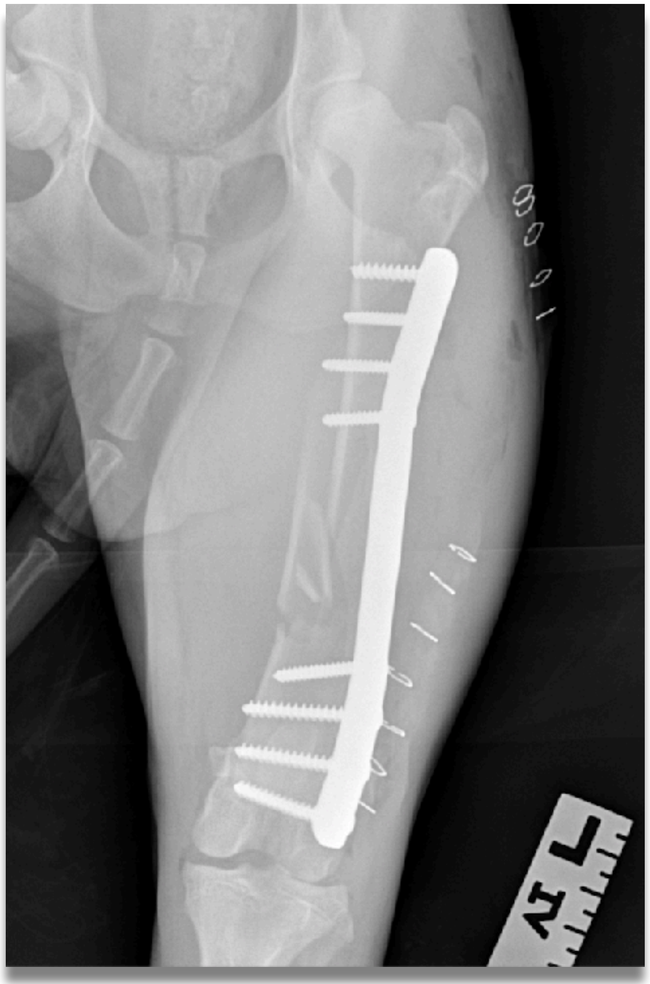
What about Plates?



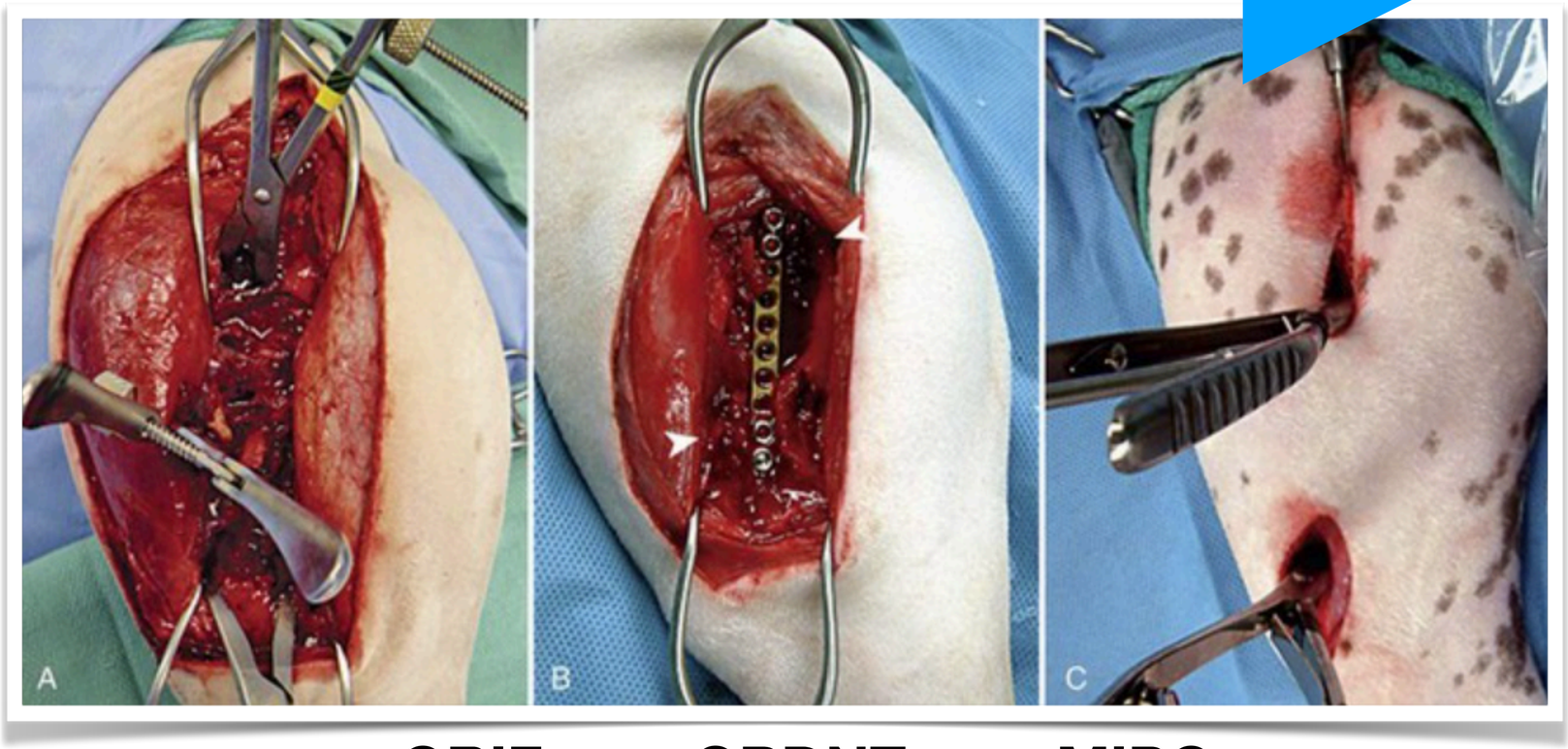
Relative stability

Flexible fixation that stimulate callus formation.





Evolution of concepts



ORIF **OBDNT** **MIPO**

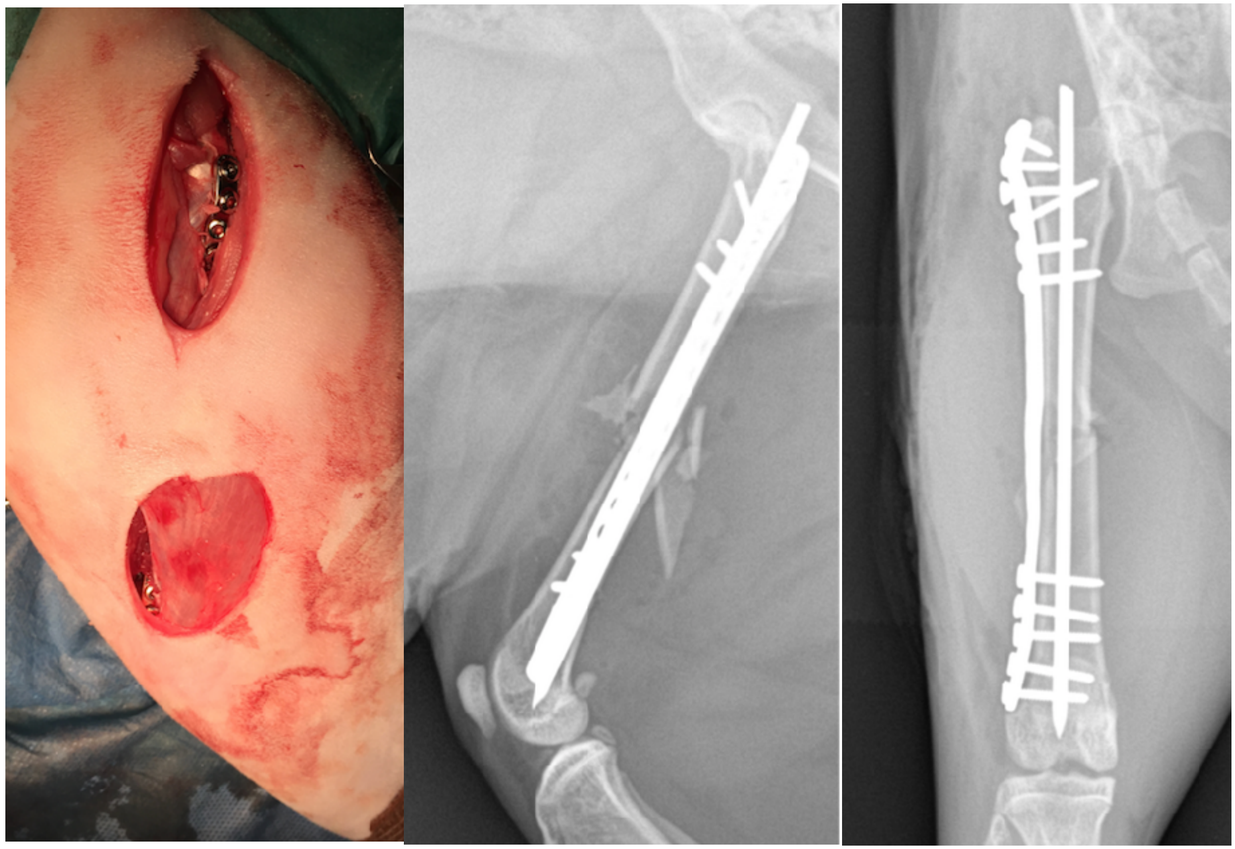
- Reduce the footprint of the implants will reduce the damage to the bone.

Courtesy: Dr. Bruno Peirone

MIPO

- Access to the bone through soft tissue **windows**.

- Minimal additional trauma to the the fracture site when direct reduction is NOT necessary.



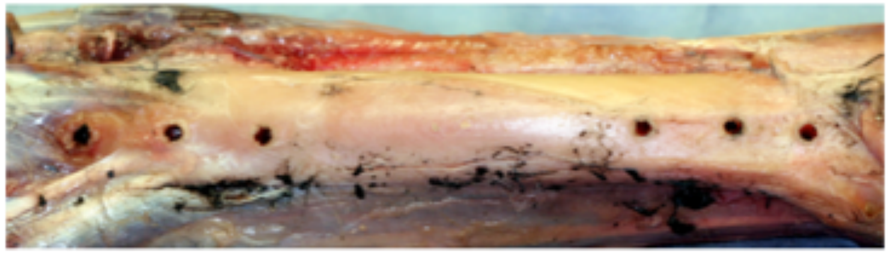
MIPO Advantages

- Preservation of biology

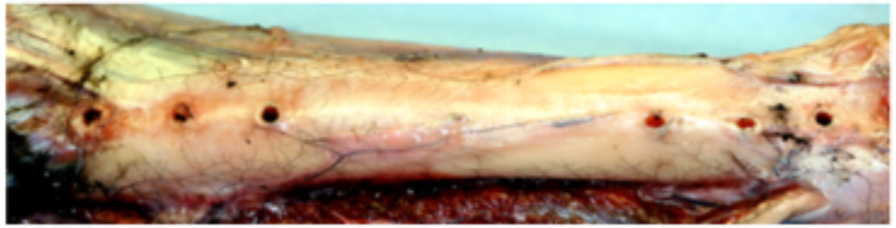
- Decreased infection
- Faster healing

- Decreased wound complications

ORIF



MIPO



Pozzi et al, VOS 2011

MIPO Disadvantages

- Disadvantages

- Limb alignment
- No fragment reduction
- Implant load
- Time consuming?

Evidence in the vet sources

Evidence in the vet sources

The first retrospective study ..

- 8 tibia ORIF vs 8 tibia MIPO
- MIPO 5/8 healed, no complication
- ORIF 2/8 healed, 1 complication

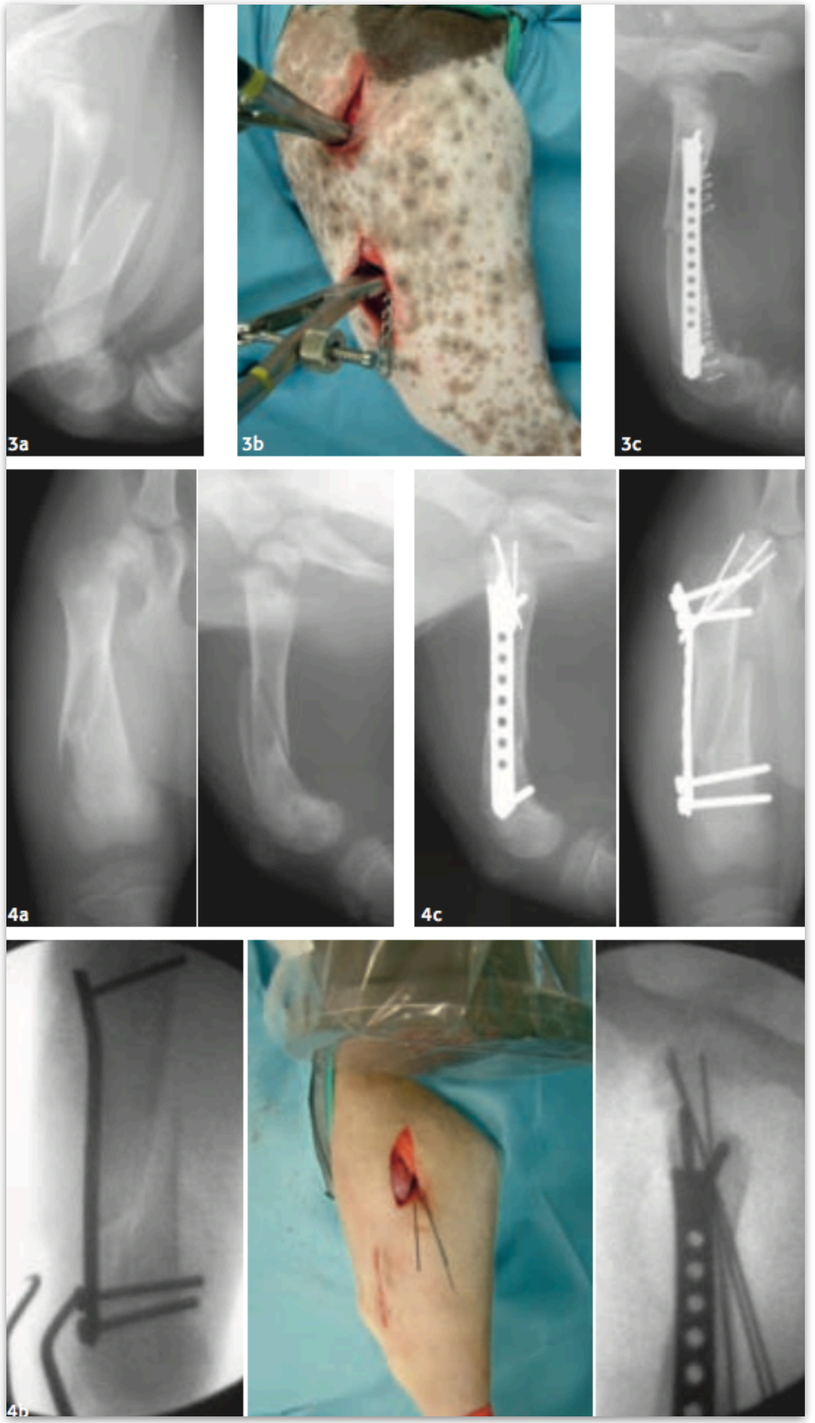
Retrospective comparison between minimally invasive plate osteosynthesis and open plating for tibial fractures in dogs

A. Boero Baroncelli[1]; B. Peirone[1]; M. D. Winter[2]; D. J. Reese[2]; A. Pozzi[2]
[1]Department of Animal Pathology, College of Veterinary Medicine, University of Turin, Grugliasco (TO), Italy; [2]Department of Small Animal Clinical Sciences, College of Veterinary Medicine, University of Florida Gainesville, FL, USA

Evidence in the vet sources

Dejardin L, Cabassu JP. Femural fractures in young dogs. AO Dialogue 3/2008

- MIPO and elastic plate fixation.
- Femoral fractures in two young dogs.



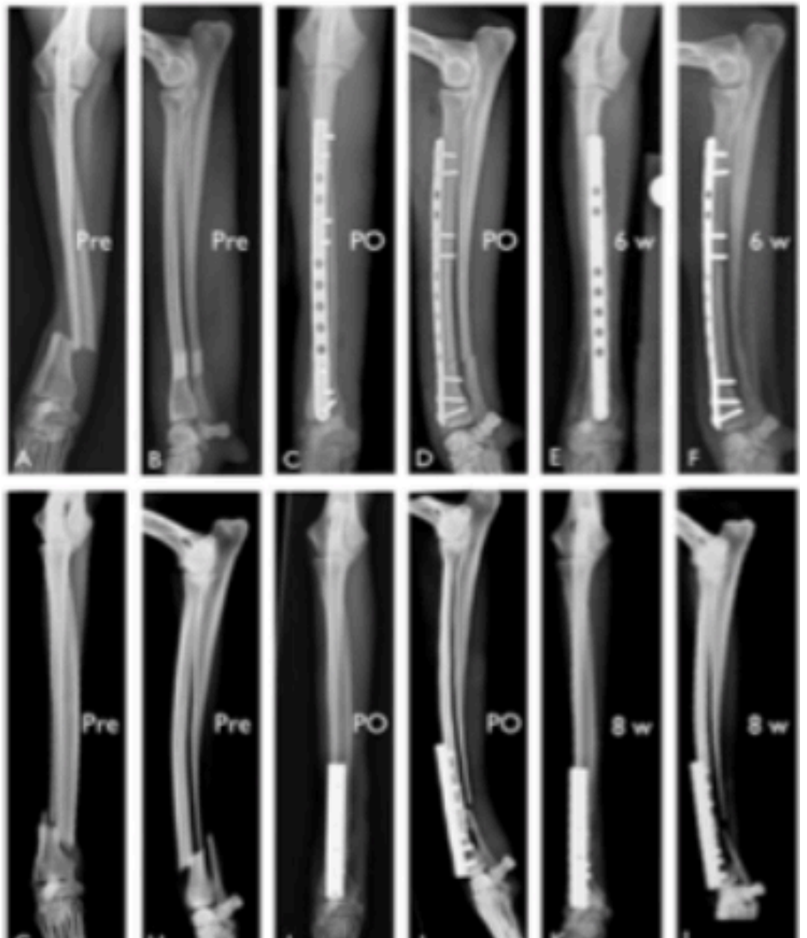
Evidence in the vet sources

Veterinary Surgery 42 (2013) 19–27 © Copyright 2012

Retrospective Comparison of Minimally Invasive Plate Osteosynthesis and Open Reduction and Internal Fixation of Radius-Ulna Fractures in Dogs

Antonio Pozzi, DMV, MS, Diplomate ACVS, Caleb C. Hudson, DVM, MS, Christopher M. Gauthier, DVM, and Daniel D. Lewis, DVM, Diplomate ACVS

- Retrospective cohort study
- MIPO vs ORIF (15 cases each)
- No statistical differences
  - Operating time
  - Postoperative alignment
  - Time to union
    - MIPO: 51.9 ± 18.4 days
    - ORIF: 49.5 ± 26.5 days



Evidence in the vet sources

Surgical approaches for minimally invasive plate osteosynthesis in dogs

A. Pozzi; D. D. Lewis
Department of Small Animal Clinical Sciences, University of Florida, Gainesville, Florida, USA

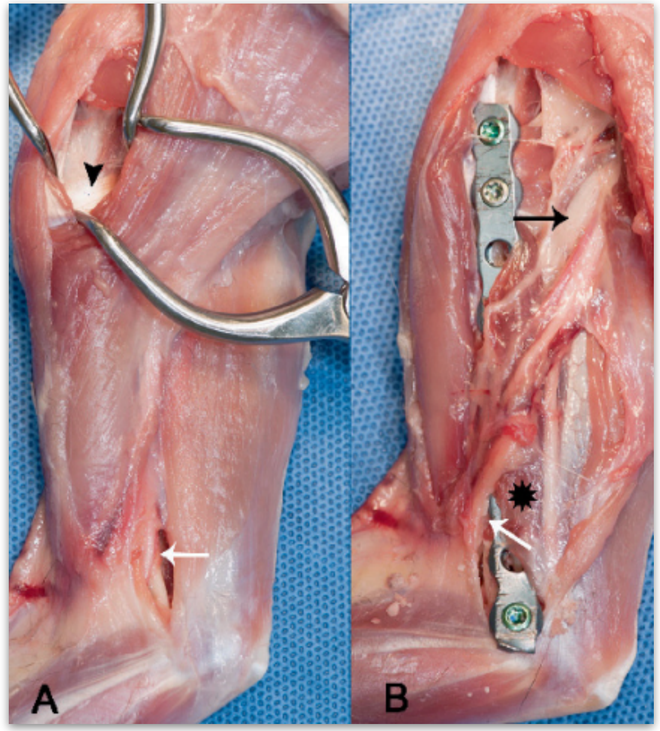
- Description of surgical approaches for MIPO
- Main bone segments

Evidence in the vet sources

Guidelines for surgical approaches for minimally invasive plate osteosynthesis in cats

Philipp A. Schmierer; Antonio Pozzi

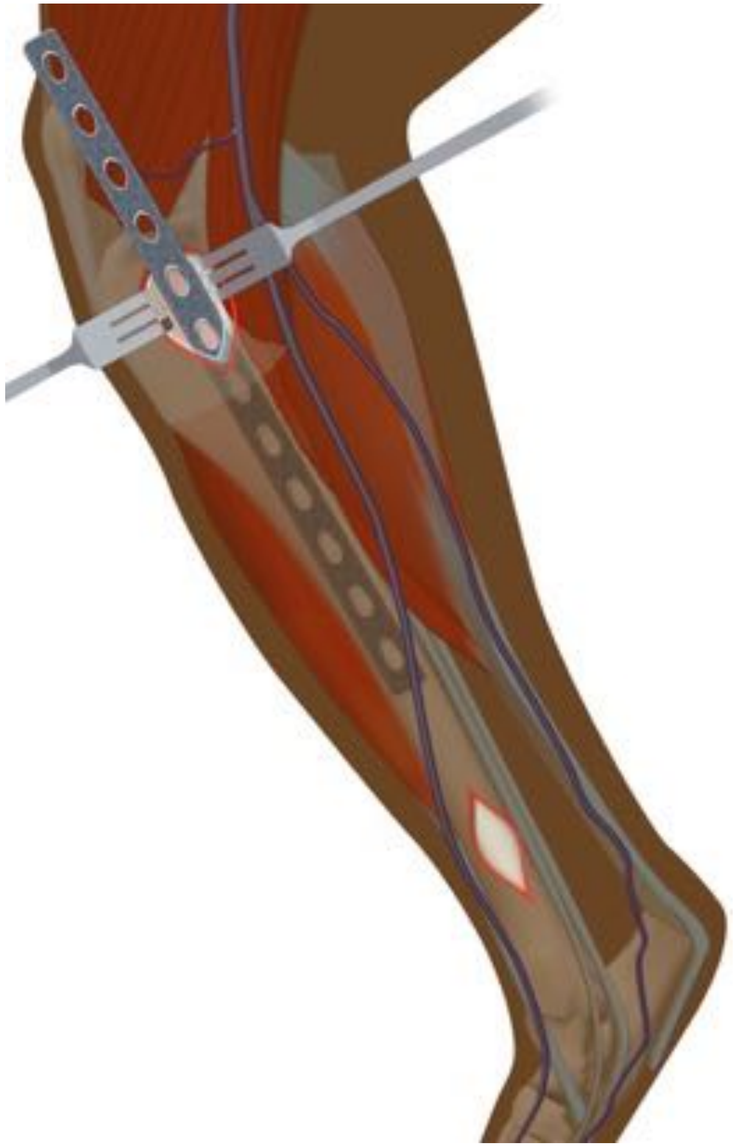
Vetsuisse Faculty University of Zurich, Clinic for Small Animal Surgery, Zurich, Switzerland



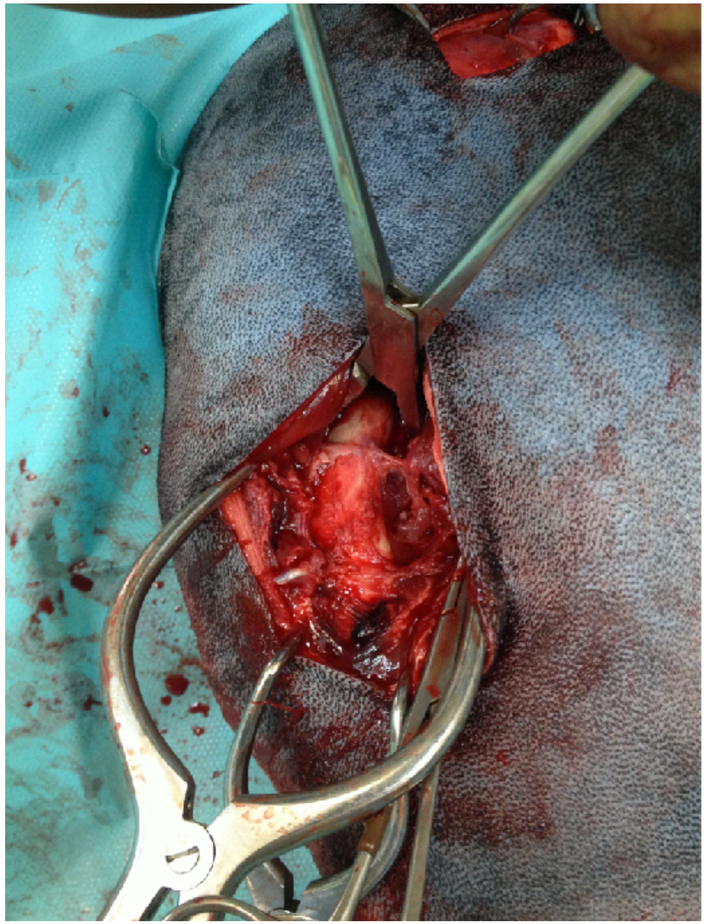
"The surgical approaches developed for the humerus and radius-ulna **<u>differed</u>** …..between **dogs and cats**"

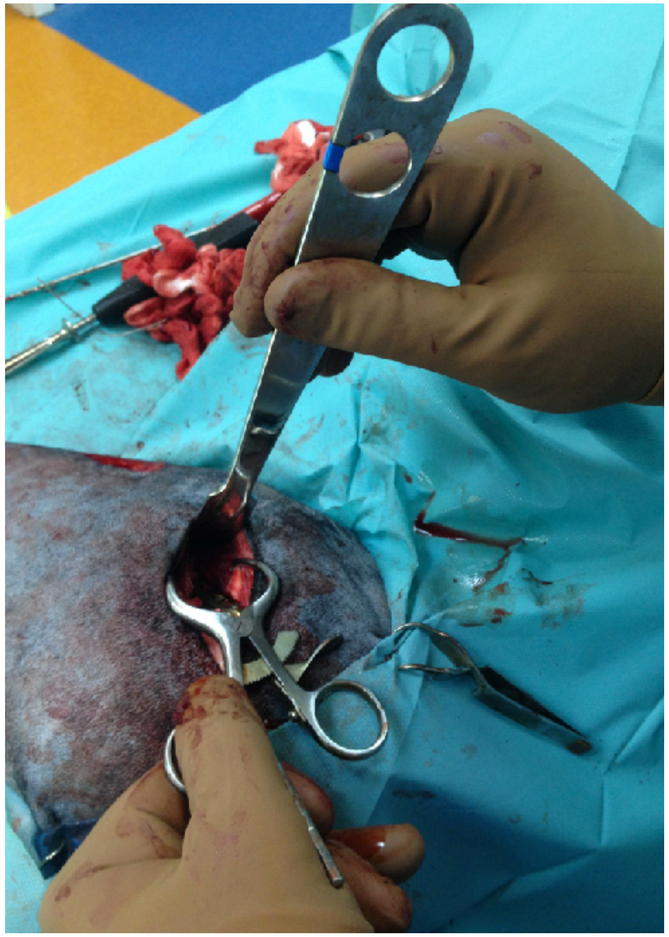
MIPO steps

- anatomy
- surgical approach
- indirect reduction
- implant selection
- intra-op imaging



