# The Kienböck disease and scaphoid fractures

Mariusz Bonczar

THE 2nd INTERNATIONAL TRAUMA SYMPOSIUM
Injuries of the Upper Extremity - from top to bottom

# The Kienböck disease

## and scaphoid fractures

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Injuries of the Upper Extremity - from top to bottom

# Kienböck  disease – personal experience

- My special interest for almost 25 years
- Thesis on  60 cases and 8 bilateral
- 8 bilateral – still the biggest series in the literature
- More then 200 surgeries
- Continuing searching the literature

# Kienböck  disease – objectives

- **The latest information on:**
  - Etiology
  - Pathomechanism
  - Treatment algorithm

# Kienböck disease- etiology

# Kienböck disease- etiology

„At risk” patient

„At risk” lunate

„At risk” surroundings

# Kienböck disease- etiology