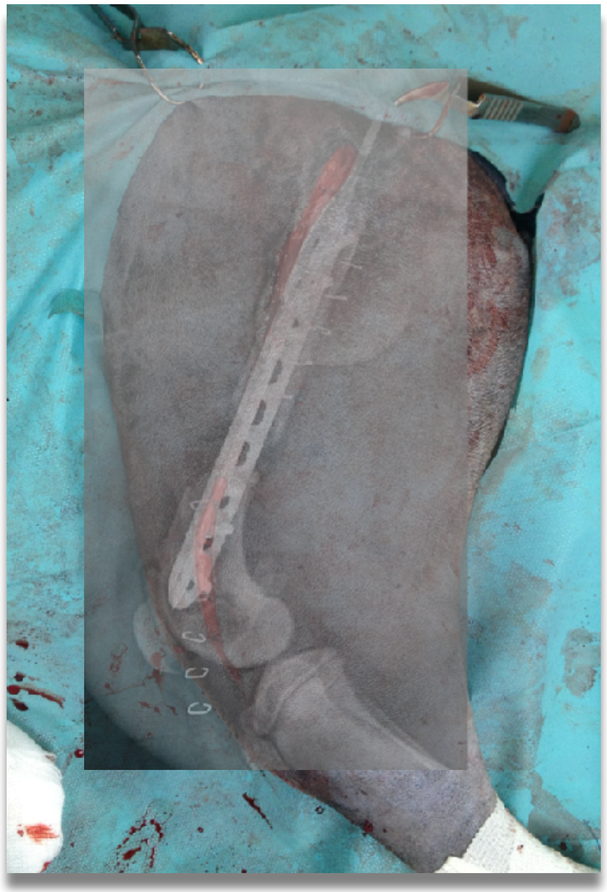
Portals





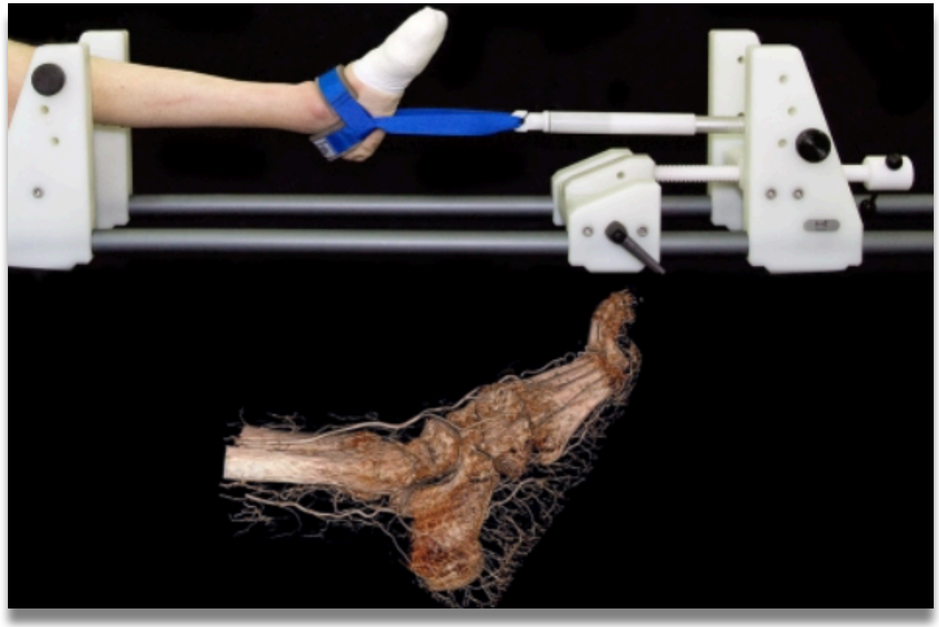
Indirect reduction

Fixation



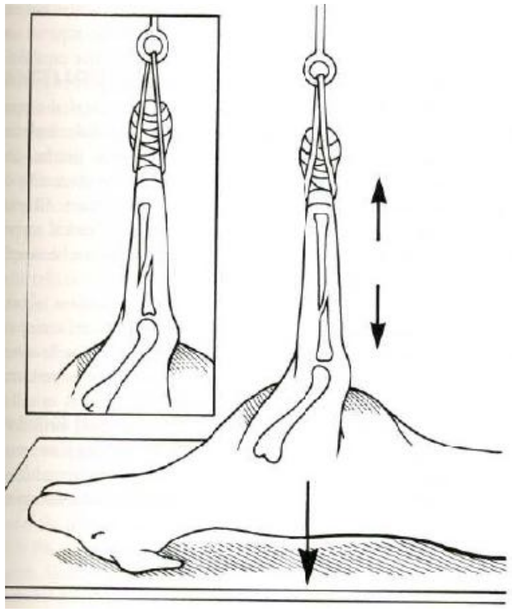
Indirect Reduction Techniques

- Traction table
- IM Pin
- Bone reduction forceps
- External fixator



Hanging Technique

Pre op distraction hanging



Traction table

Clinical application of intraoperative skeletal traction in the dog

G. L. Rovesti[1], A. Margini[1], F. Cappellari[2], B. Peirone[2]
[1]Veterinary Clinic M. E. Miller, Cavriago, Reggio Emilia, Italy
[2]Department of Animal Pathology, School of Veterinary Medicine of Turin, Grugliasco, Turin, Italy

Intraoperative skeletal traction in the dog

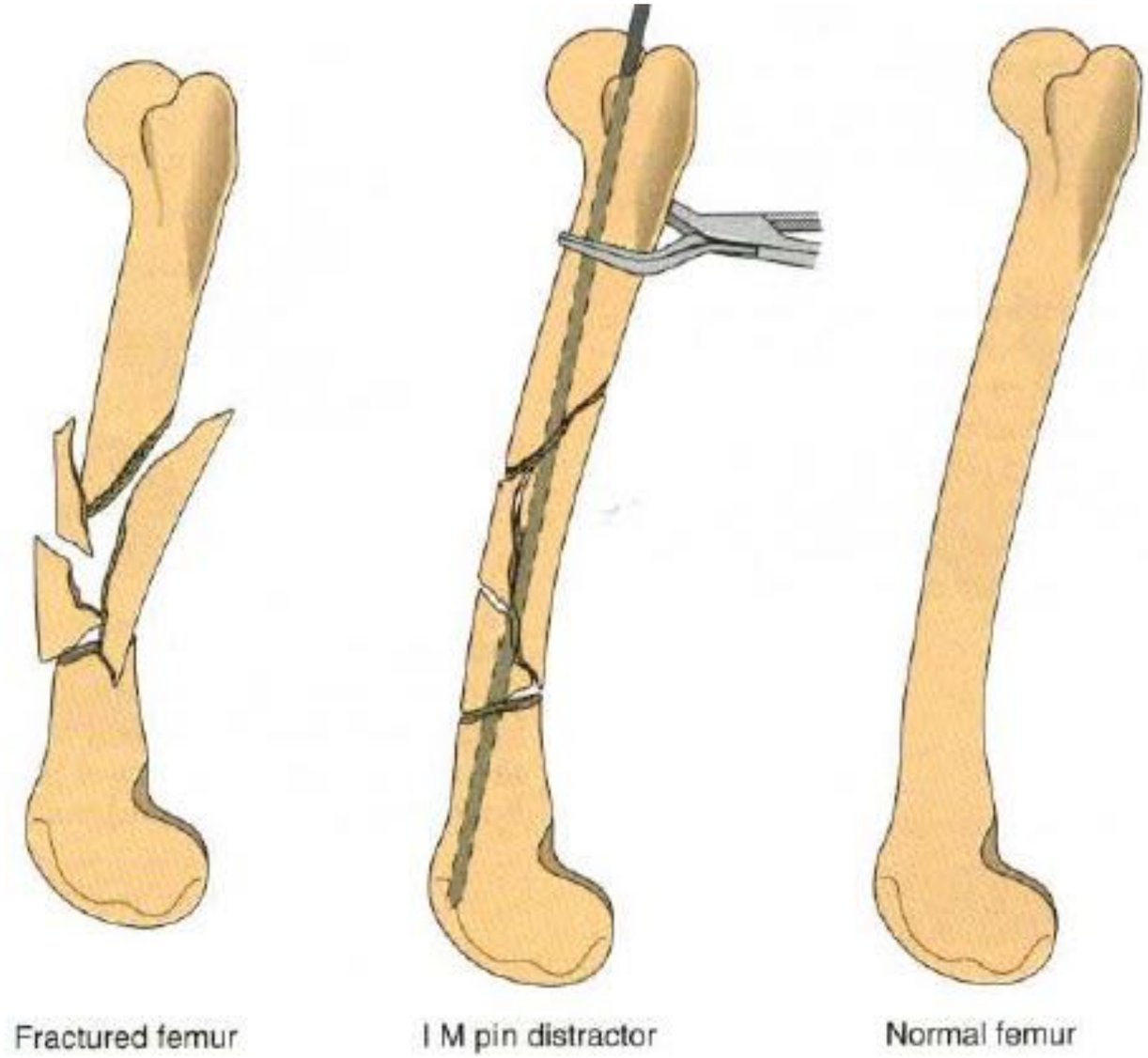
A cadaveric study

G. L. Rovesti[1], A. Margini[1], F. Cappellari[2], B. Peirone[2]
[1]Veterinary Clinic M. E. Miller, Cavriago, Reggio Emilia, Italy
[2]School of Veterinary Medicine of Turin, Grugliasco, Turin, Italy

Vet Comp Orthop Traumatol 2006; 19: 9–13

Vet Comp Orthop Traumatol 2006; 19: 14–9

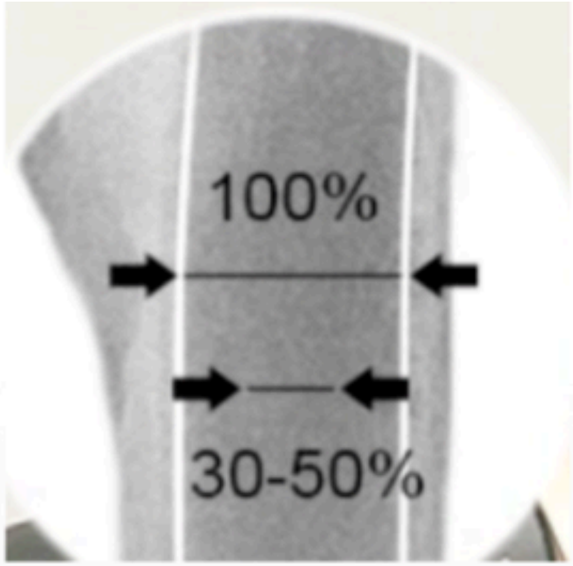
IM pinning



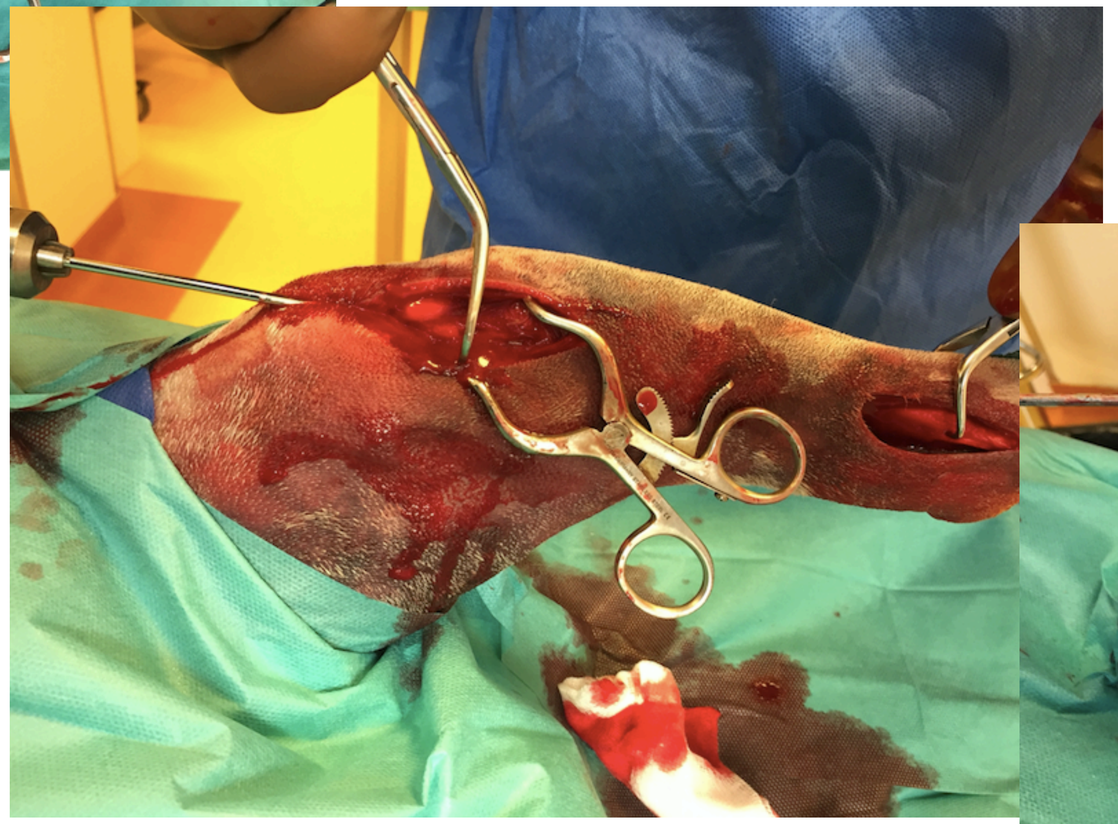
IM pinning

- Diameter 30-50% of medullary canal

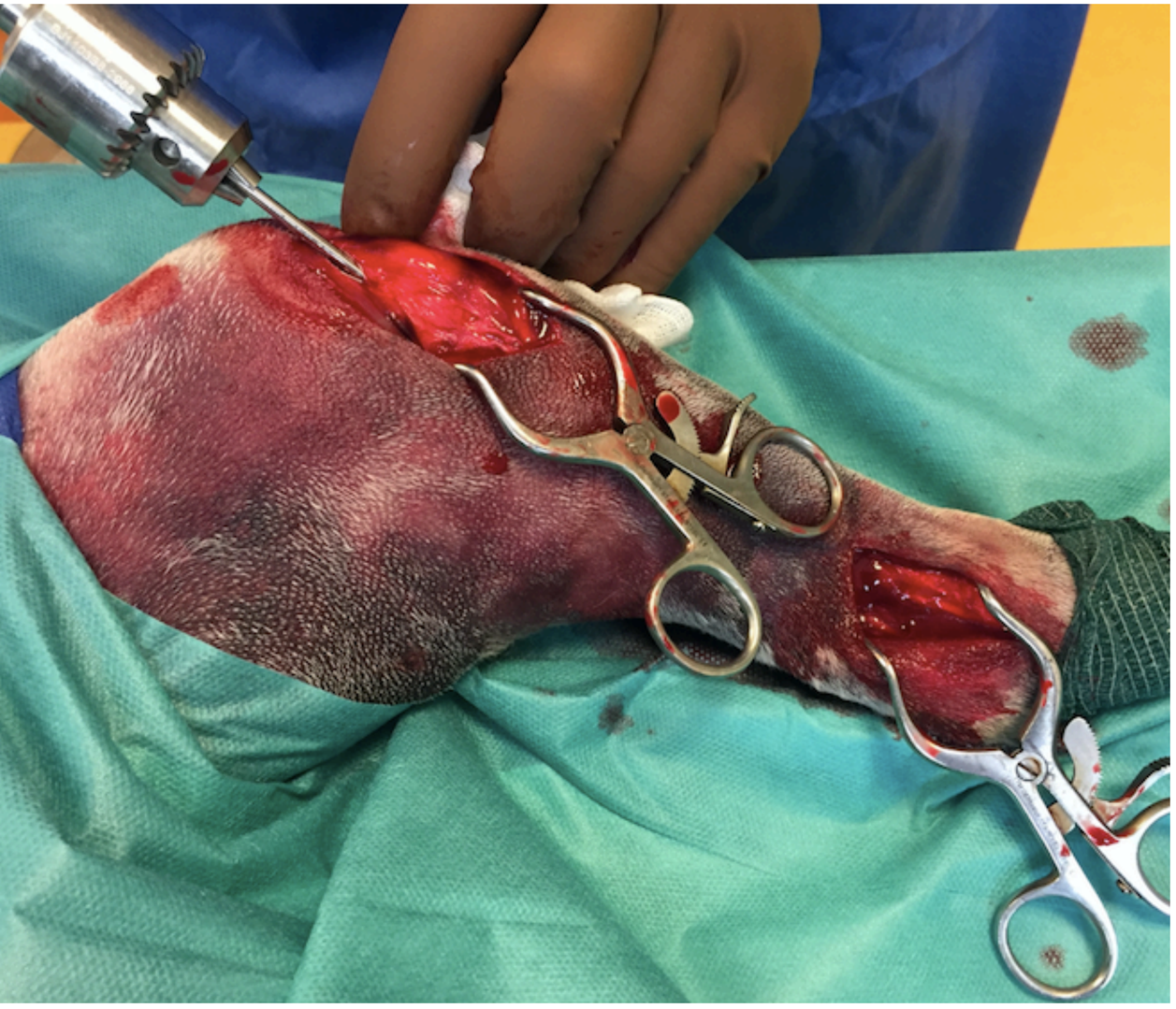
- Distally- engaging the metaphyseal area



IM pinning

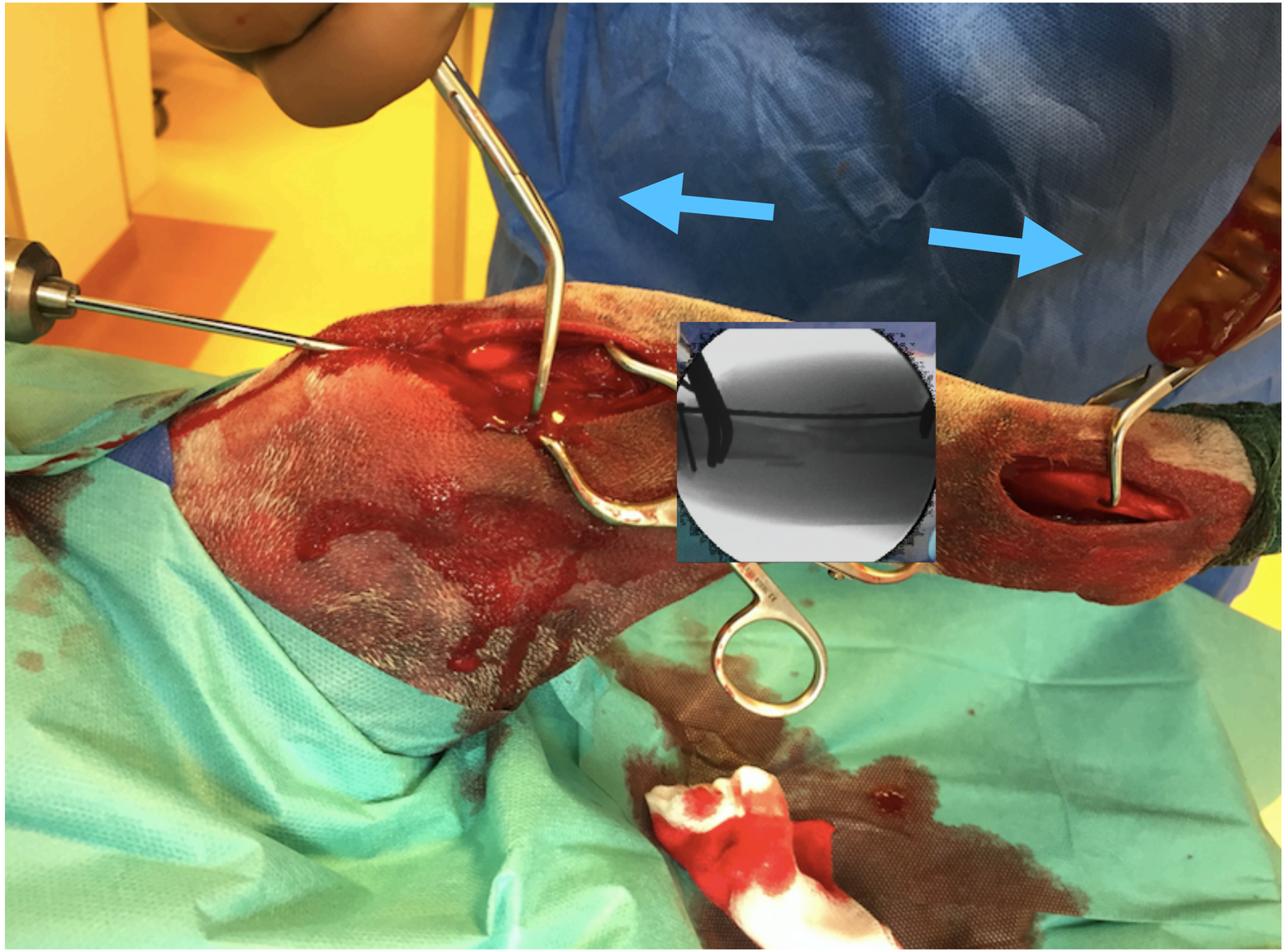


IM pinning



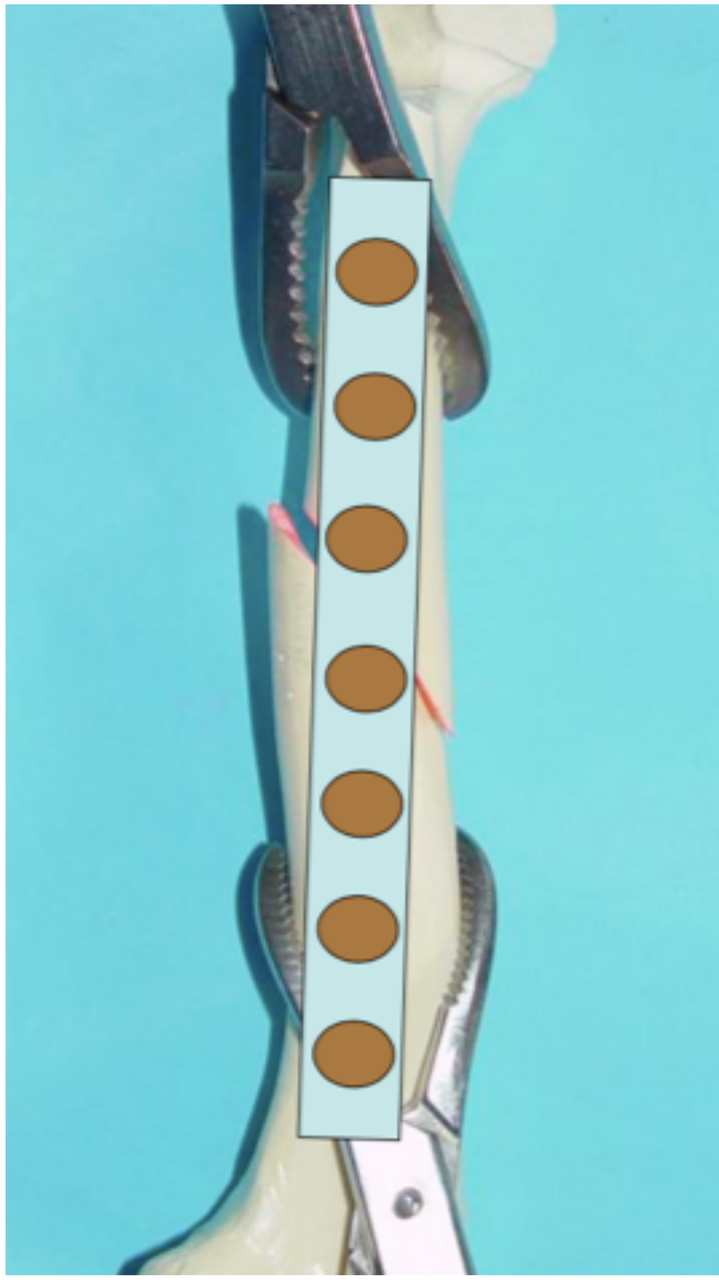
Bone holding forceps

Bone holding forceps



Bone holding forceps

- Distract/ manipulate bone segments
- Serrated bone holders- space occupying
- Can interfere with the plate



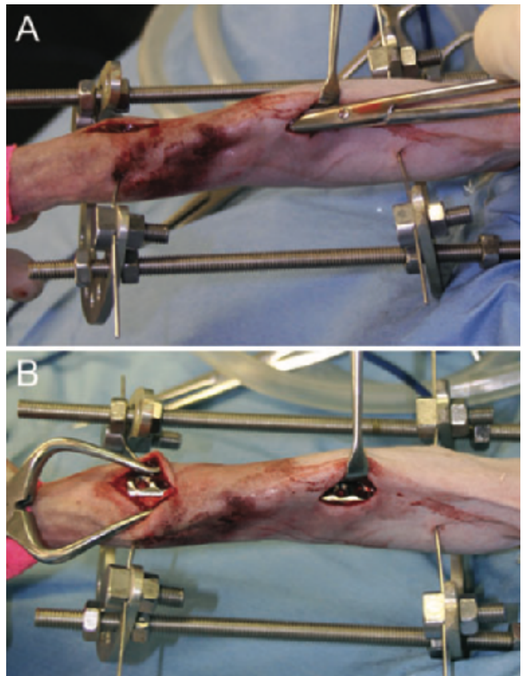
Courtesy: B. Peirone

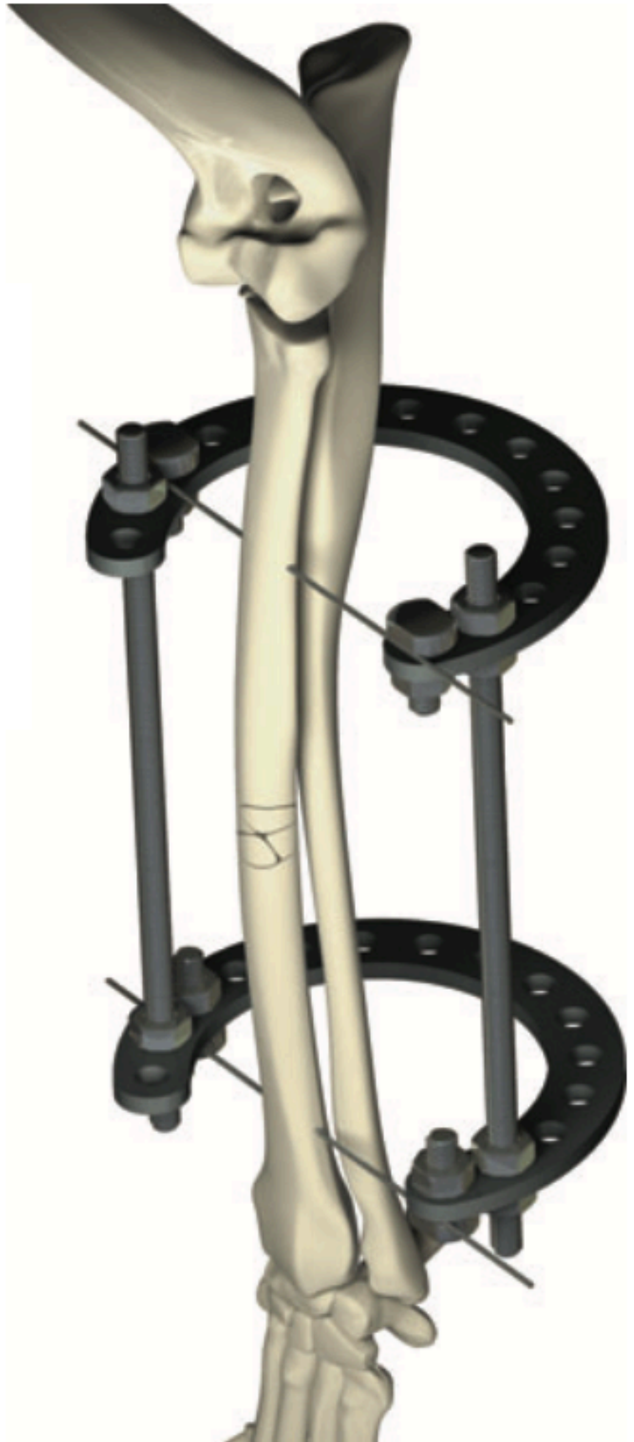
External Fixator

Retrospective Comparison of Minimally Invasive Plate Osteosynthesis and Open Reduction and Internal Fixation of Radius-Ulna Fractures in Dogs

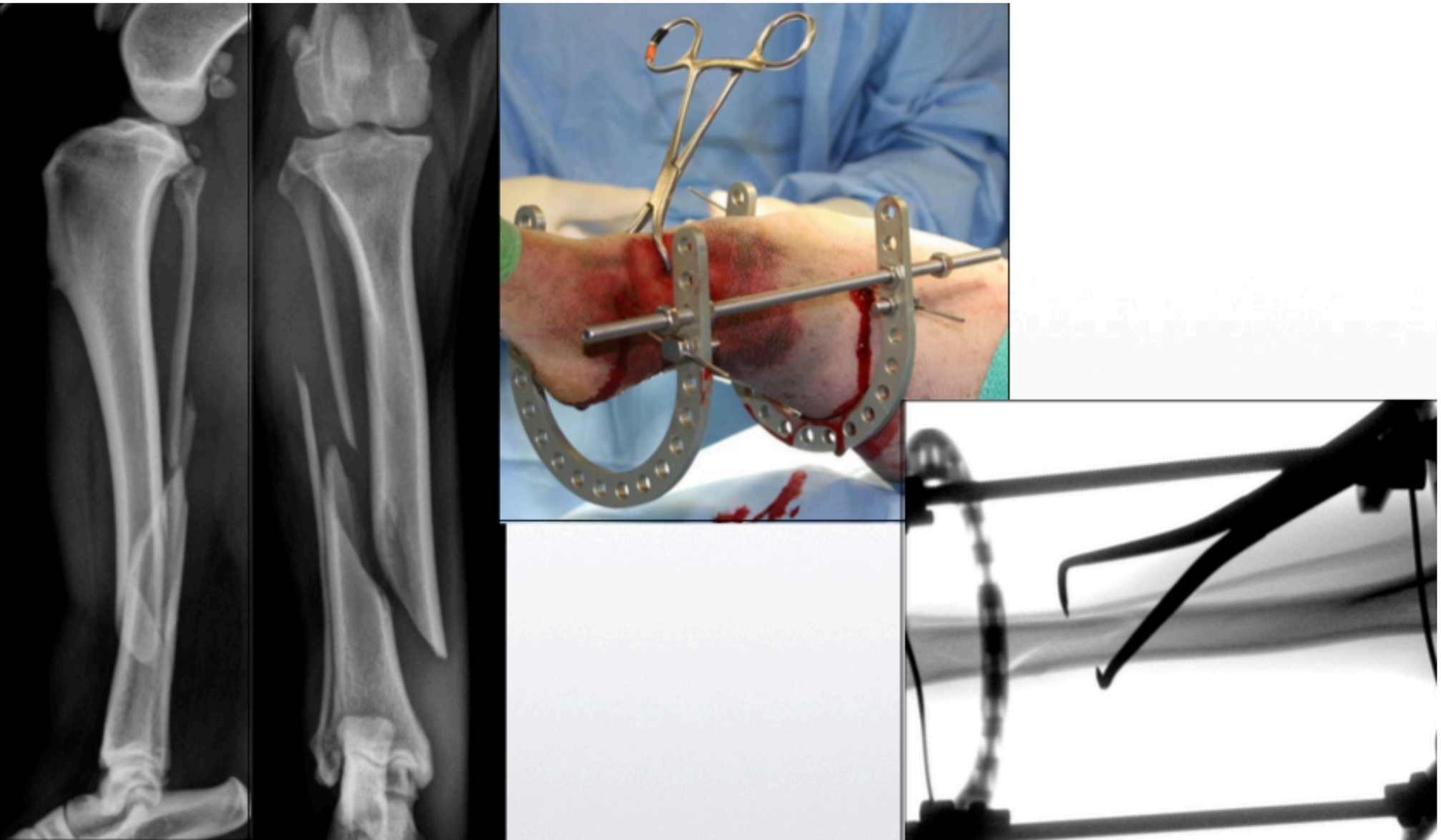
Antonio Pozzi, DMV, MS, Diplomate ACVS, Caleb C. Hudson, DVM, MS, Christopher M. Gauthier, DVM, and Daniel D. Lewis, DVM, Diplomate ACVS

Department of Small Animal Clinical Sciences, University of Florida, Gainesville, FL





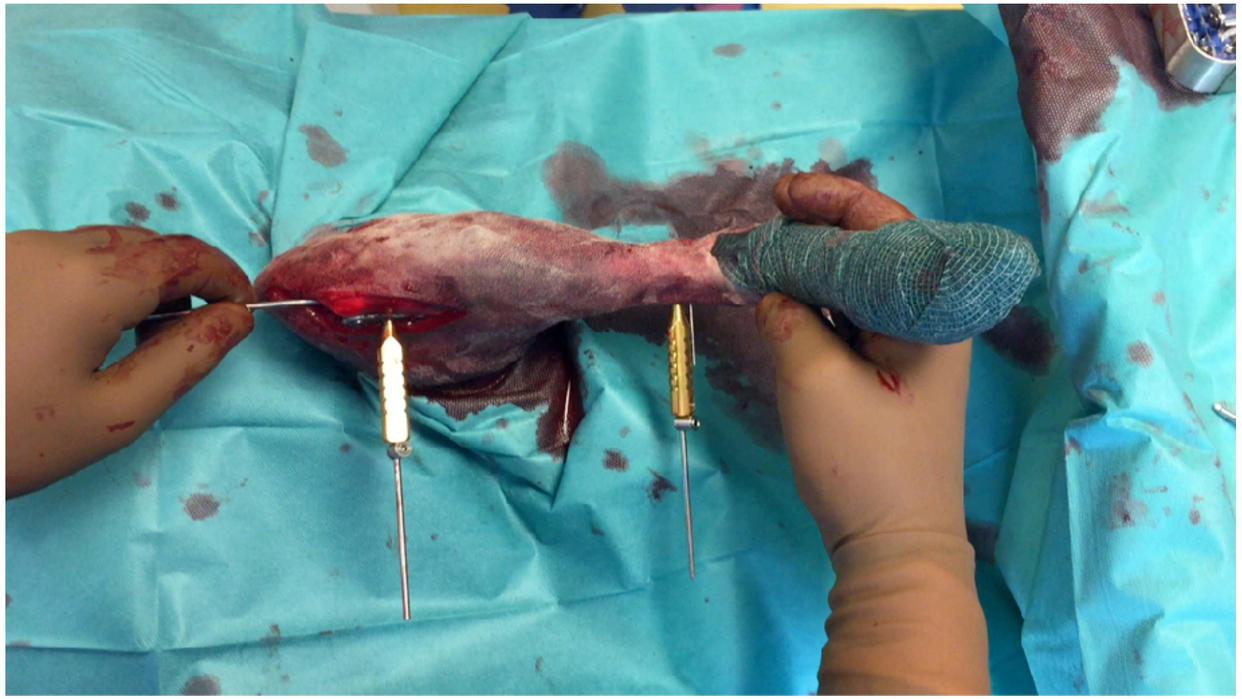
External Fixator



Courtesy:
Dr. A.Pozzi

Reduction with a plate

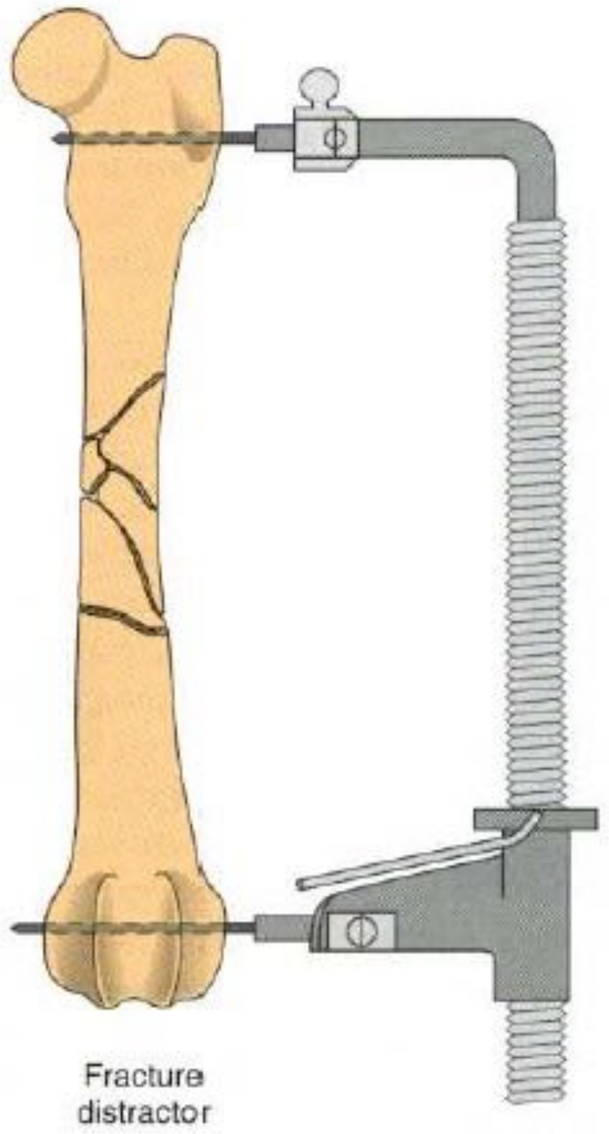
- **Push-Pull device**
- **Check alignment!!**



Distraction device

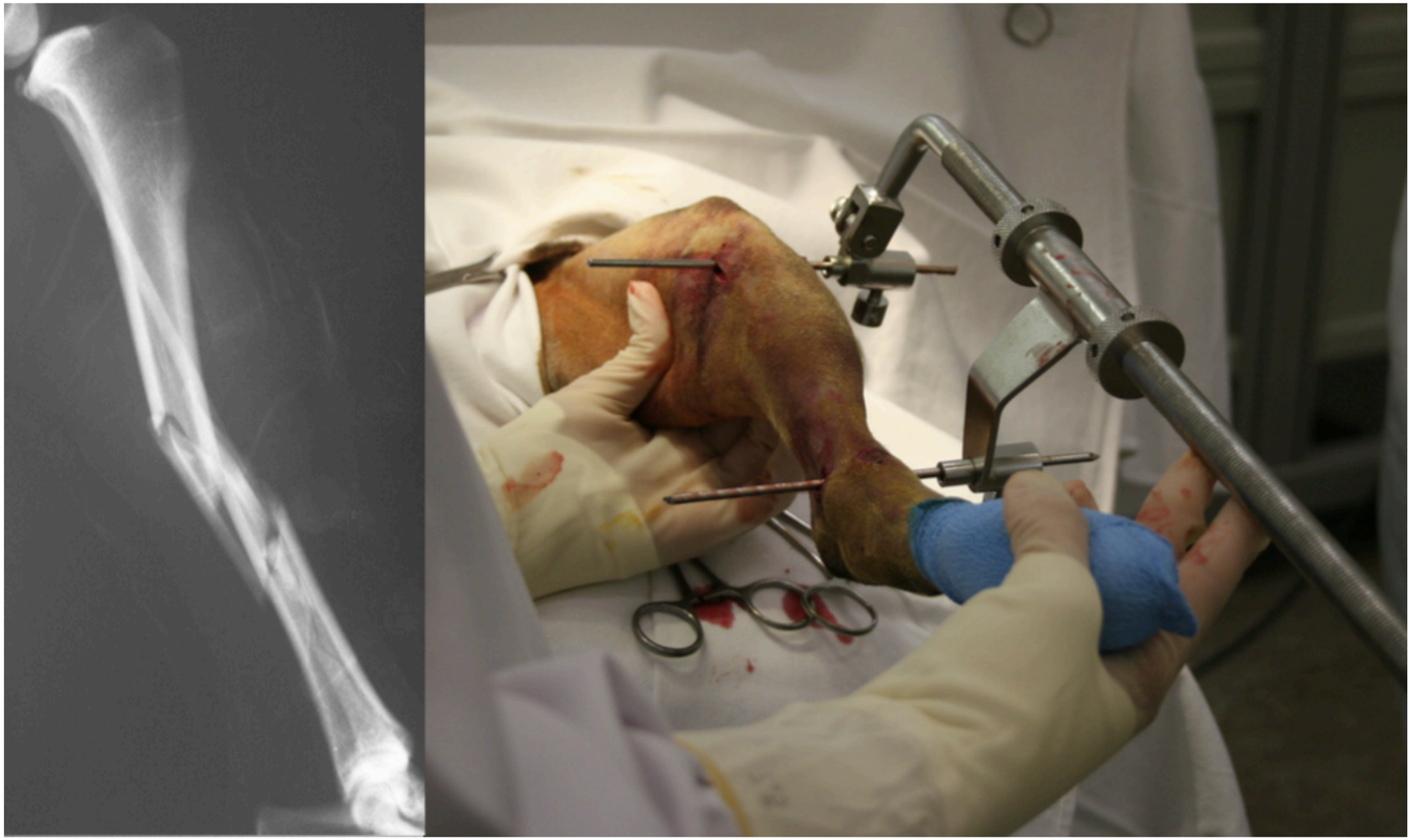
- VI orthopaedic distractor

- Muscle contraction overcoming
- Accurate alignment



Fracture distractor

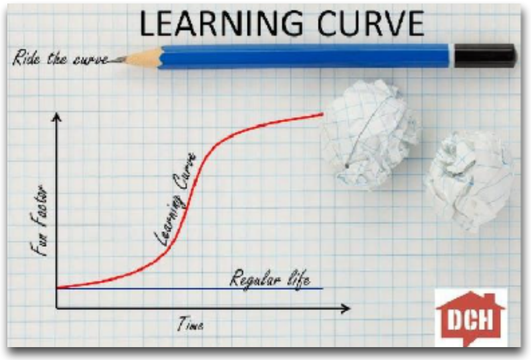
Distraction device



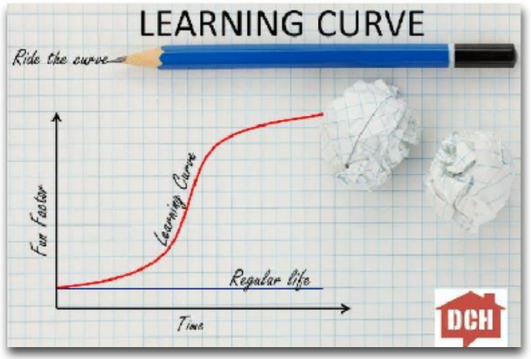
Courtesy: A. Pozzi

Fluoroscopy

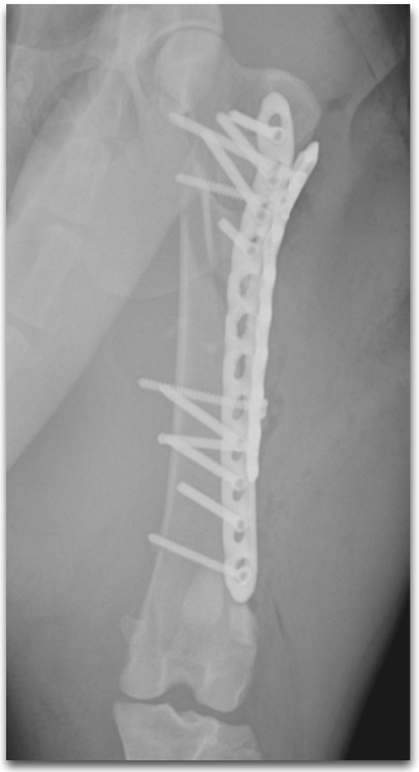
Leraning curve

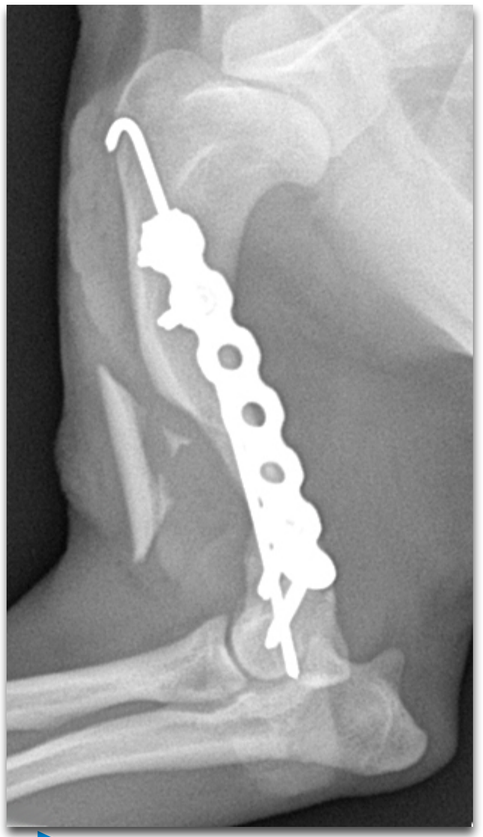


Leraning curve



Experience





Difficulty

Case selection

Chose your battles wisely..

Difficulty

MIPO - TIBIA

Plate length

- ML view contralateral limb Xray.
- Assessment of plate length.
- 90% of the tibia length.

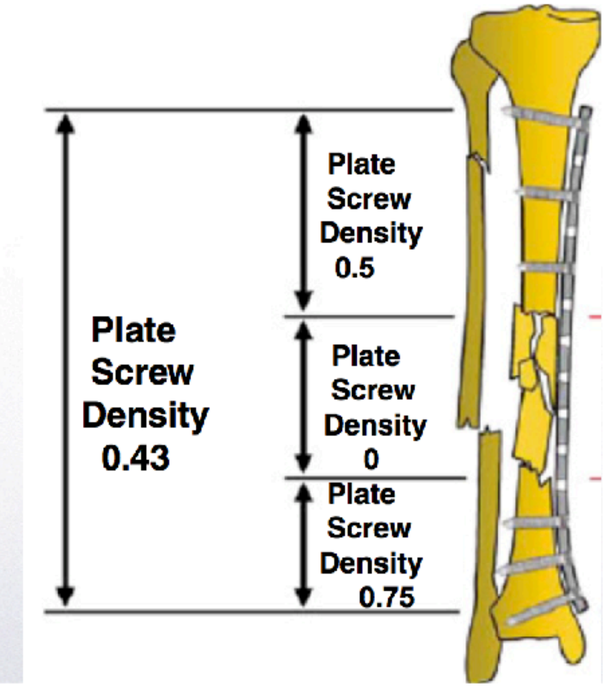


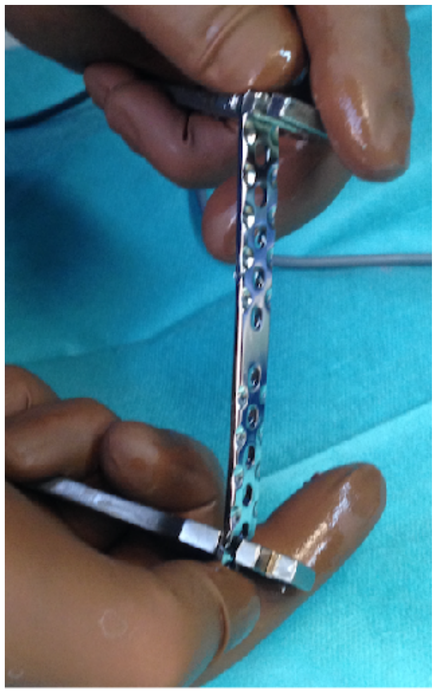
Plate pre-contouring

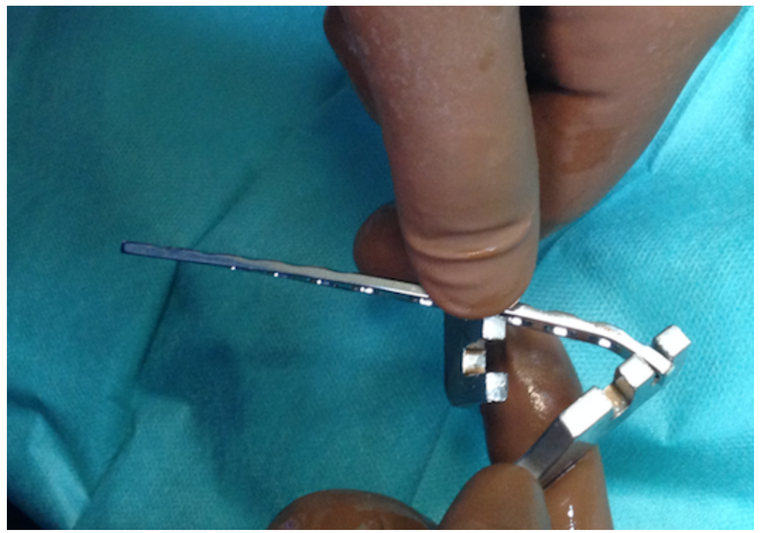
Contour the plate on the **AP view** of the unaffected limb.

Plate pre-contouring

Bending

Twisting





Prox

First fix the plate proximally to avoid external rotation

Schmokel HG et al, VCOT 2003

Dist

Plate pre-contouring

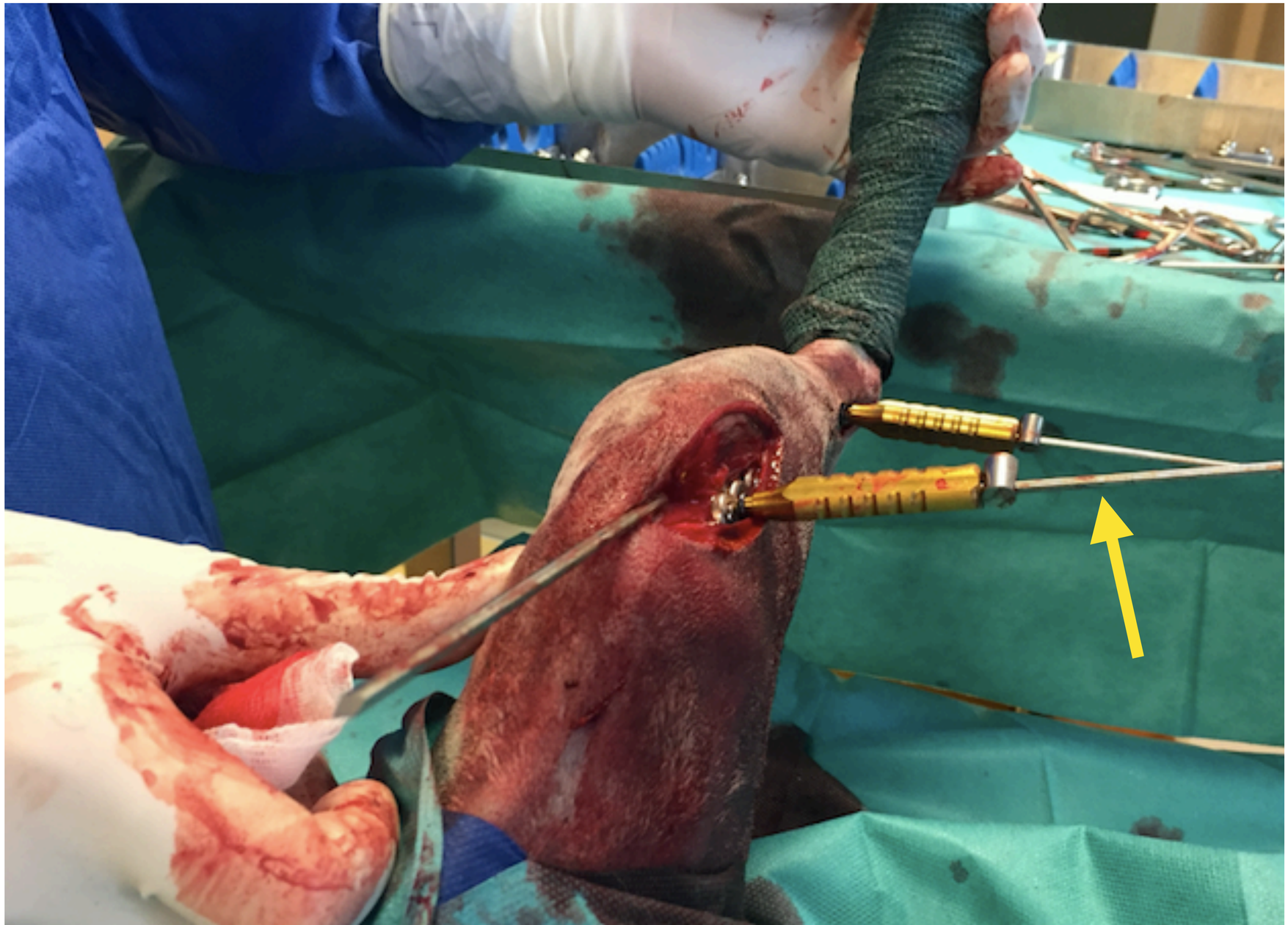
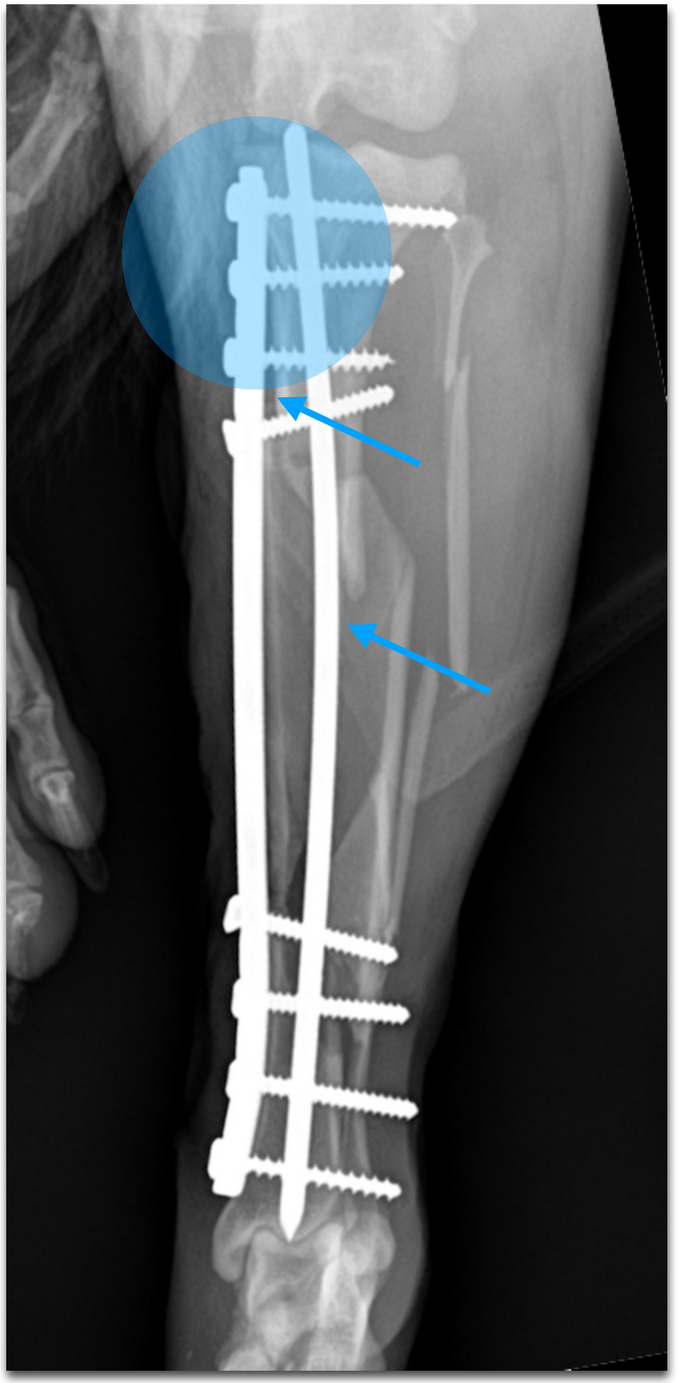


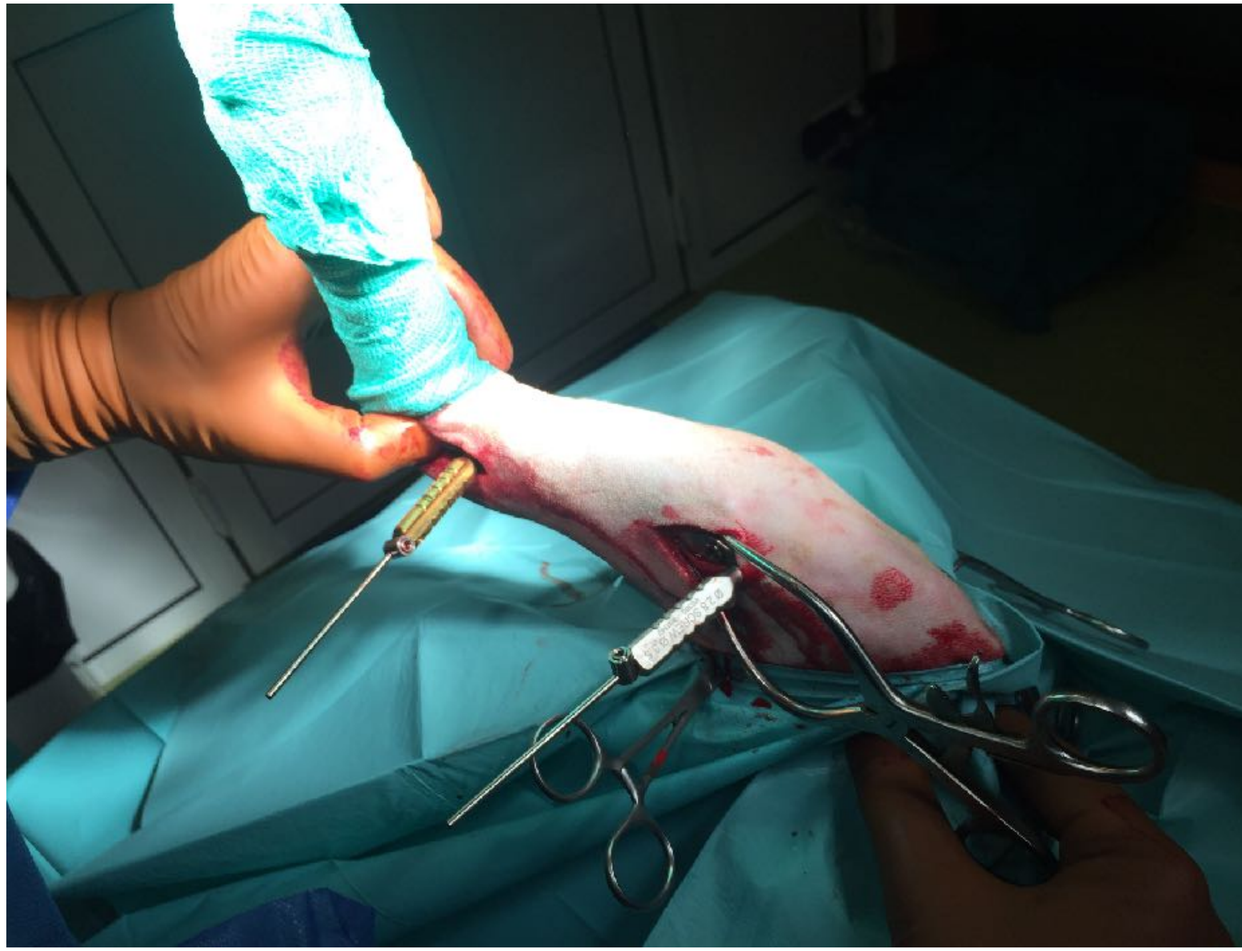
Plate pre-contouring



Patient positioning

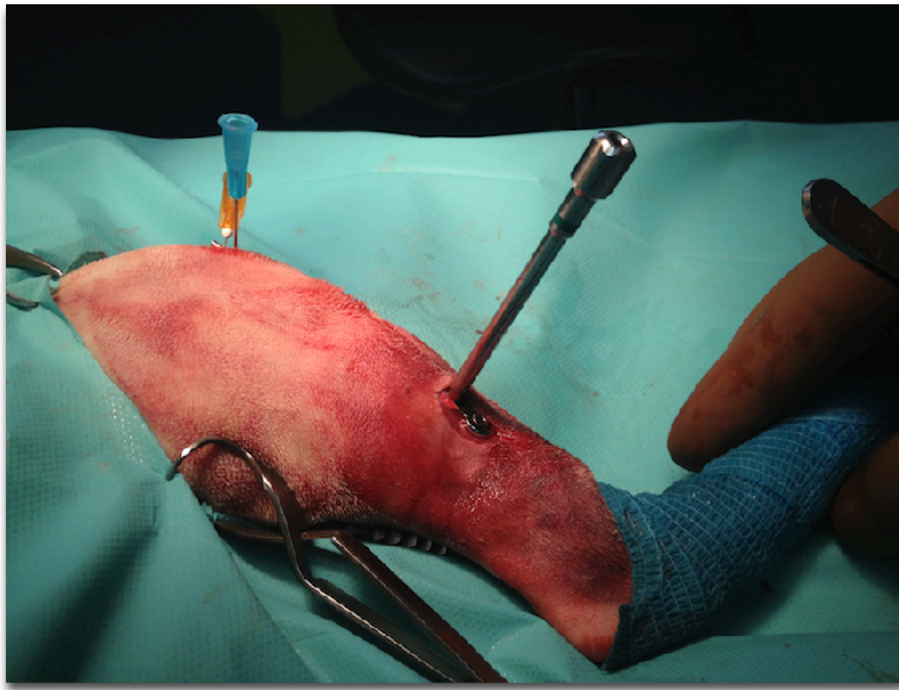
- **Dorsal recumbency**

- Affected tibia out from the surgical table.

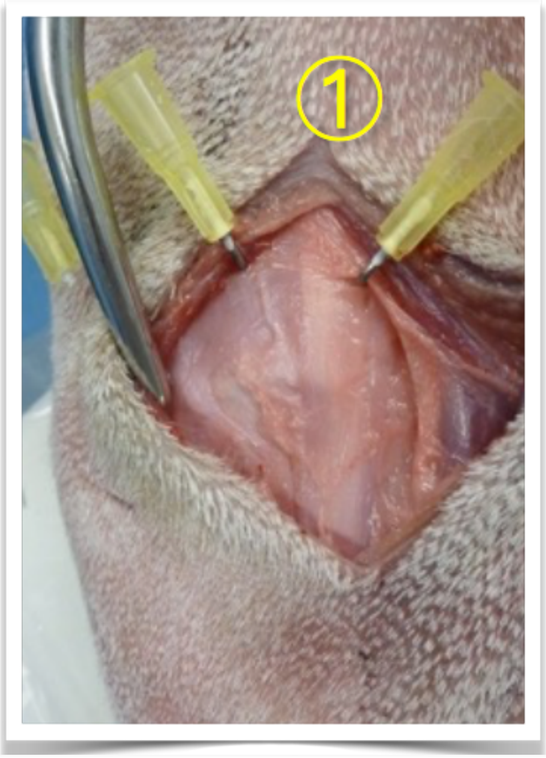


Patient positioning

- **Lateral recumbency**
- Affected tibia over the surgical table
- Torsional alignment ?

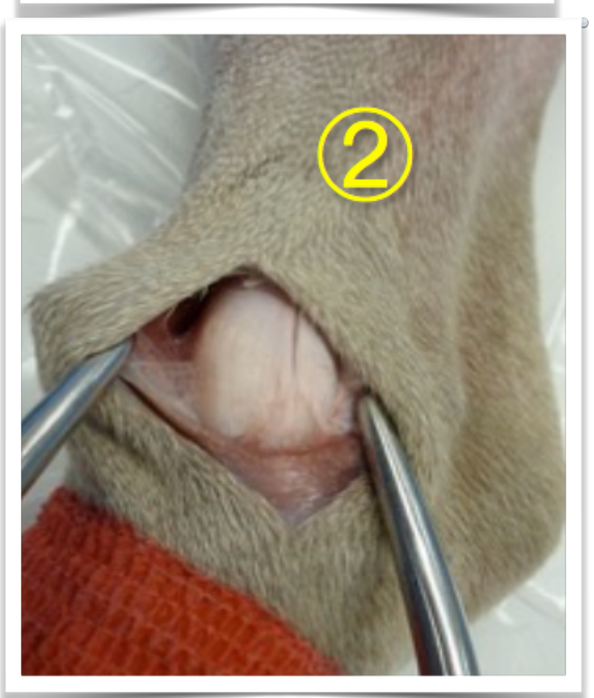


Surgical portals



Proximal approach

- Skin incision over *medial* collateral ligament
- Retract m. sartorius caudally

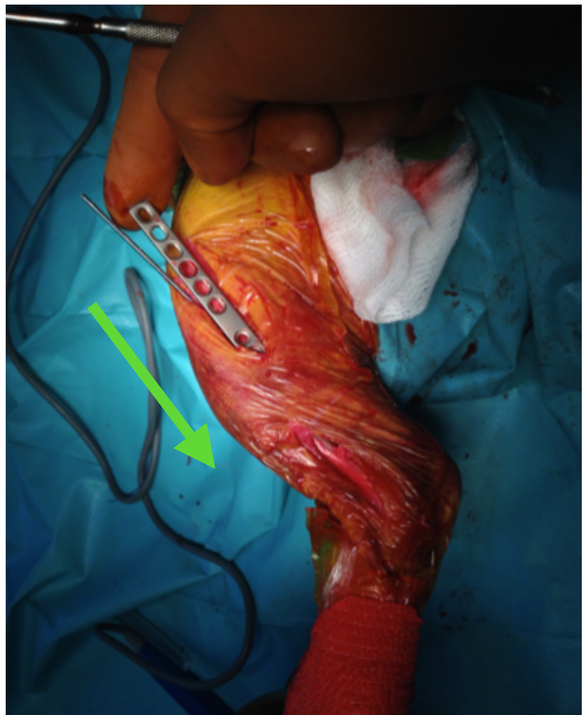


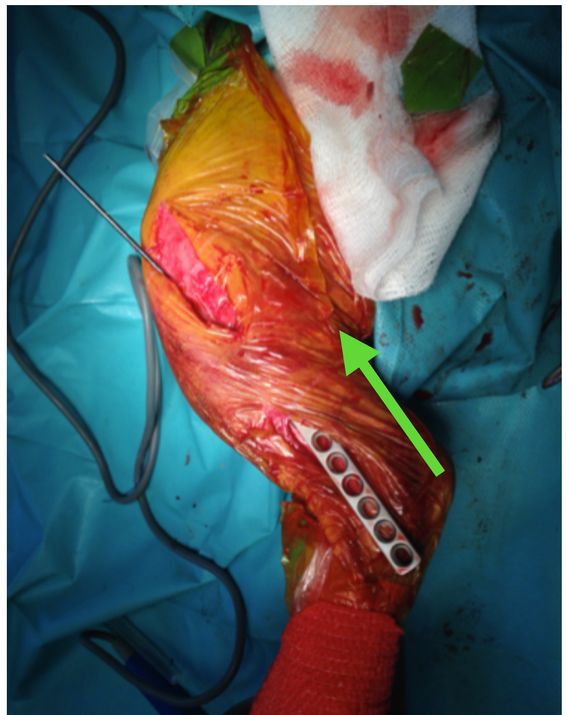
Distal approach

Skin incision centered over medial malleolus

Bone tunnelling

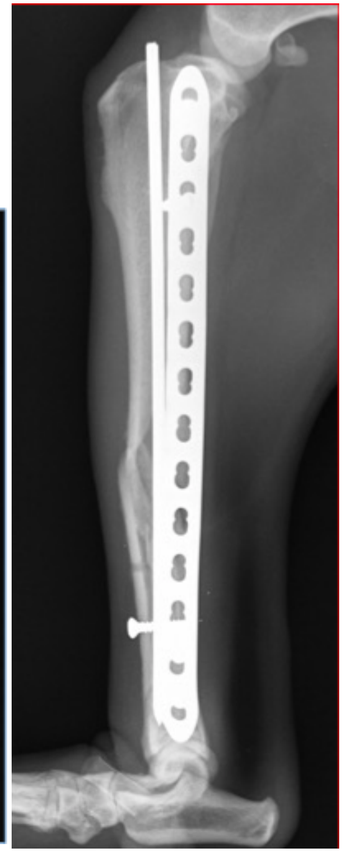
- Proximal to distal
- Distal to proximal
- Both ways
- Fracture configuration and fragments dispersion





Alignment evaluation

- Frontal and sagittal plane – Length
  - Varus / valgus
  - Pro / retrocurvatum
- Rotational



Courtesy Dr. L. Dejardin

Plate and rod

ADVANTAGES

- Temporary aliment tool
- If the pin left, 30 % stronger

MIPO Radius

MIPO Radius

Anatomic considerations

- Plate positioning
  - Dorsal
  - Medial
- Neurovascular structures

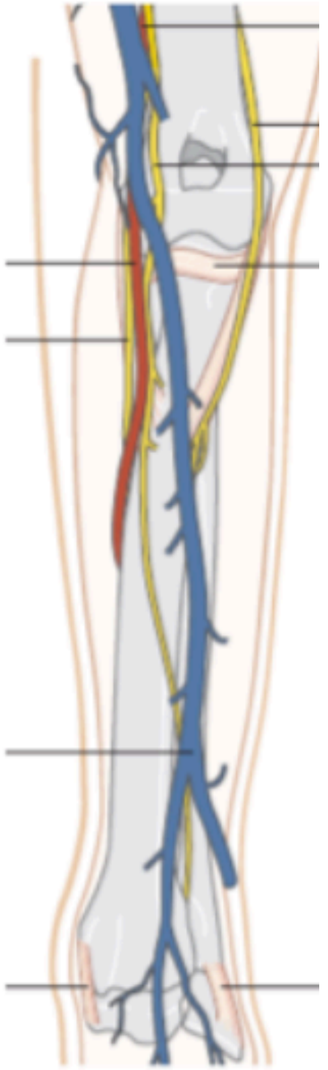
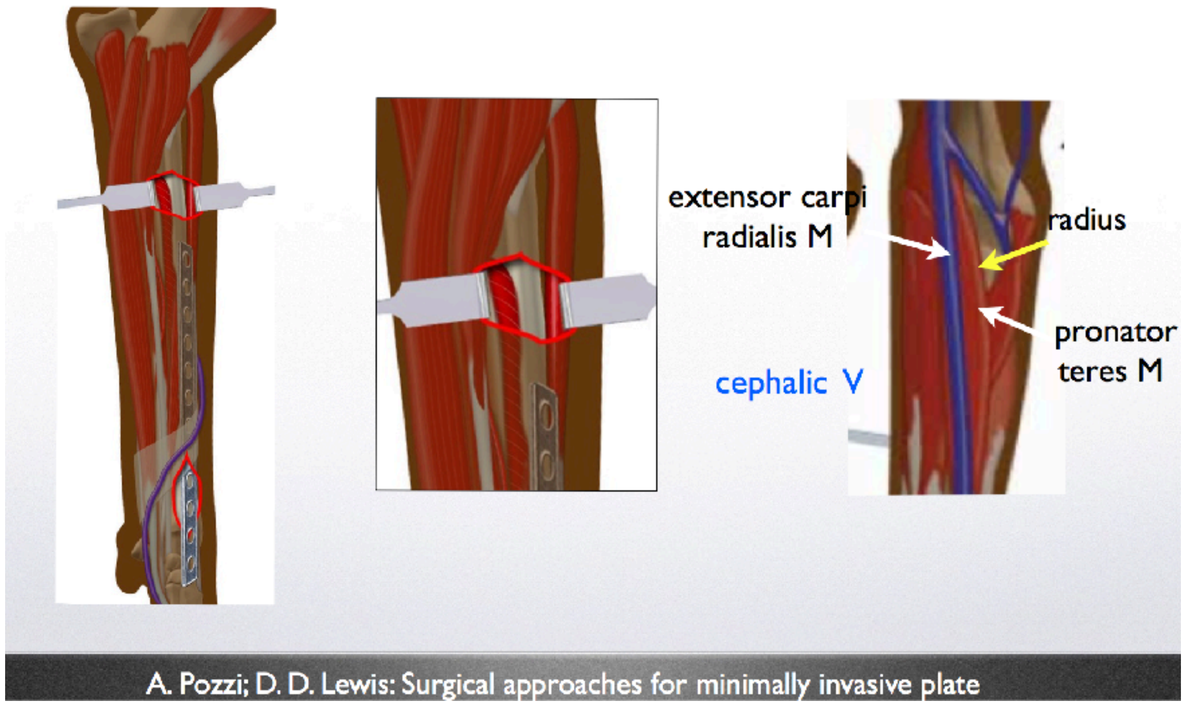


Plate pre-contouring

Contour the plate on the lateral view of the unaffected limb.

MIPO Radius

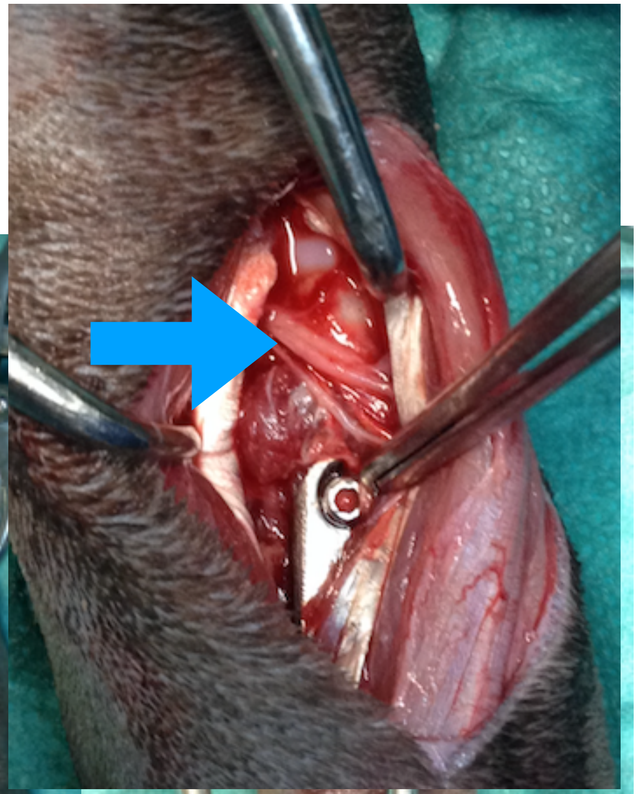
- **Cranio-medial** approach to the radius.
- Dorsal recumbency.
- A foam pad under the ipsilateral shoulder.
- The limb is extended caudally.

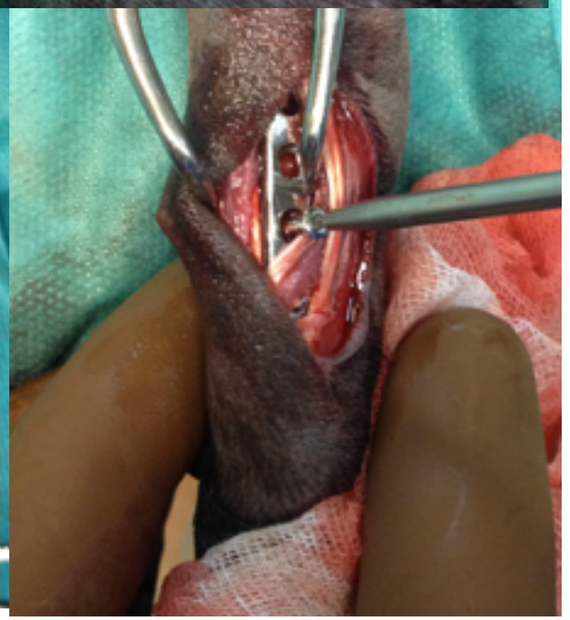


MIPO Radius

Medial

Cranio-Lateral





What about the ulna?

Ulna pinning

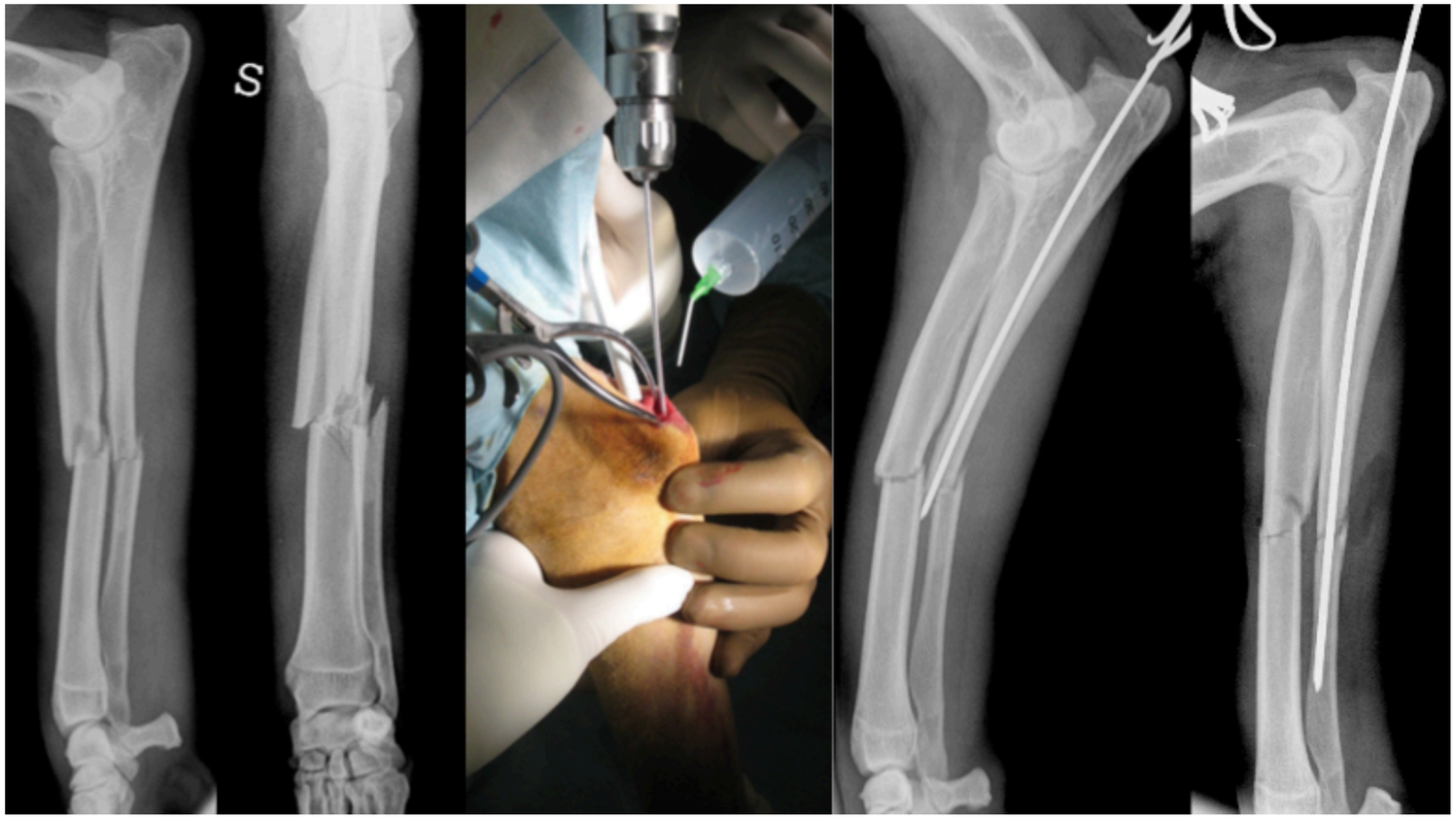
Minimally invasive application of a radial plate following placement of an ulnar rod in treating antebrachial fractures

Technique and case series

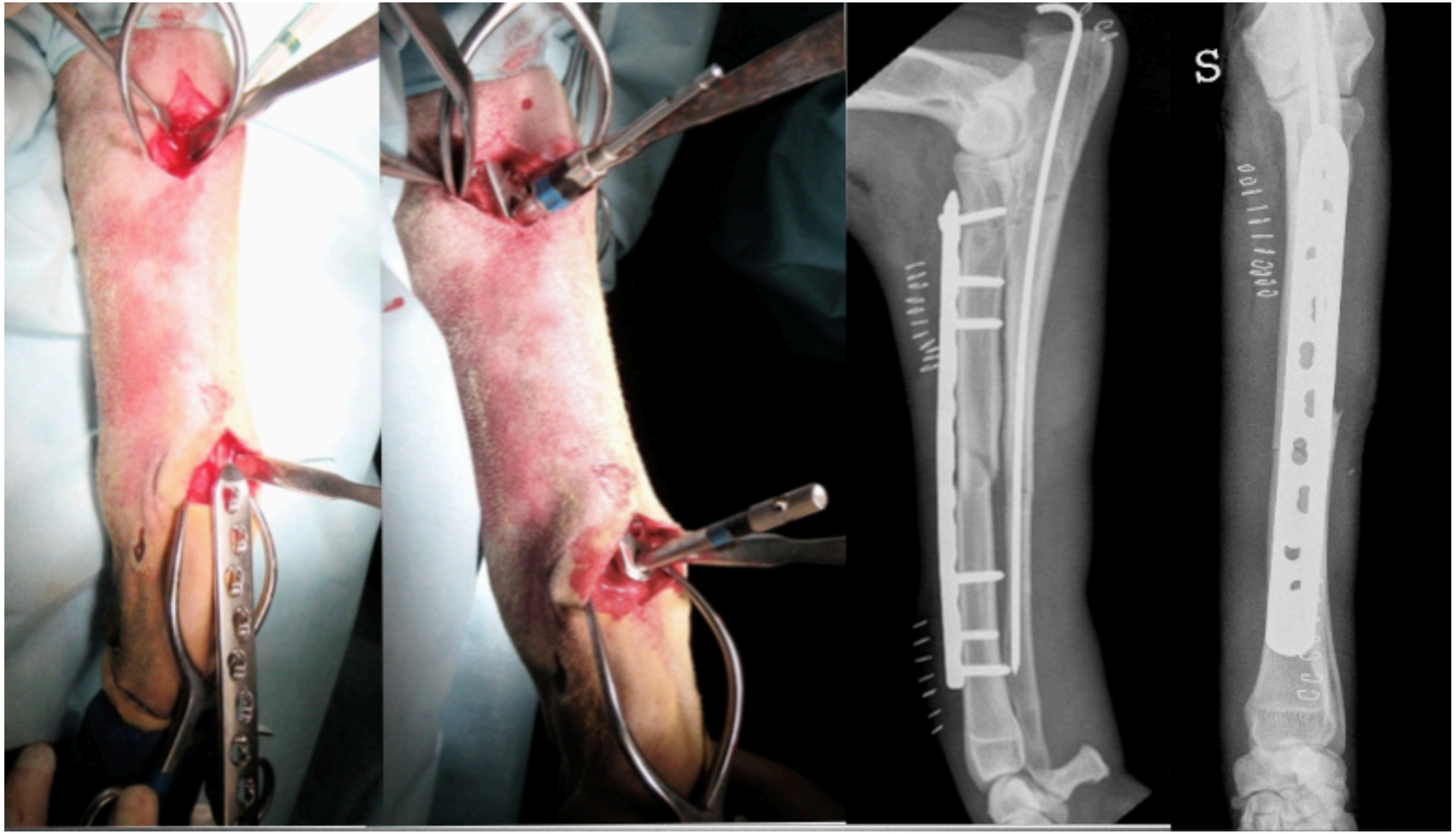
T. H. Witsberger[1]; D. A. Hulse[1,2]; S. C. Kerwin[1]; W. B. Saunders[1]
[1]Department of Veterinary Small Animal Clinical Sciences, College of Veterinary Medicine and Biomedical Sciences, Texas A&M University, College Station, Texas, USA; [2]Veterinary Orthopedic Center, Round Rock, Texas, USA

Ulna pinning

- Normograde insertion from olecranon
- Retrogarde insertion from ulna site

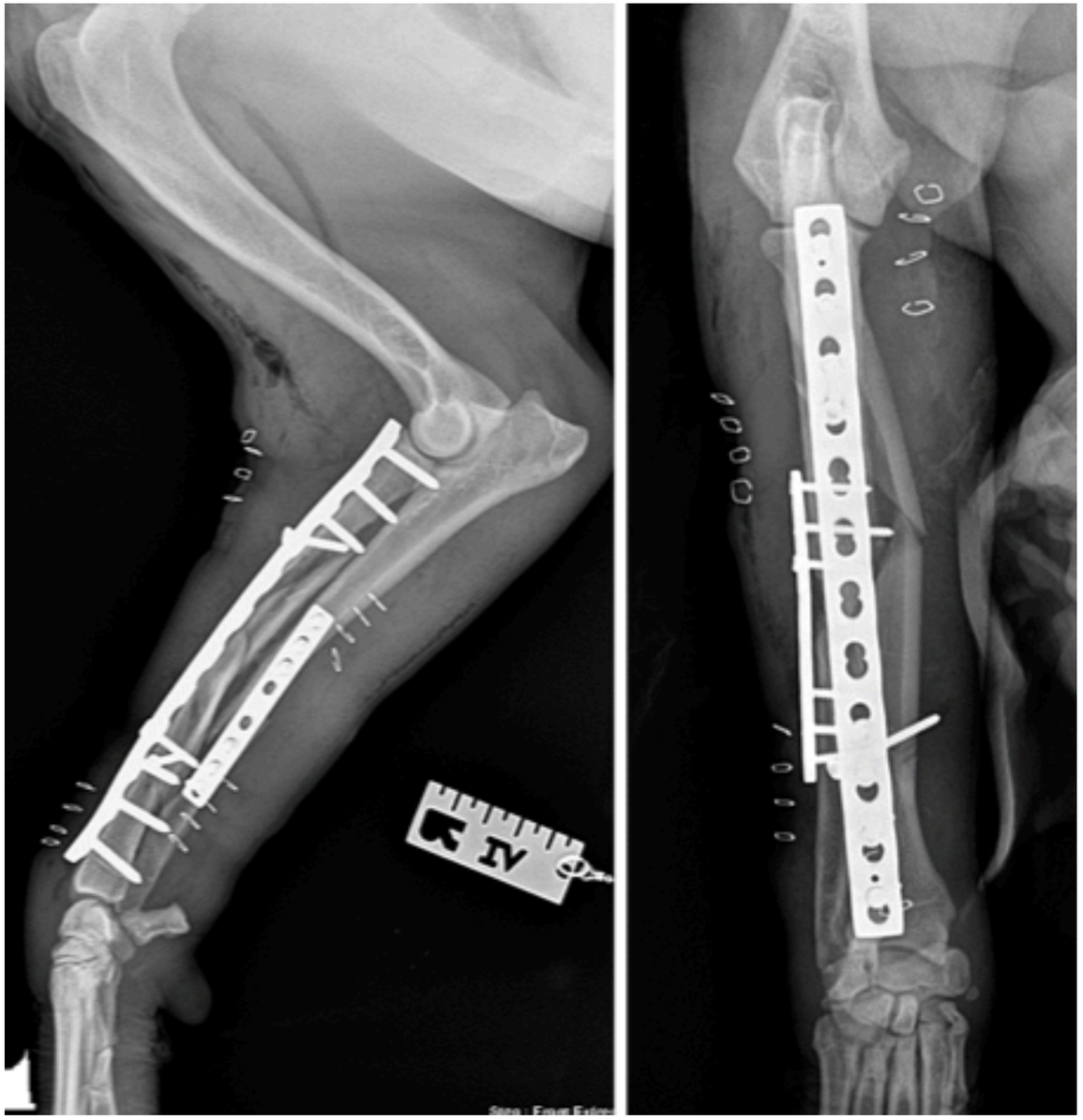


Courtesy: A. Pozzi



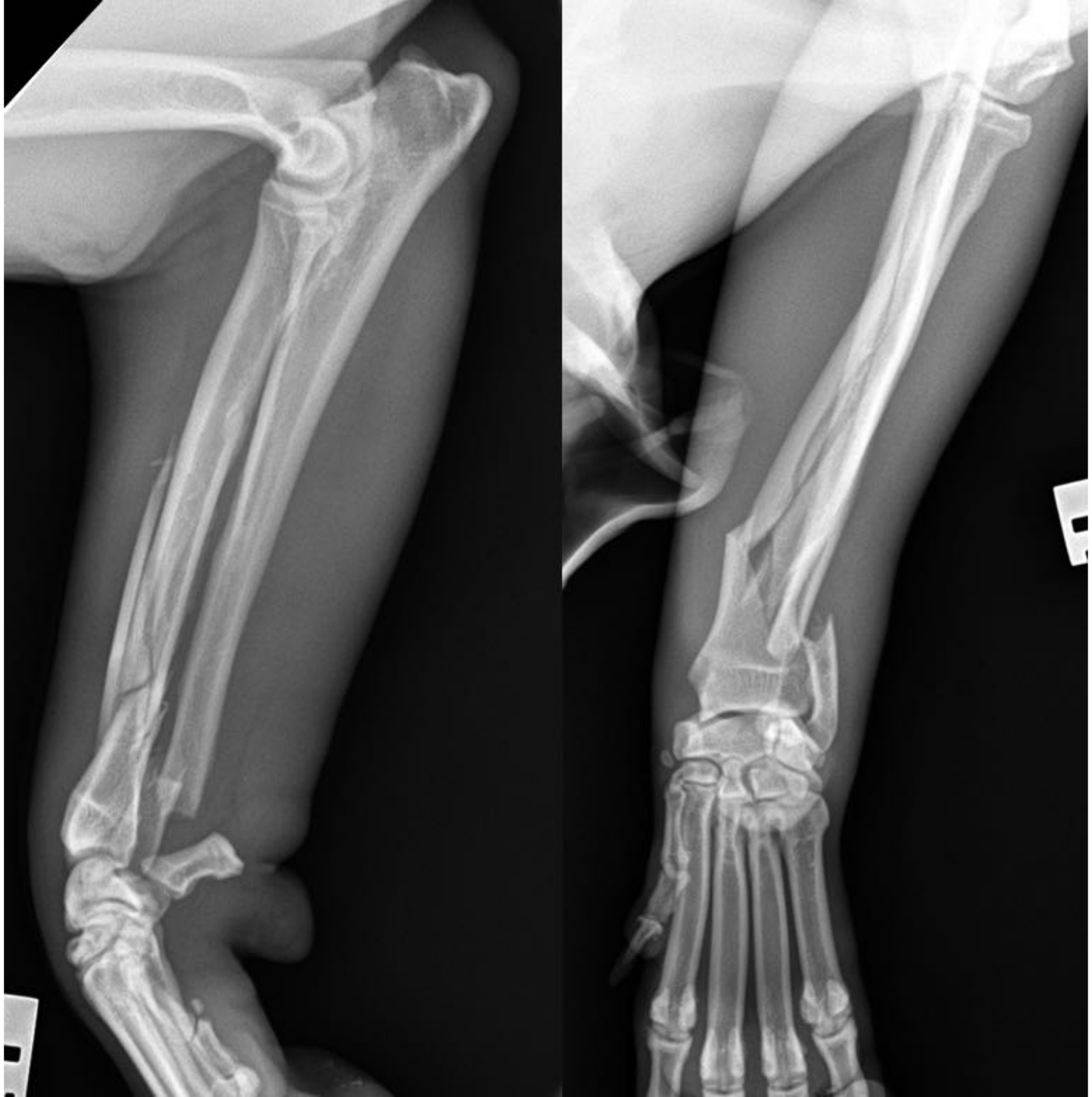
Courtesy: A. Pozzi

Ulna plating

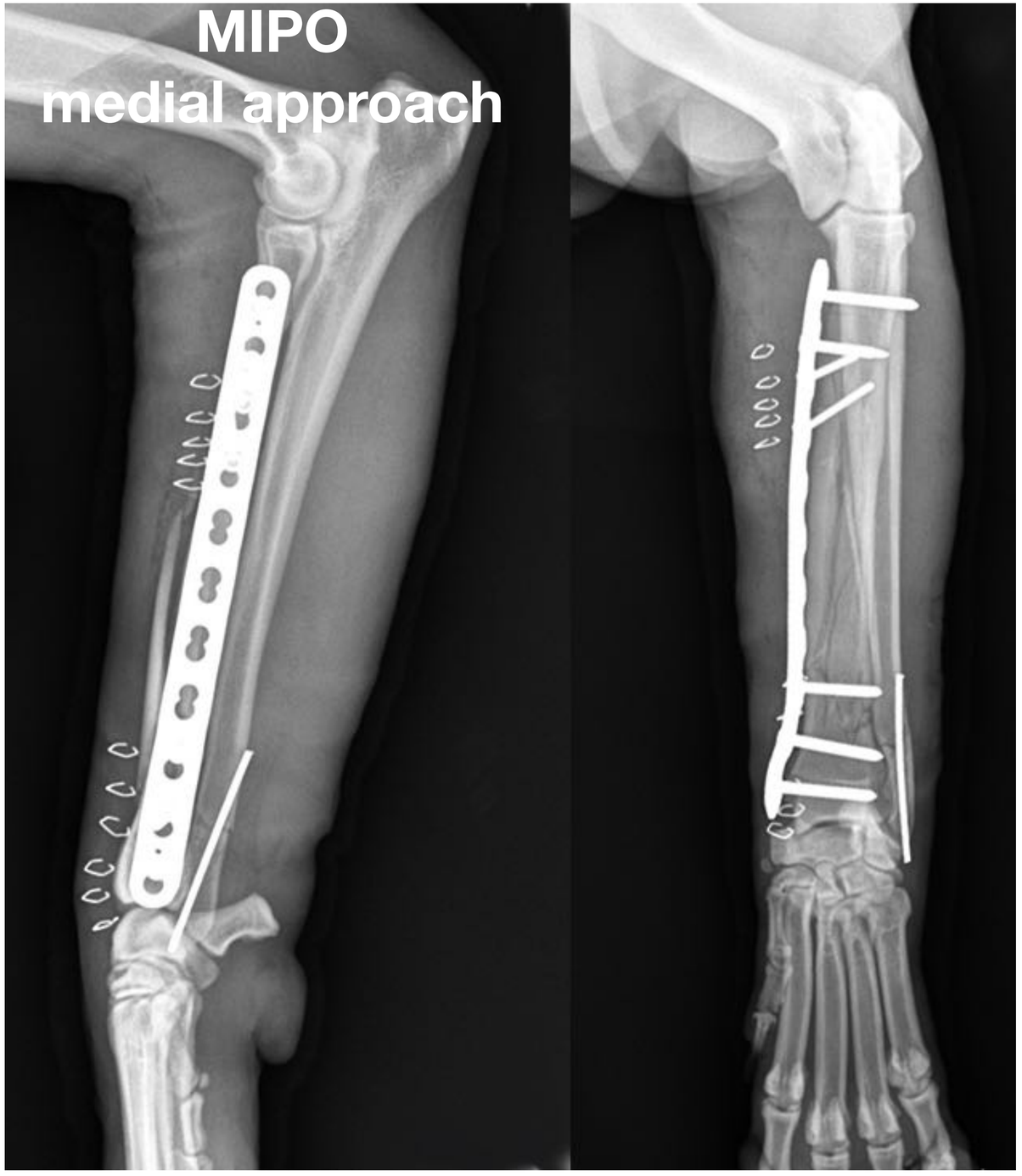


Shizu

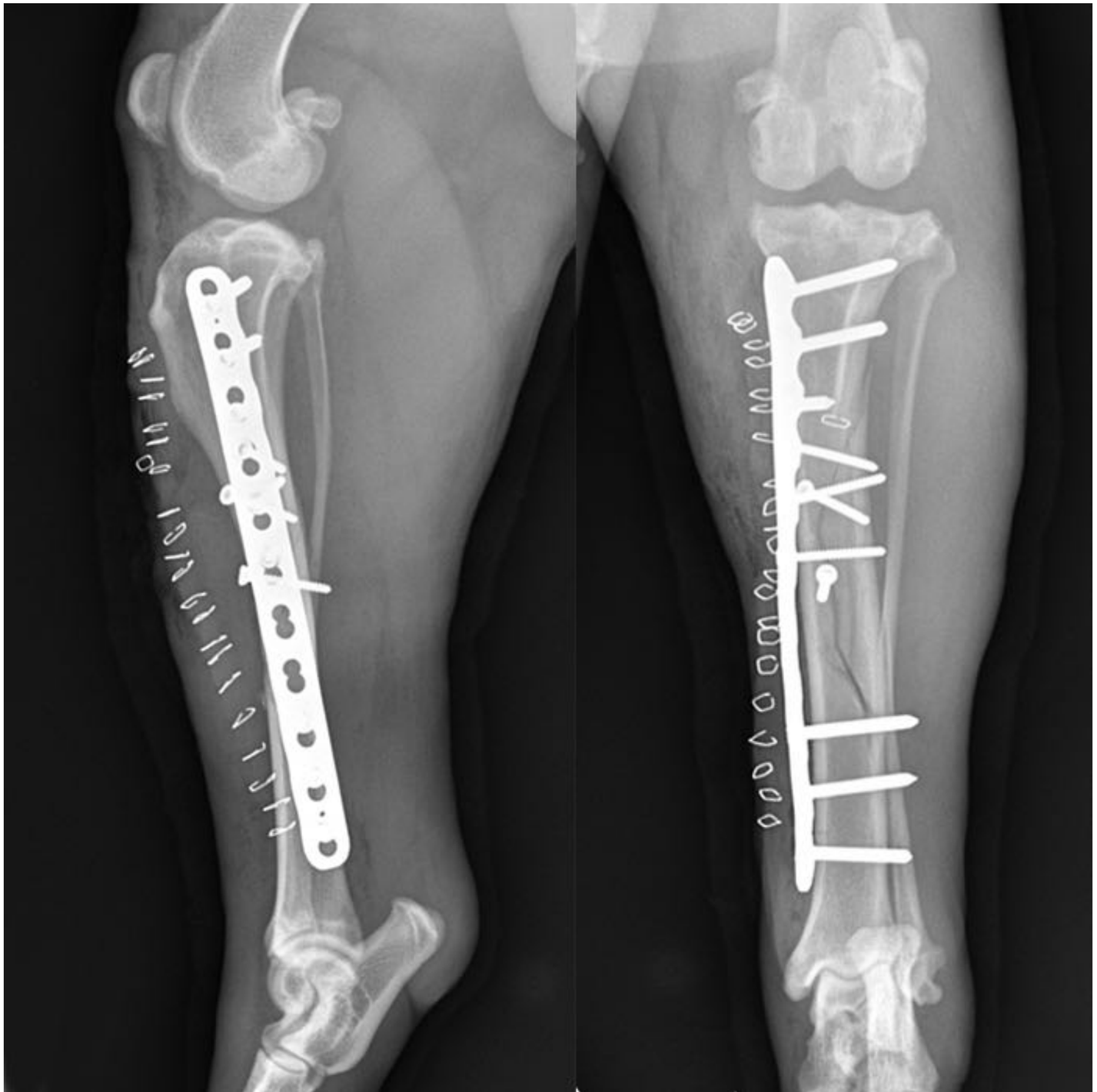
2y, male, pitbul, 28 kg
HBC



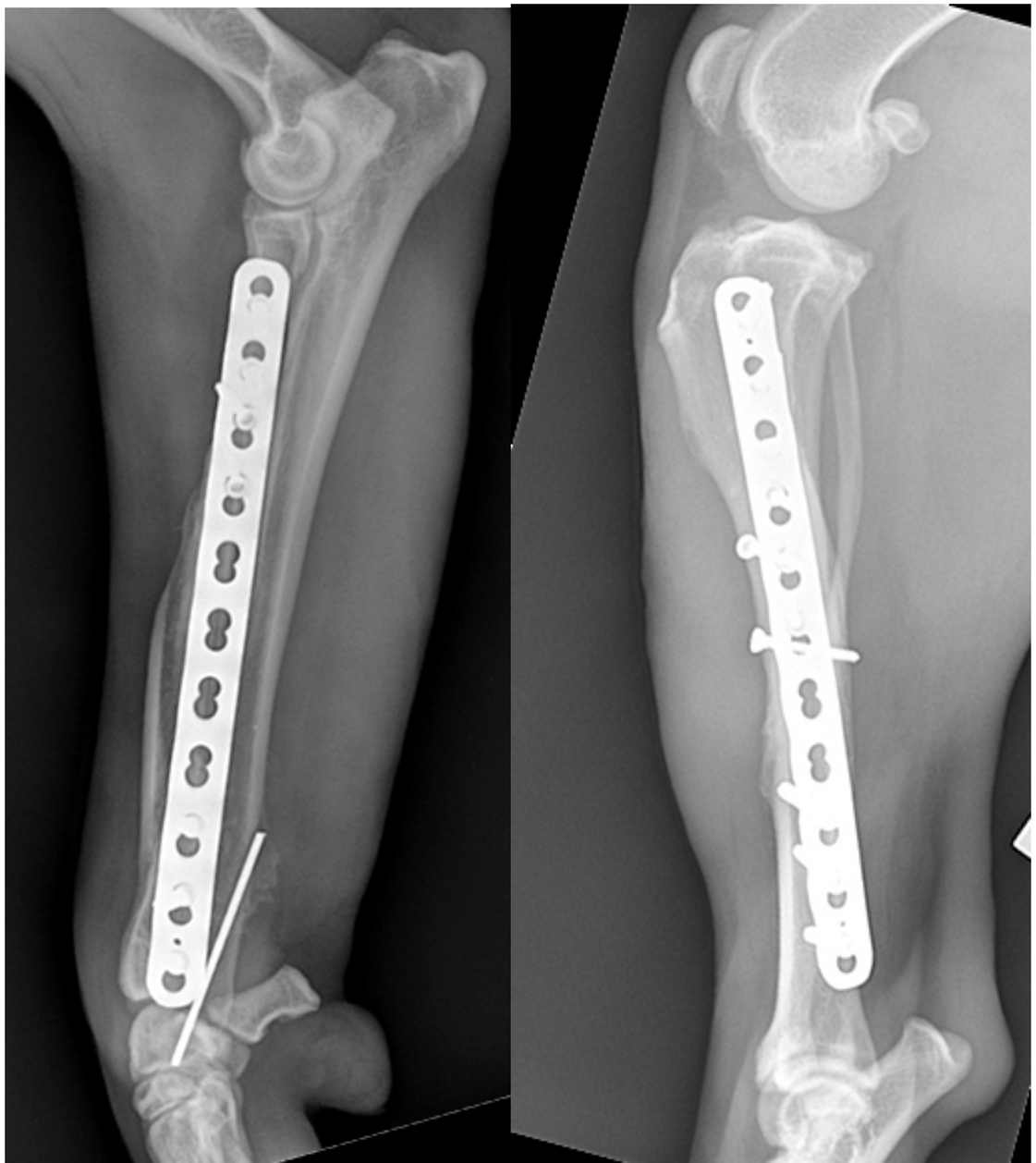
MIPO
medial approach

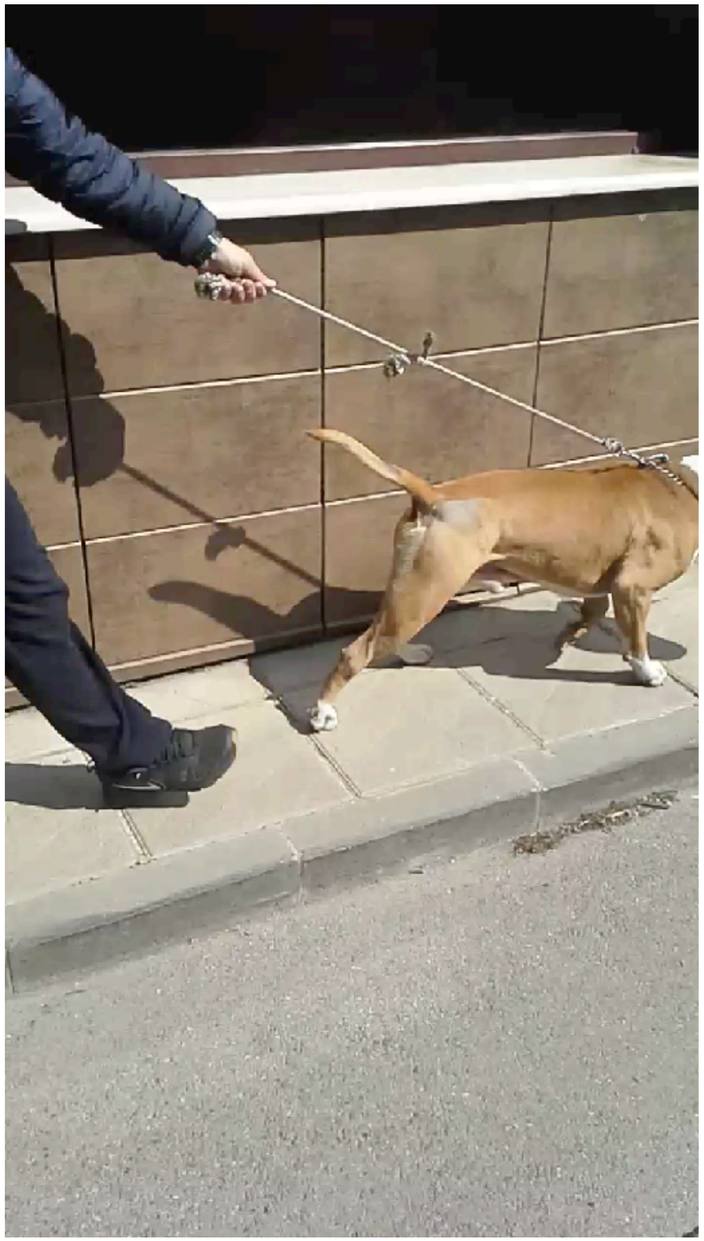


ORIF



10 weeks f up





15 y old dachshund, 6,5 kg
HBC

12 weeks follow up

MIPO Femur

Surgical approaches for minimally invasive plate osteosynthesis in dogs

A. Pozzi; D. D. Lewis
Department of Small Animal Clinical Sciences, University of Florida, Gainesville, Florida, USA

"Combination approaches to the greater trochanter and the approach to the distal femur through a lateral incision. "

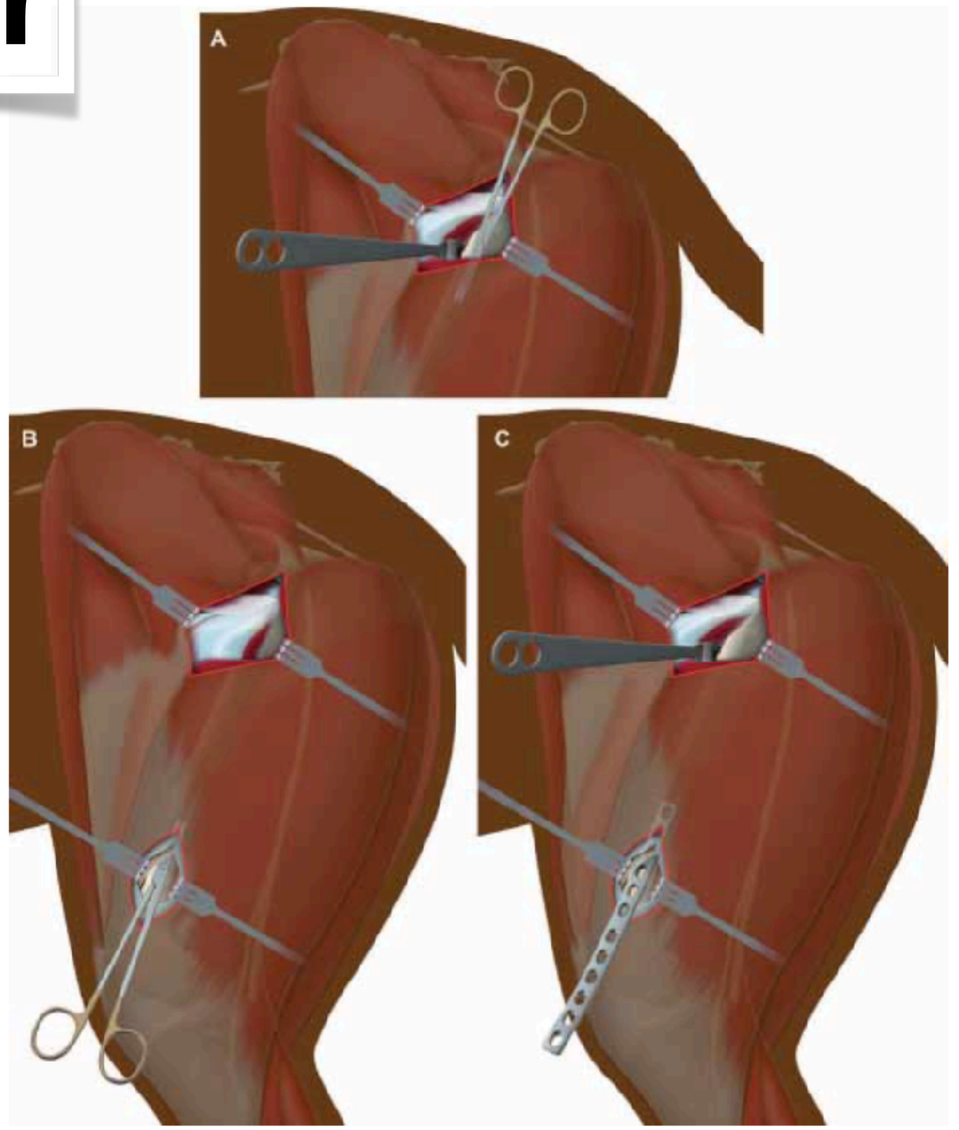
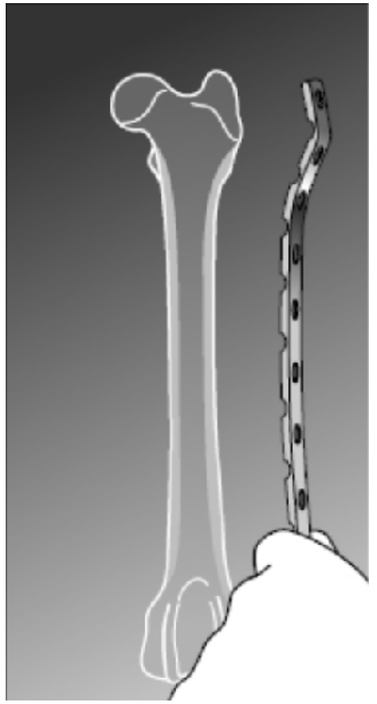


Plate pre-contouring



VD view of the unaffected limb.

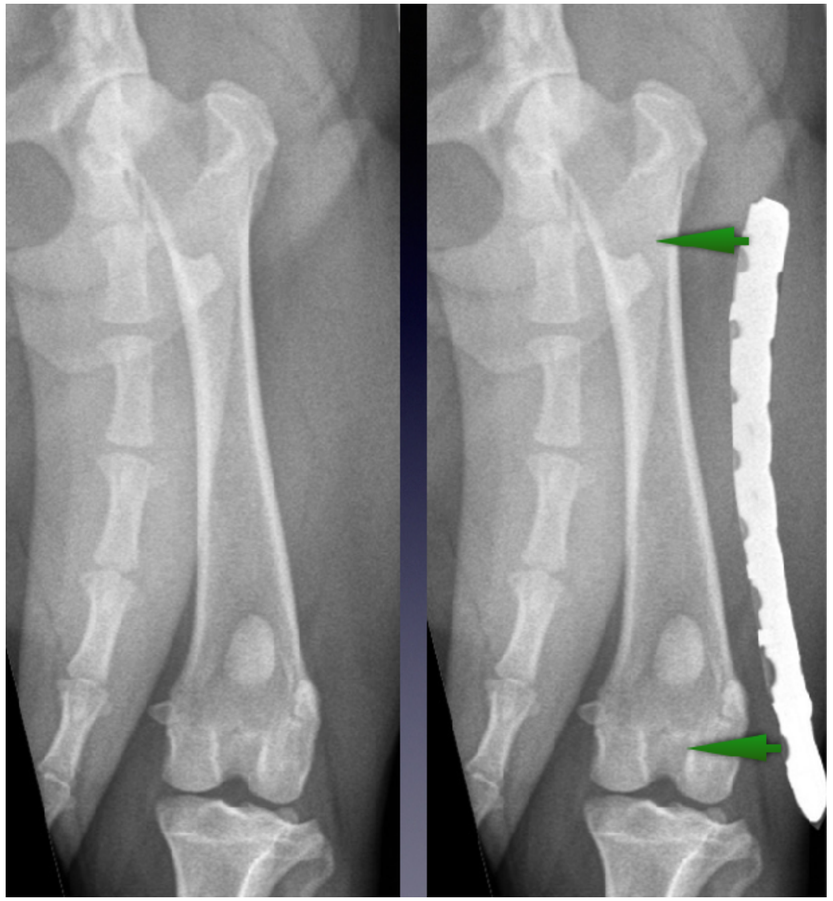


Plate pre-contouring

Chondrodistrophic breeds- **also lateral**

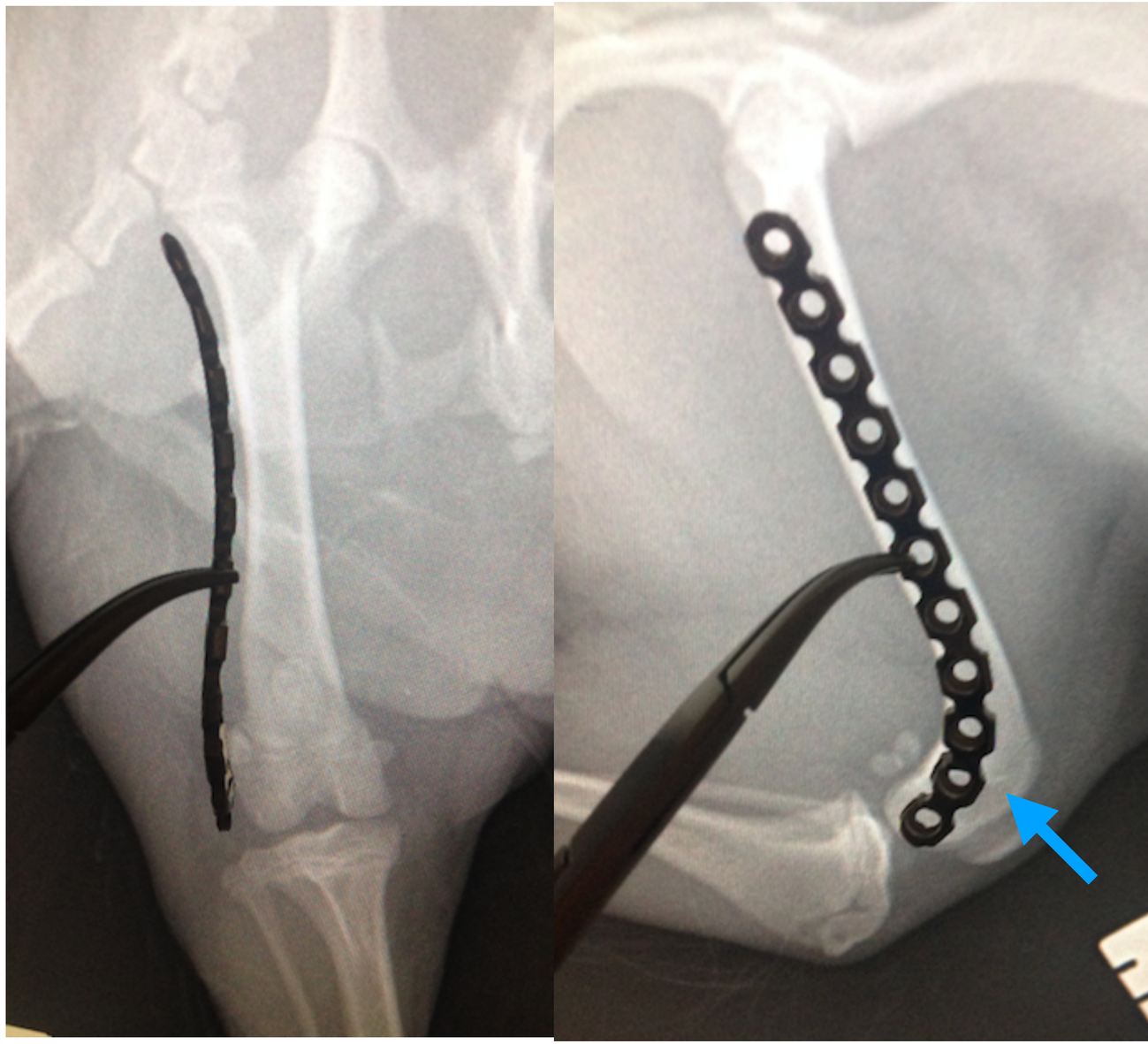
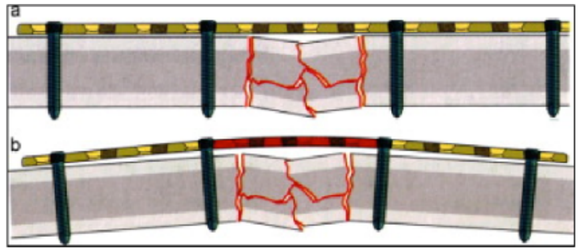


Plate length

- Plate/bone ratio 80-90%
- Allows **elastic** fixation



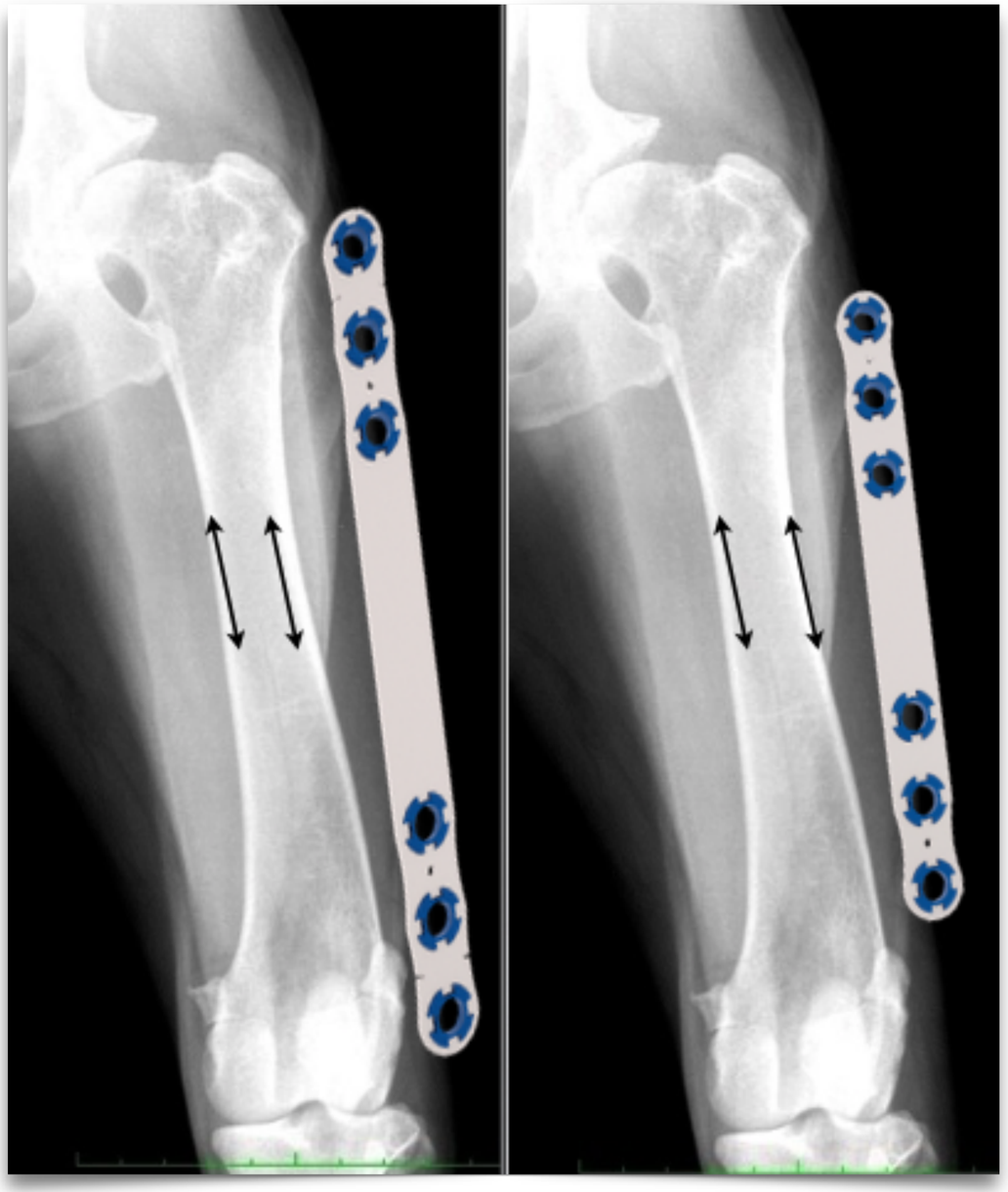
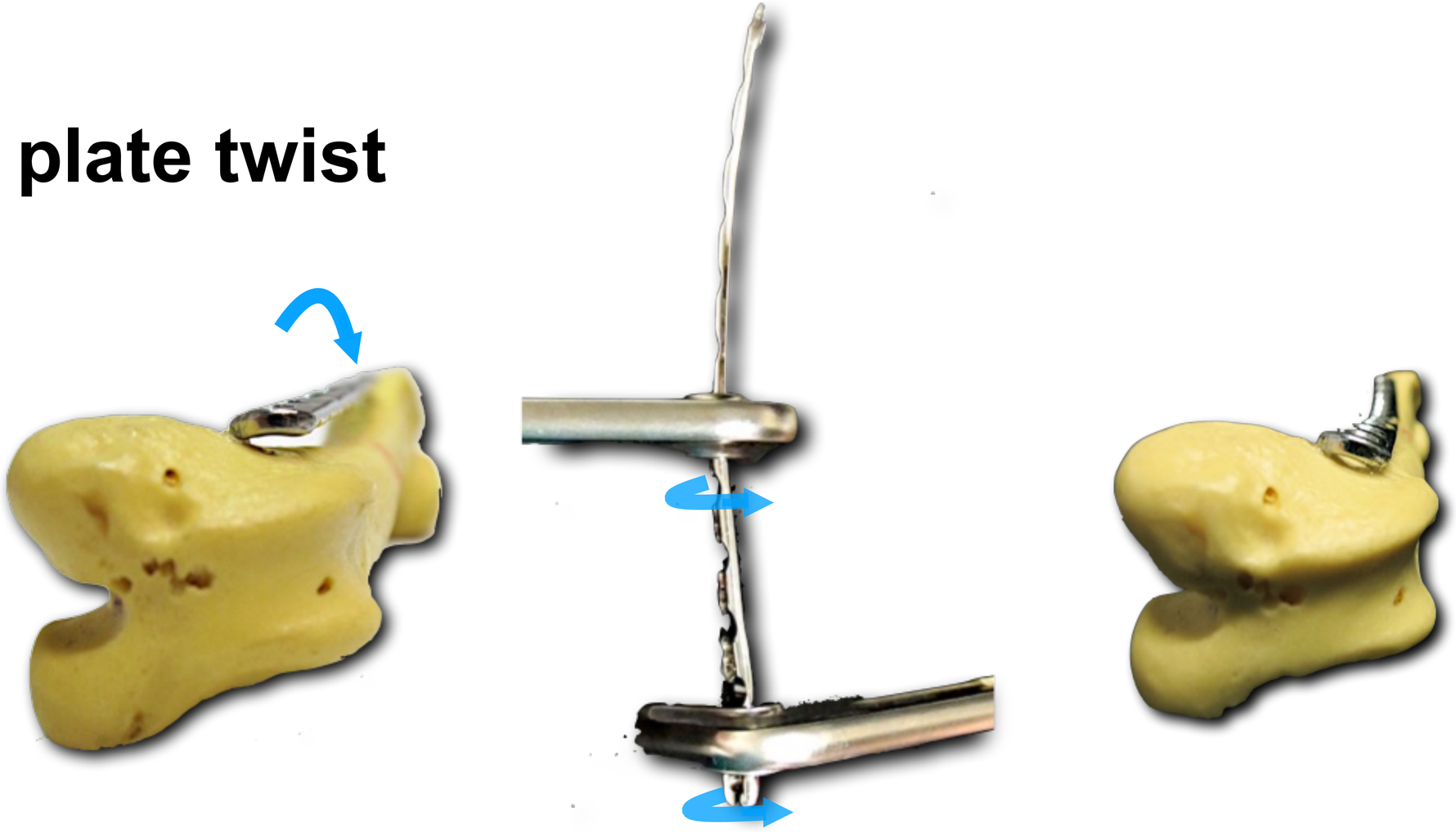


Plate pre-contouring

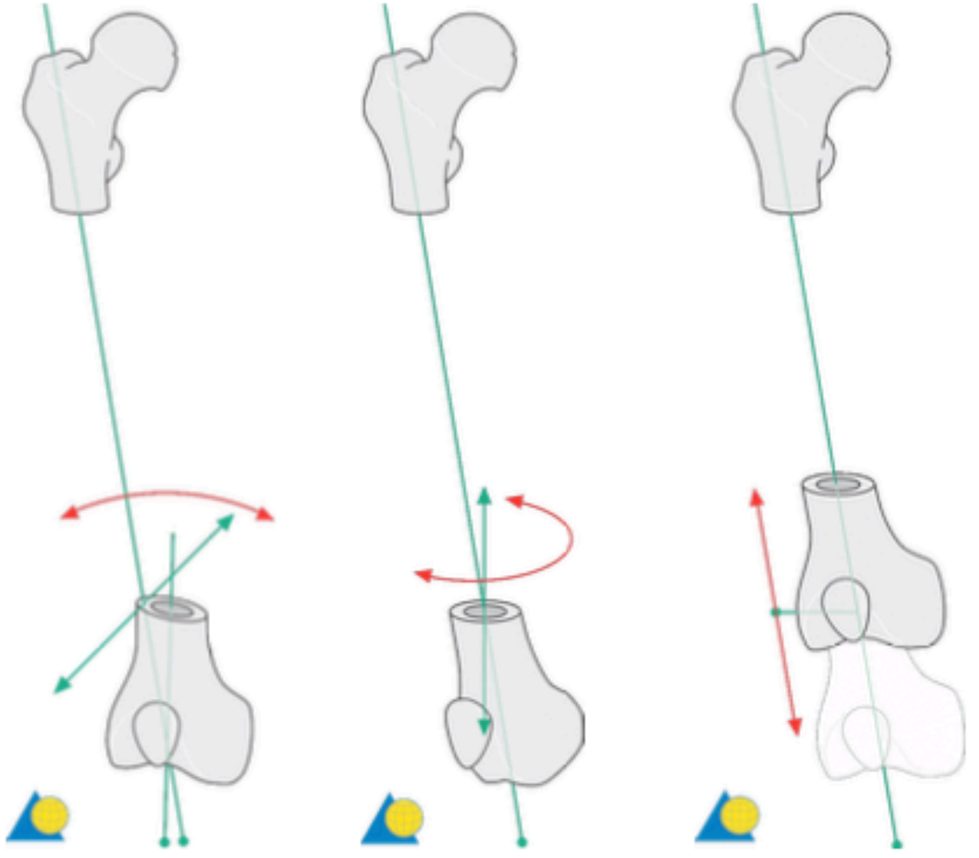
Distal plate twist



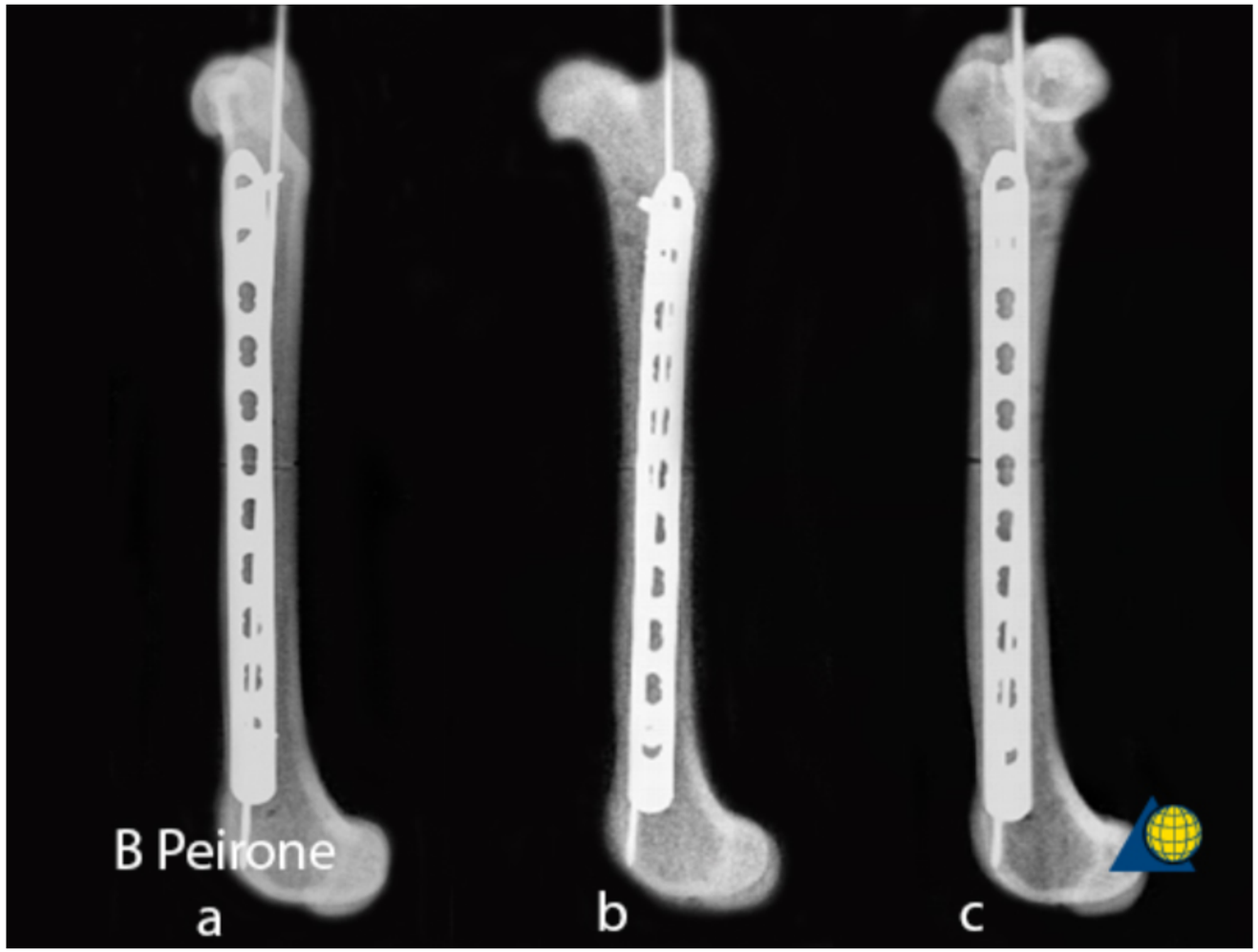
2nd bend out of the plane (twist)

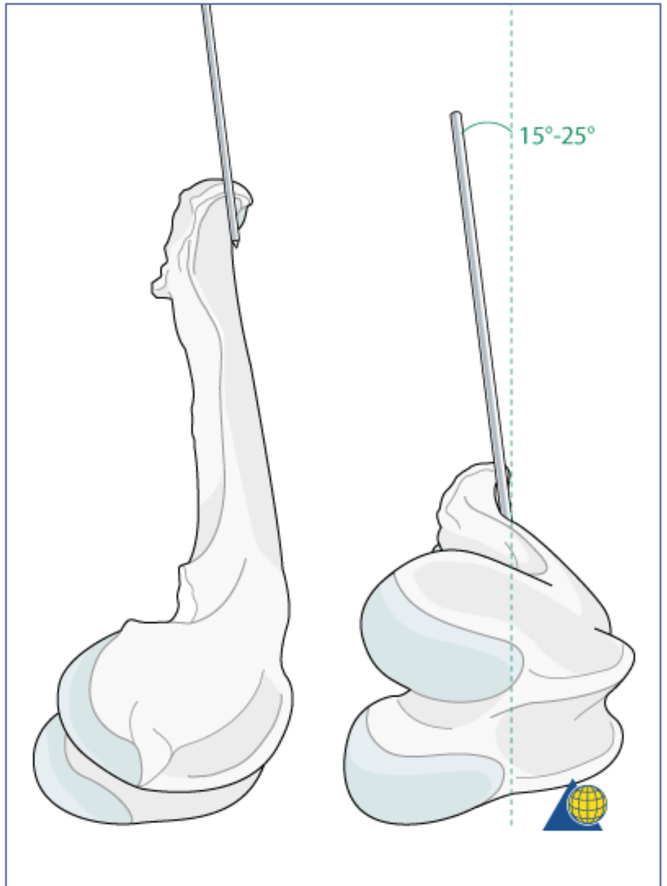
Alignment of Bone and Limb

- Correct the alignment of the bone and limb
  - Angulation
  - Translation
  - Rotation
  - Length



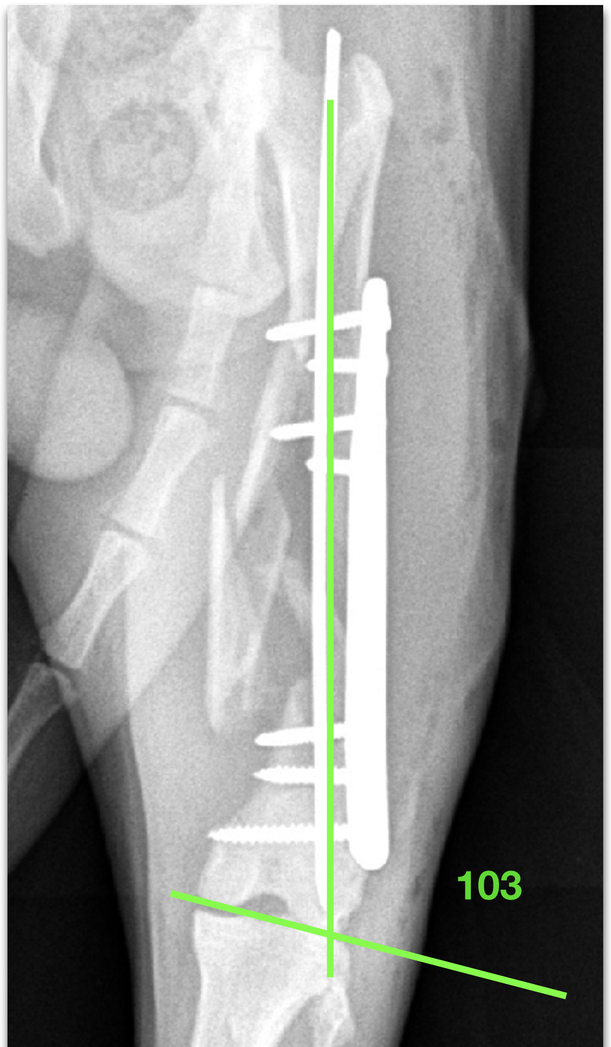
Anteversion angle- intra operatively

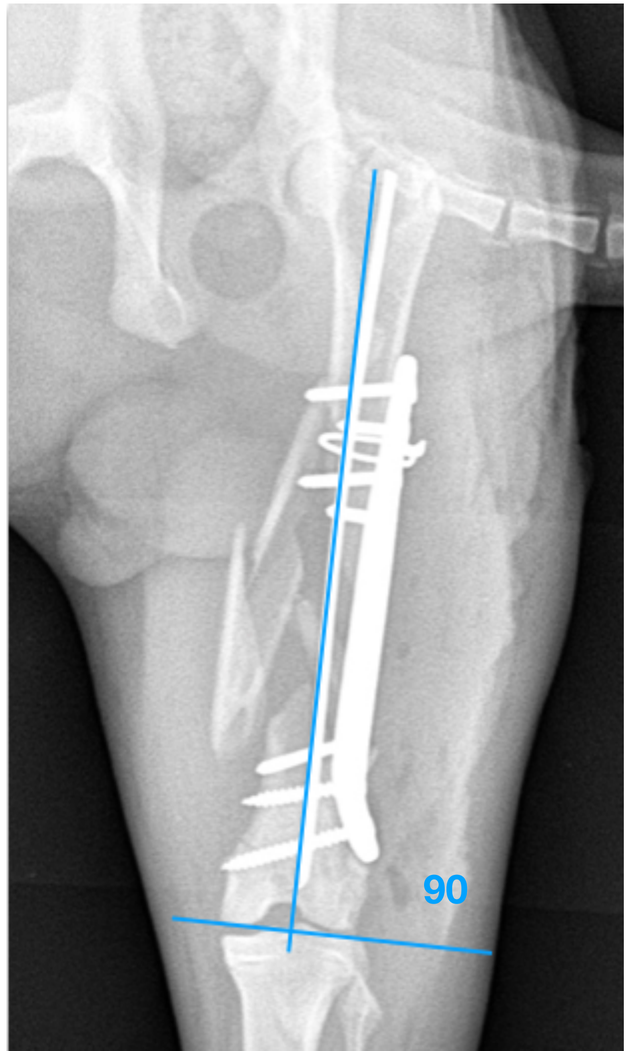




Anteversion angle- intra operatively

AAAA post op evaluation





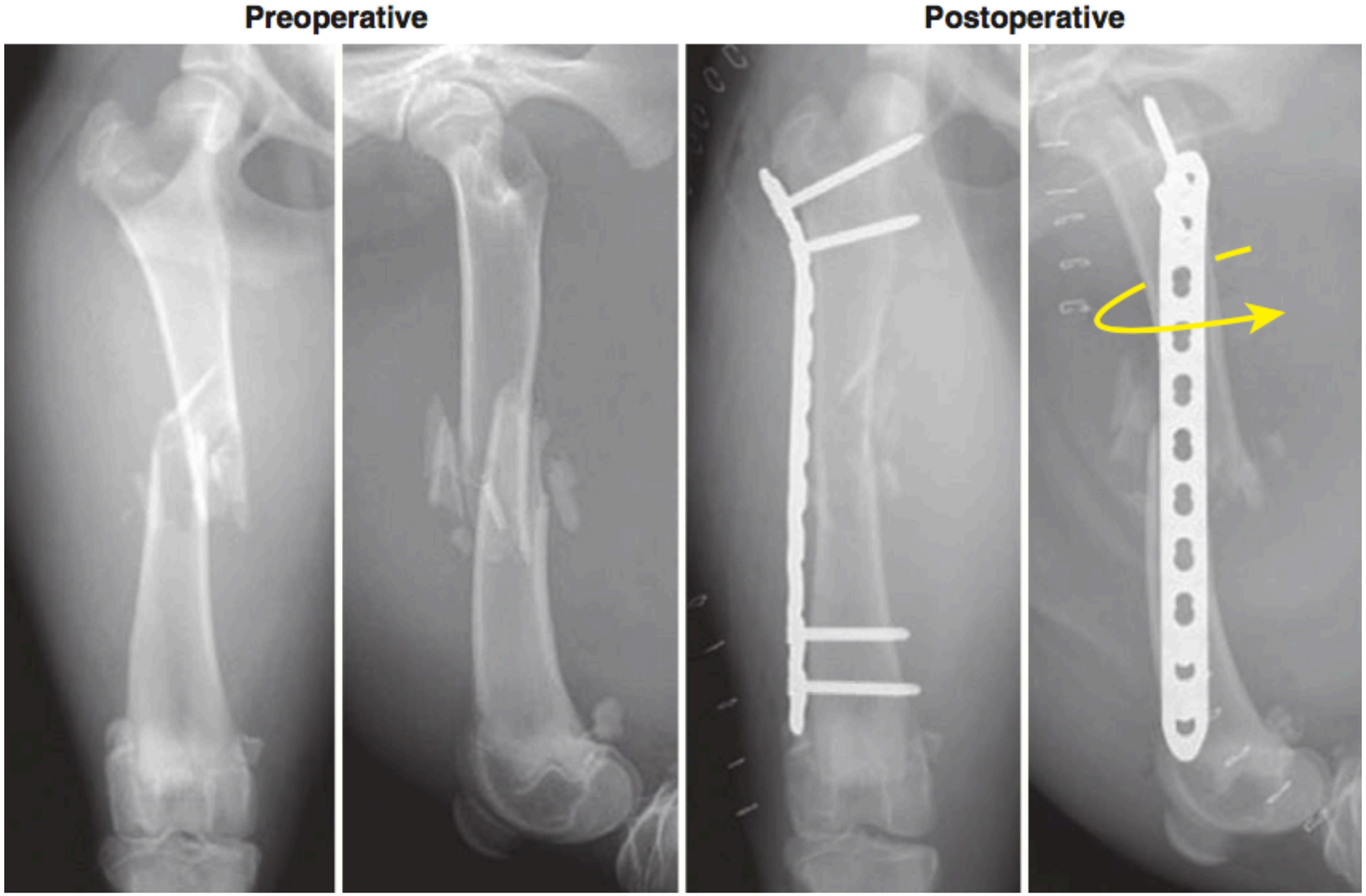
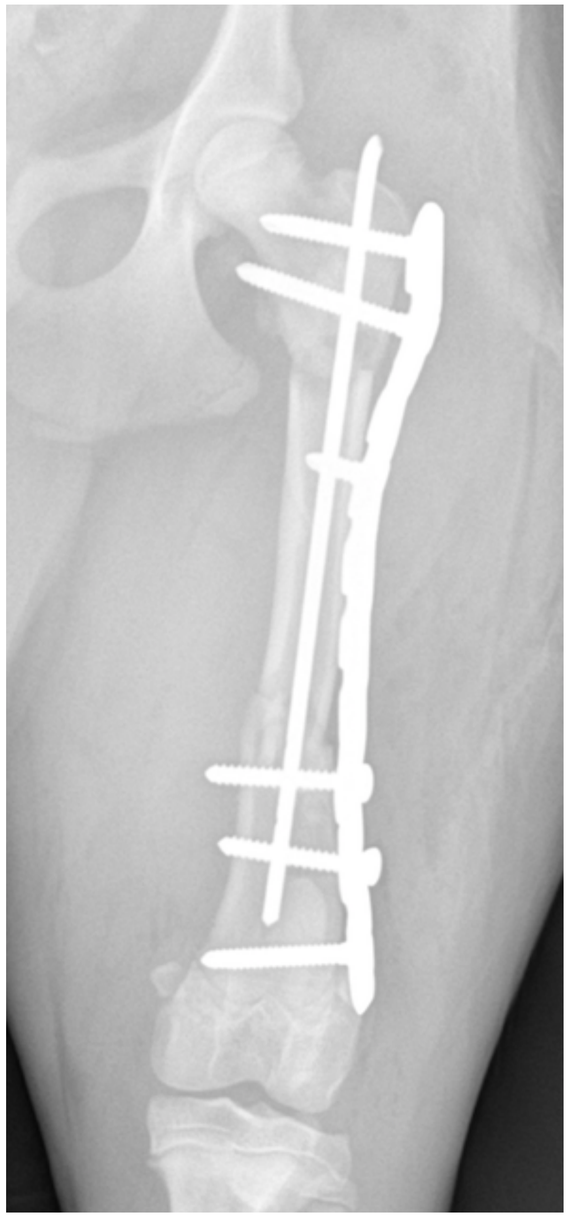

Preoperative
Postoperative

Plate and rod

ADVANTAGES

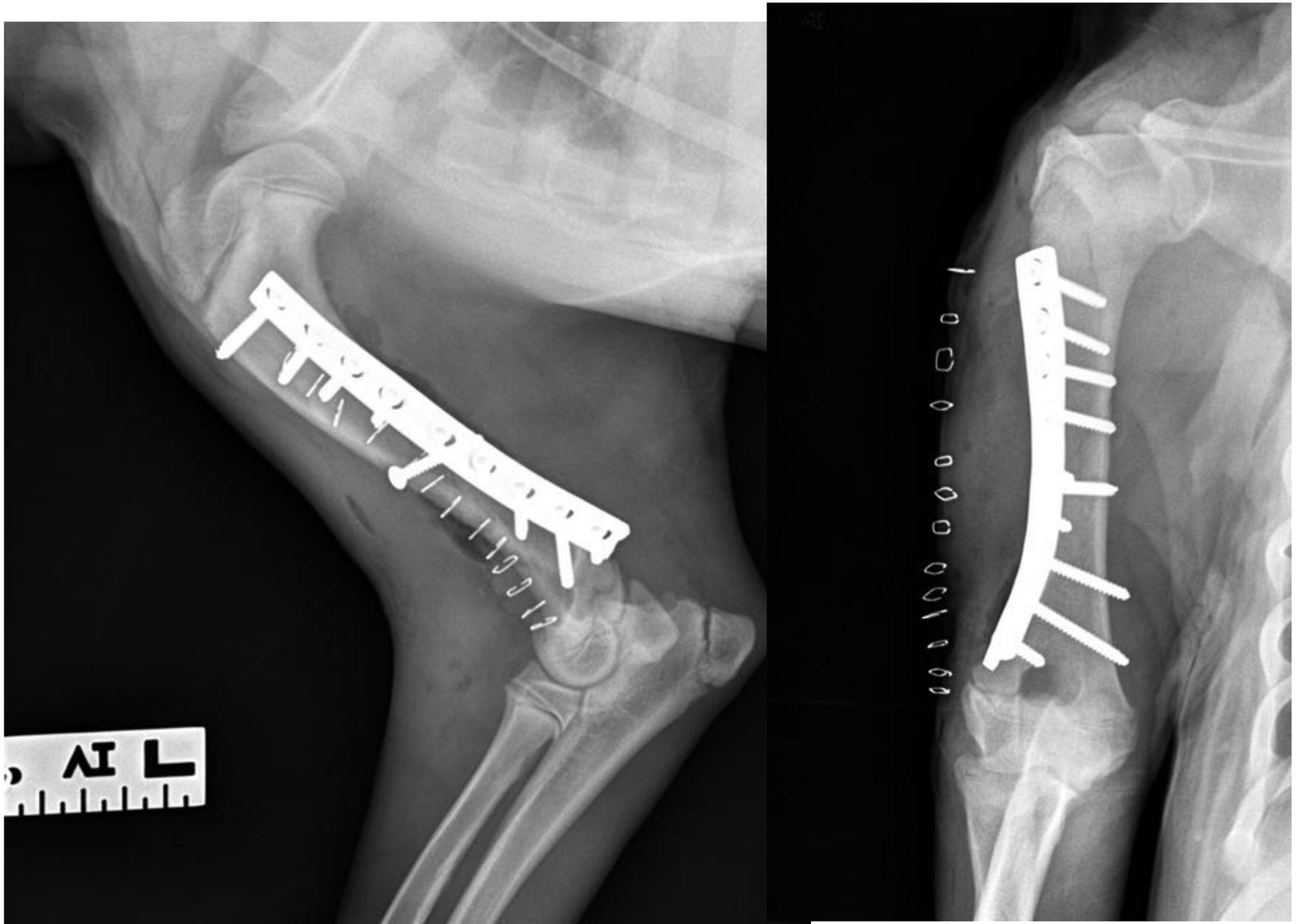
- Temporary aliment tool
- 30 % stronger



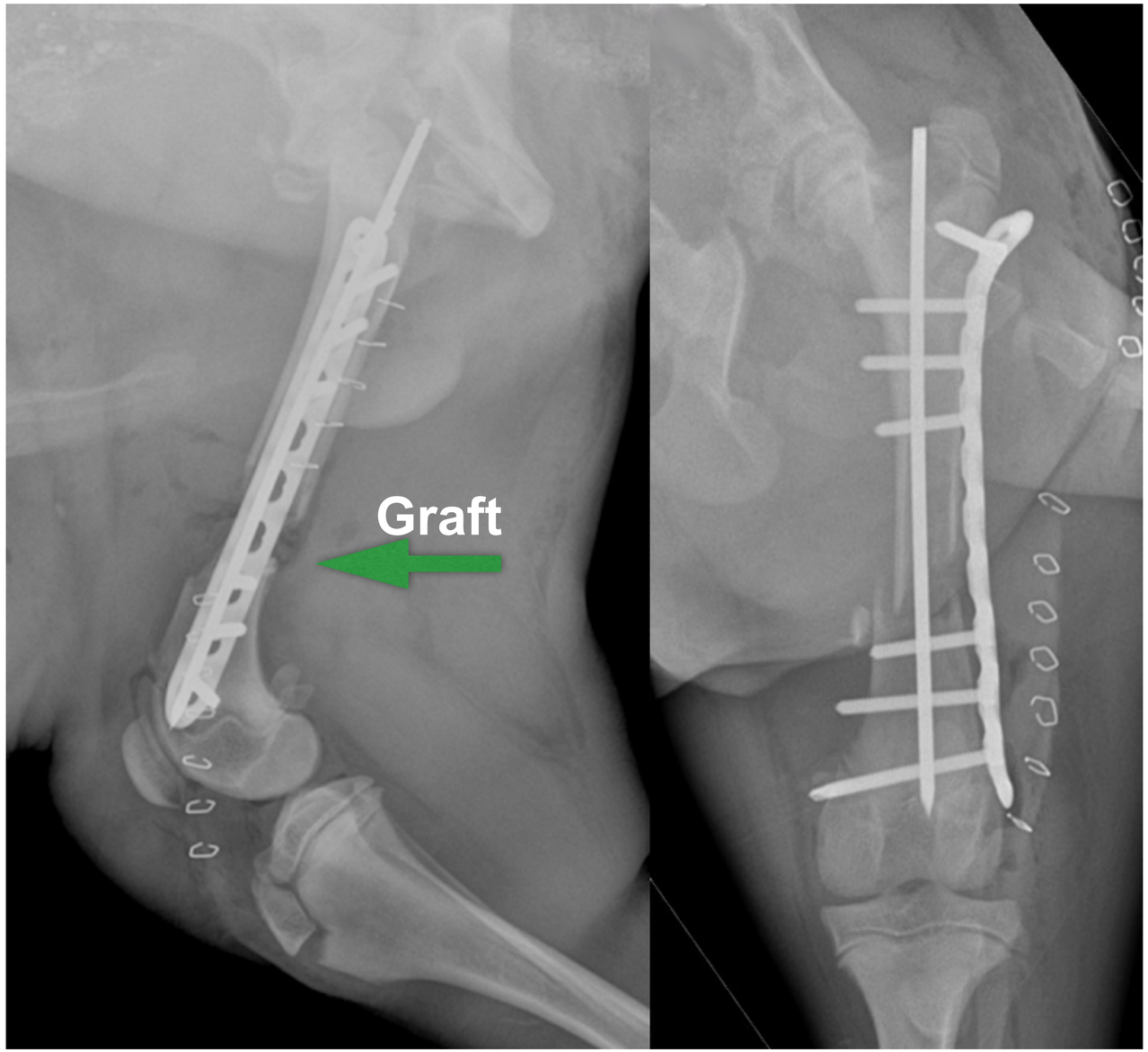
Gino
6.5 months, mix, 20 kg
Hit by a car,
Multiple injuries

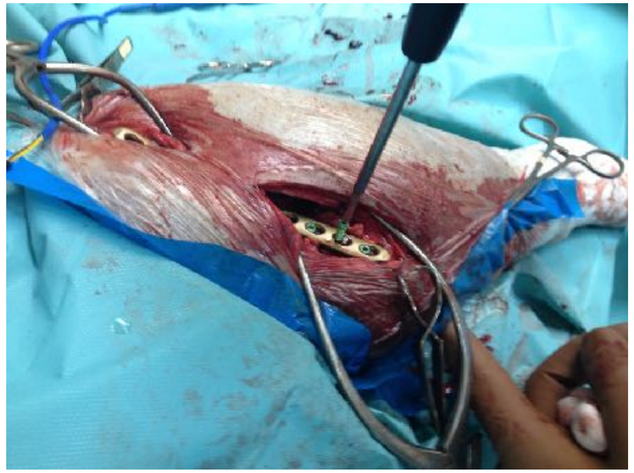

134 m

DCP osteosynthesis

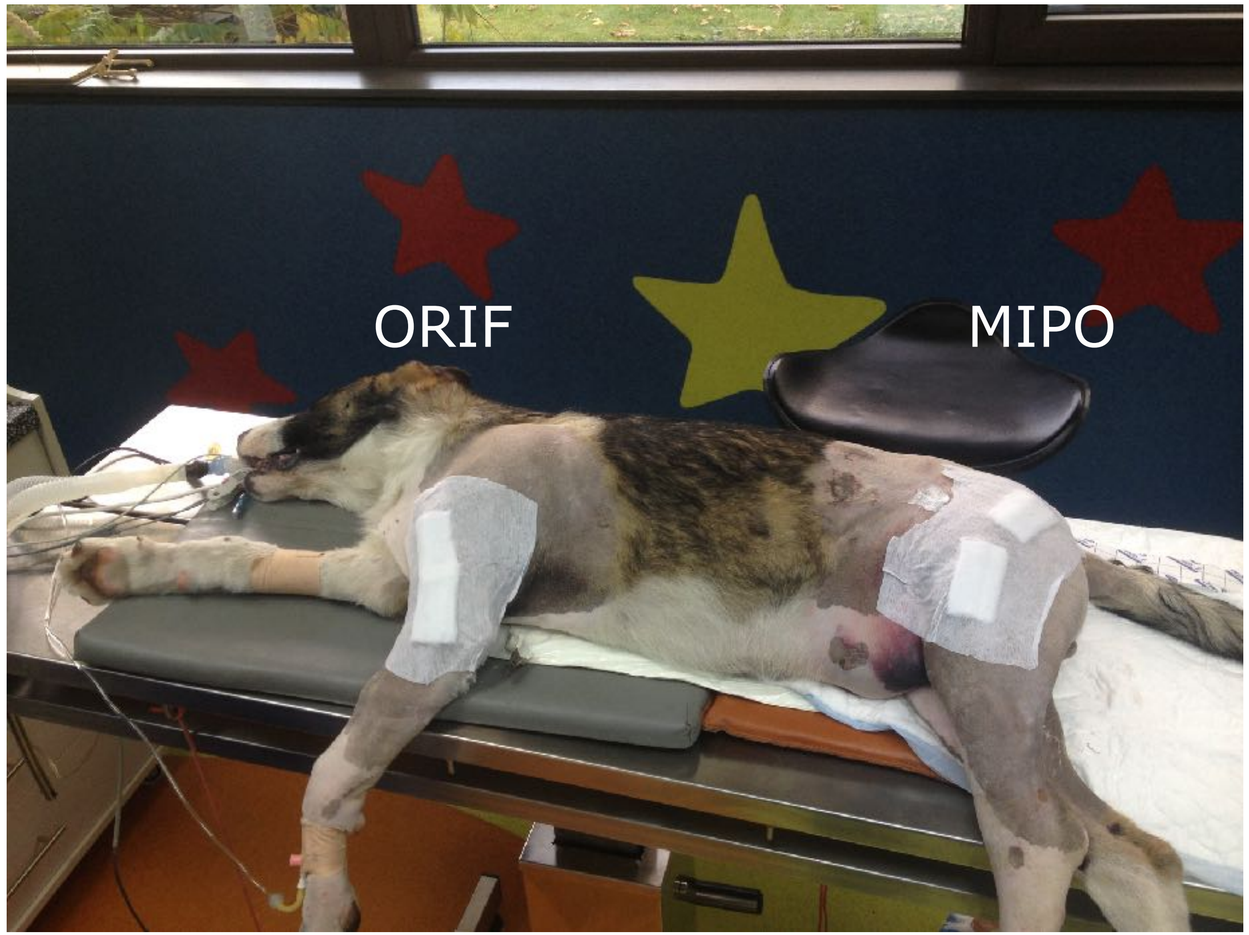


MIPO, plate + rod



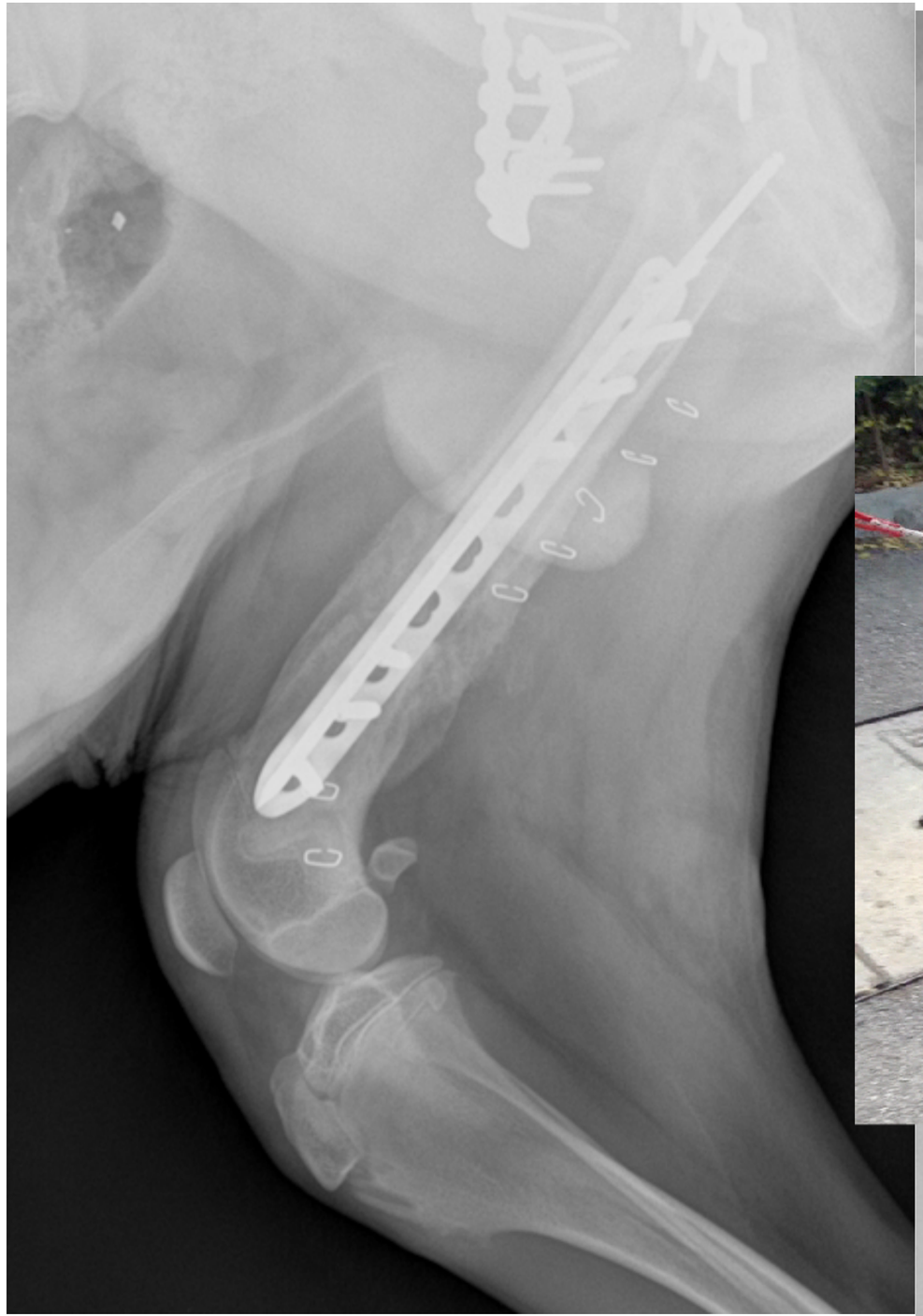


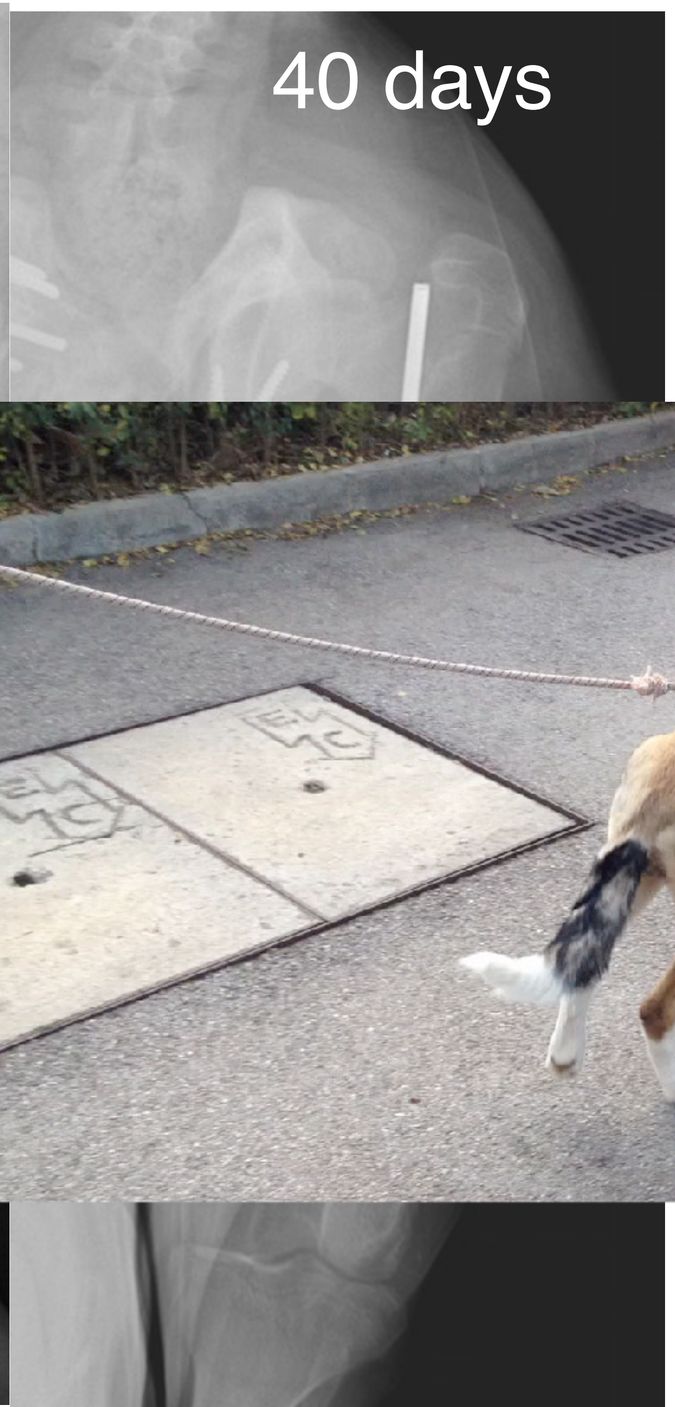
2,4 locking Mikromed



10 d post op

40 days

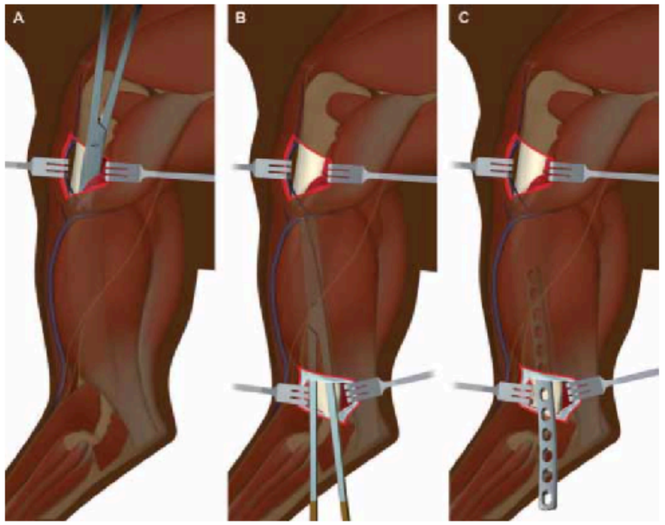



40 days

Remodeling phase

4 months, f up

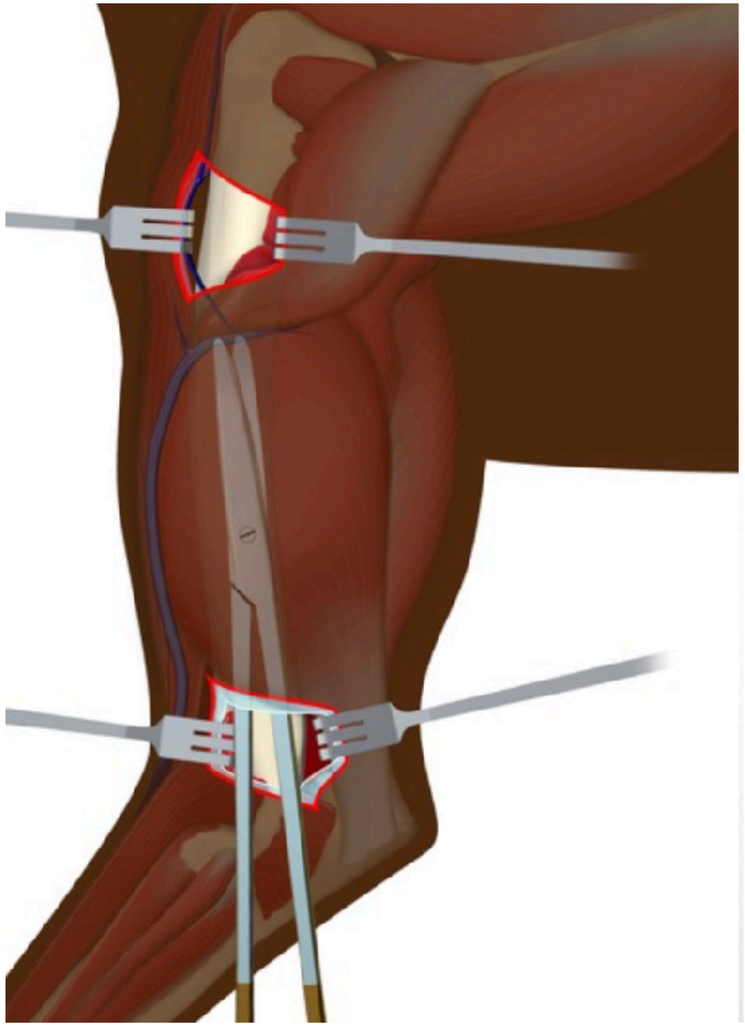
MIPO Humerus

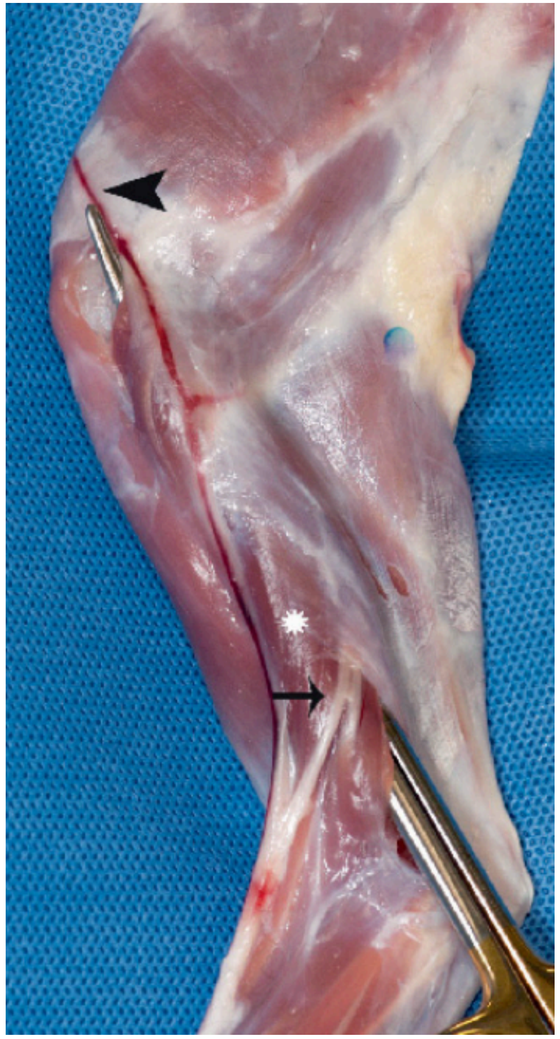


Combination of the approaches- proximal shaft of the humerus and the lateral condyle.

- Avoid the radial nerve - retraction with a Senn retractor.
- Plate, under the brachialis muscle.
- “..sliding the plate **cranially** .. to prevent caudal displacement of the plate…”

MIPO Humerus



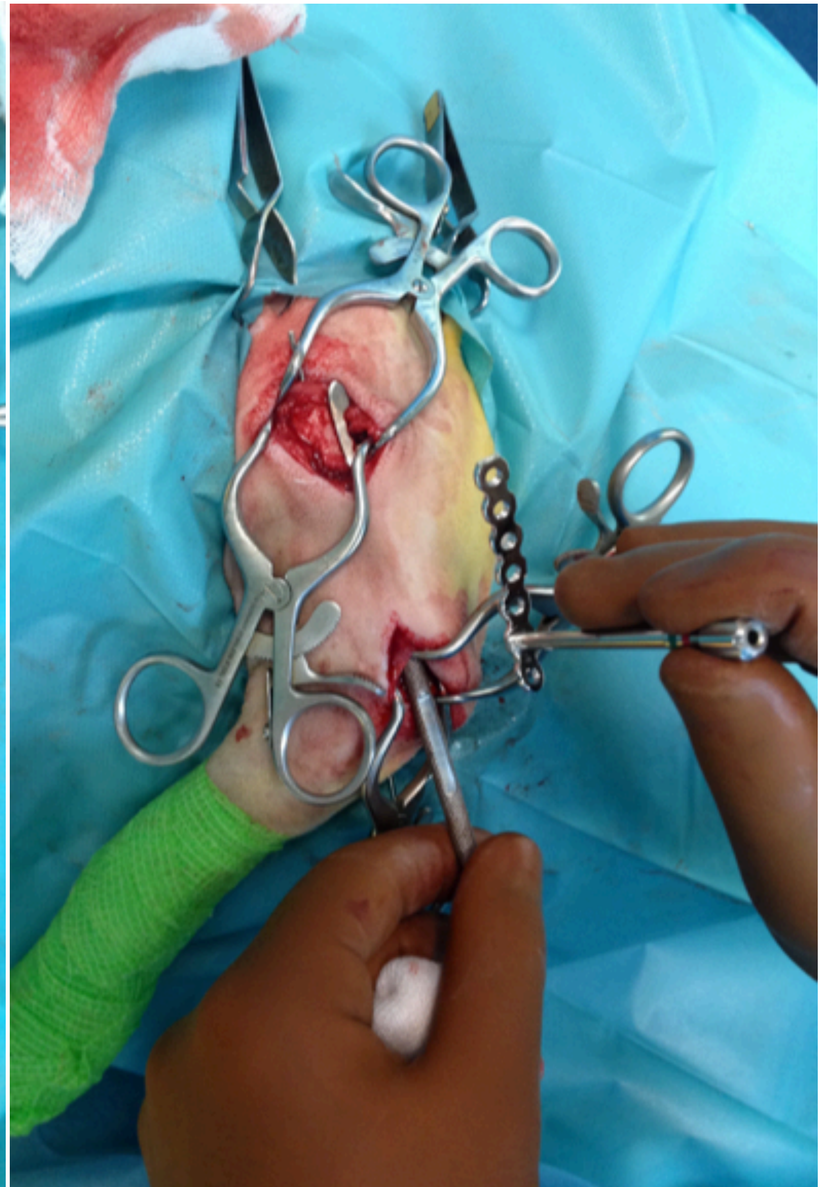


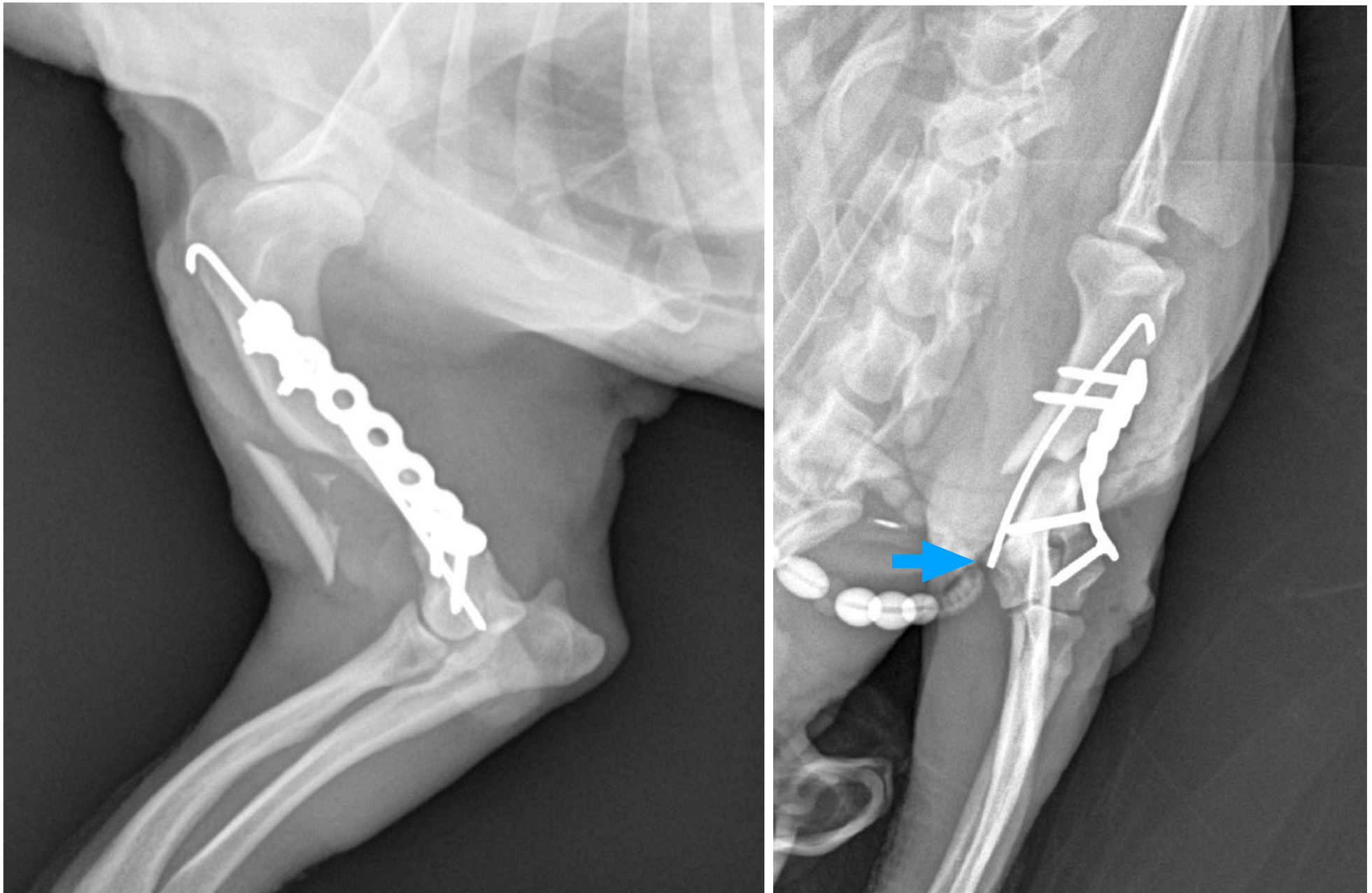
Lateral vs Medial Plating

Buki,
2 y old pekingese
HBC

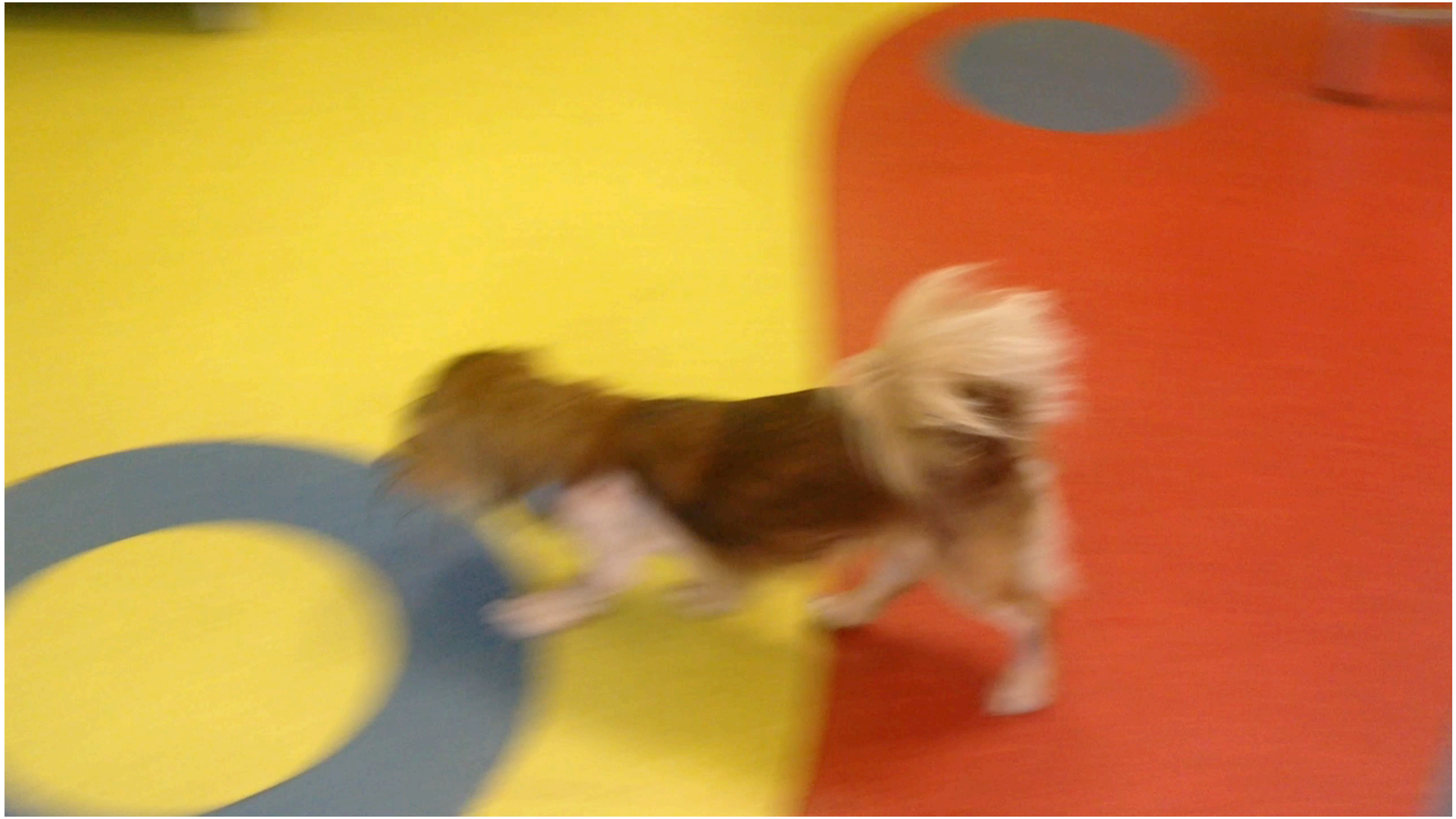

103.95 mm

MIPO Humerus

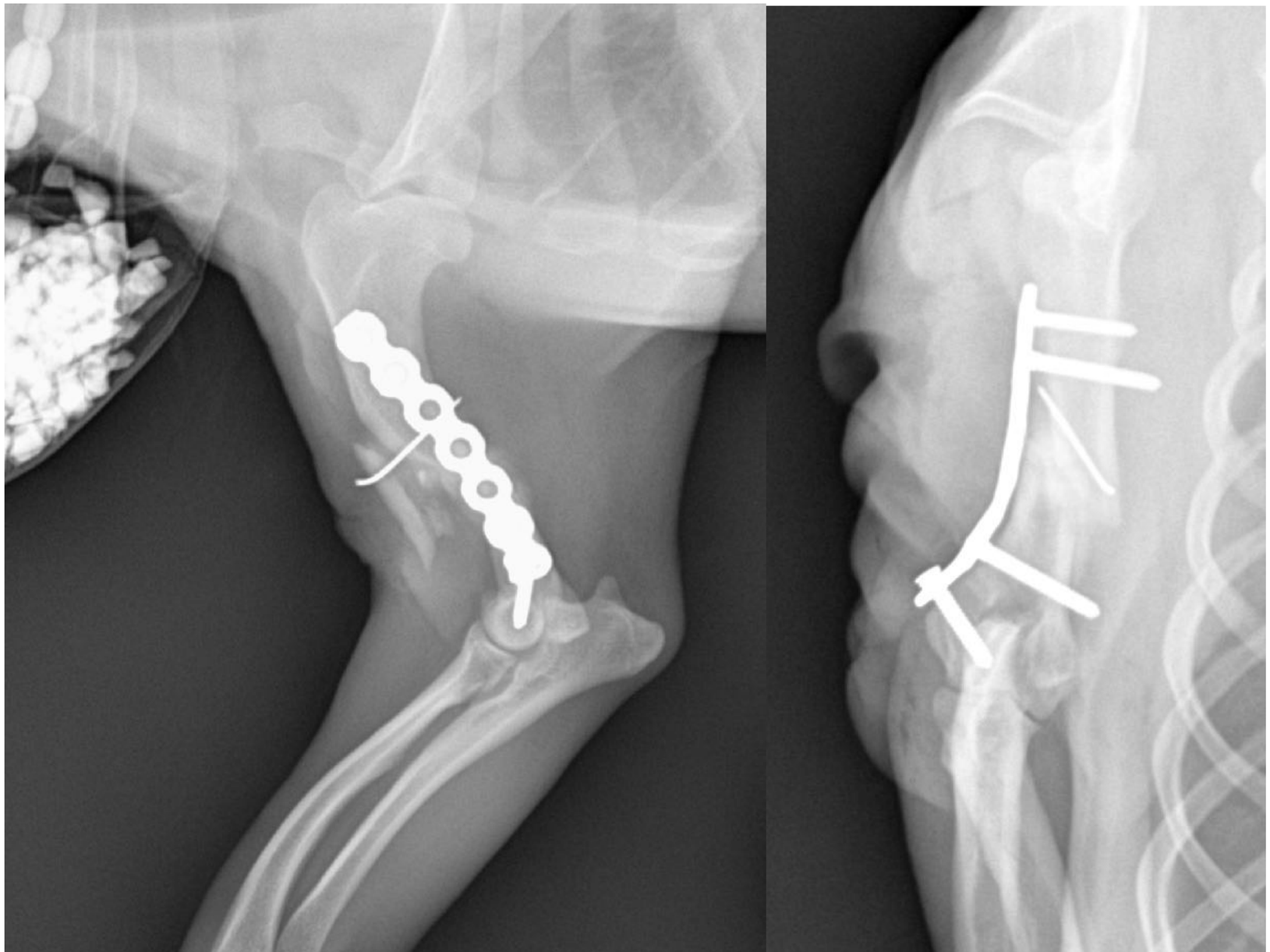


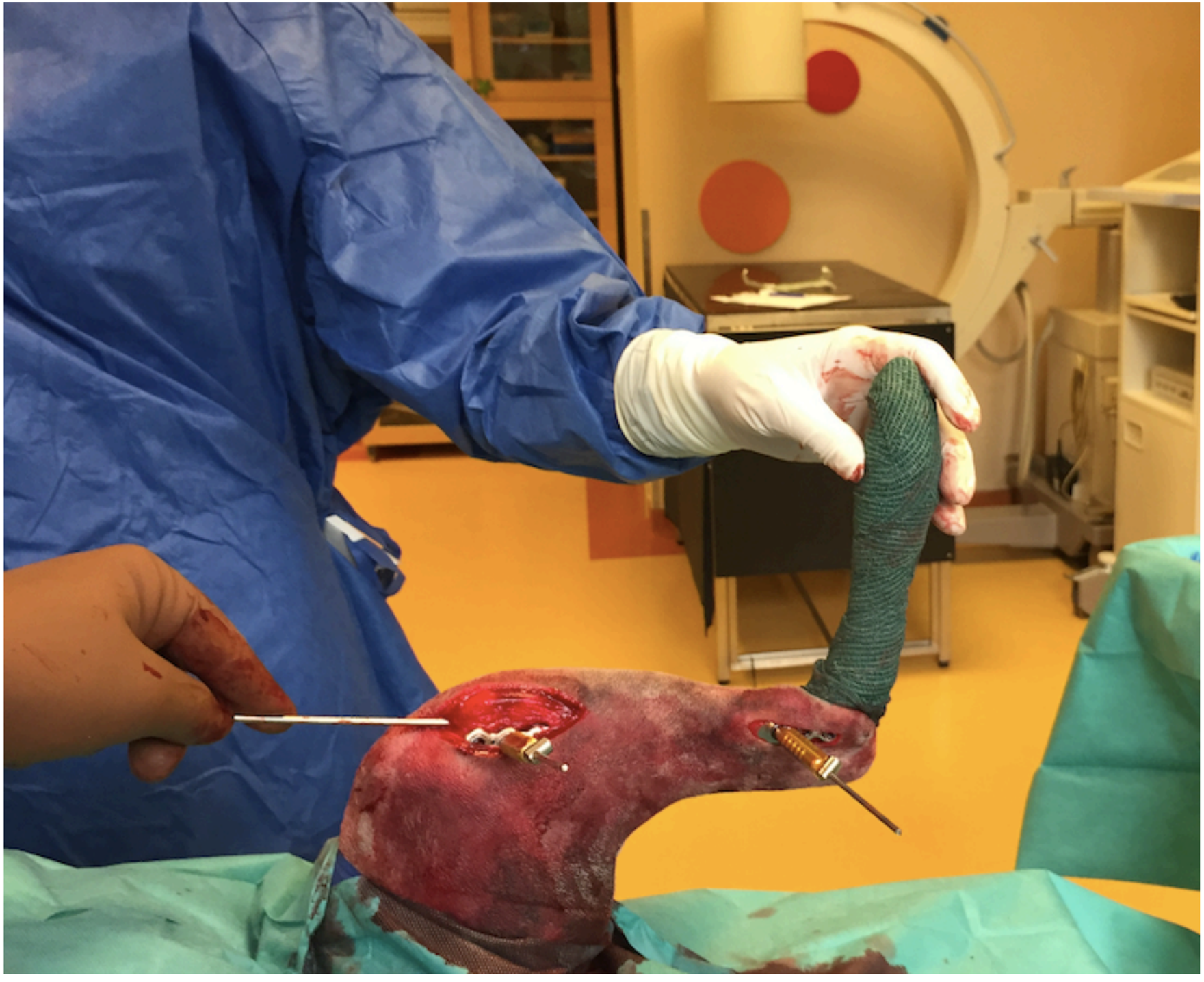


8 days post op

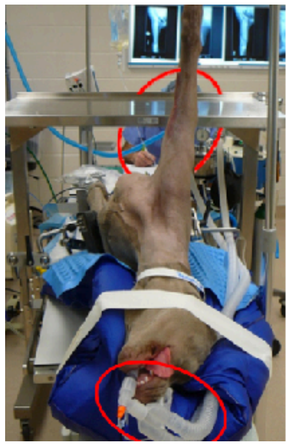
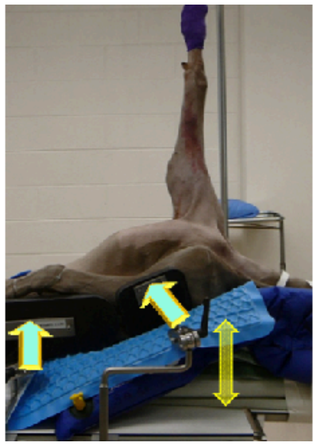


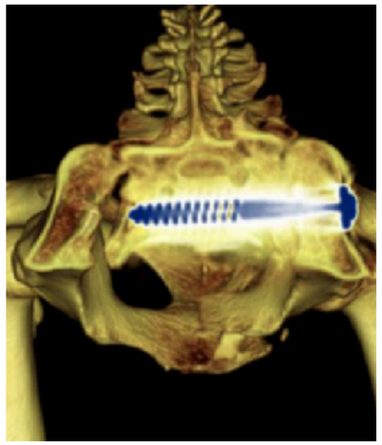
10 weeks f up



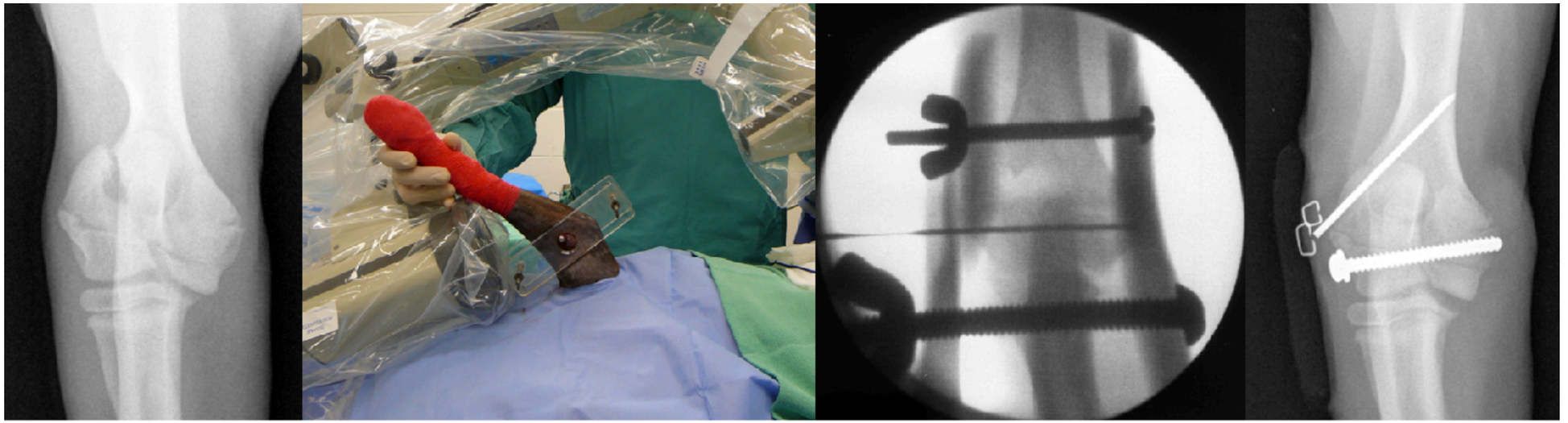


MIPO Humerus- intraairticular



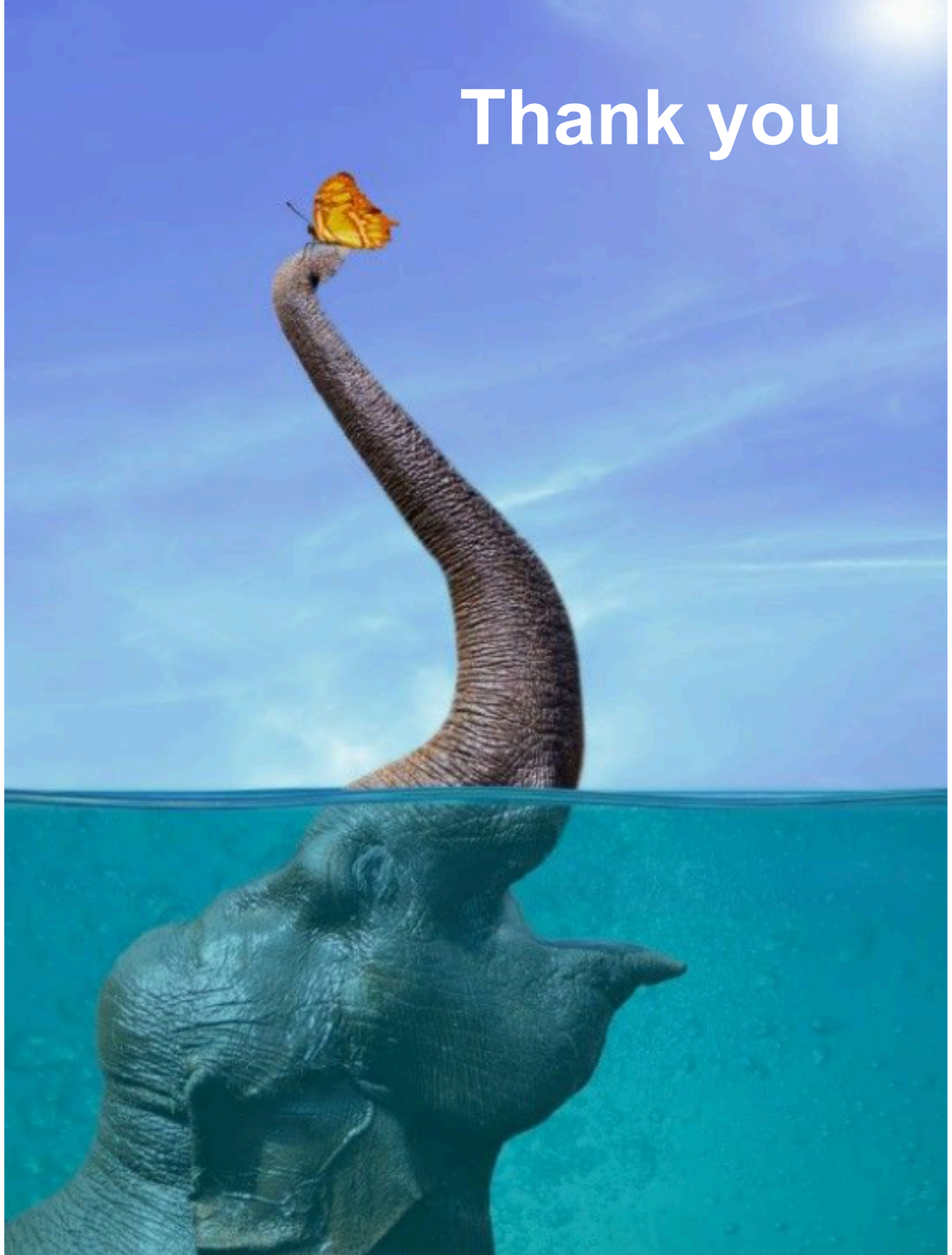
https://www.acvs.org



MINIMALLY INVASIVE OSTEOSYNTHESIS IN NON-DIAPHYSEAL FRACTURES
Kenneth A Johnson MVSc, PhD, FACVSc, DACVS, DECVS University of Sydney – Sydney NSW 2006
AUSTRALIA Loïc M. Déjardin, DVM, MS, DACVS, DECVS Michigan State University, East Lansing – Michigan

Take home messages

- Proper fx selection
- Start with the tibia
- Do not struggle
- Ready to switch to OPEN Check proper alignment


Thank you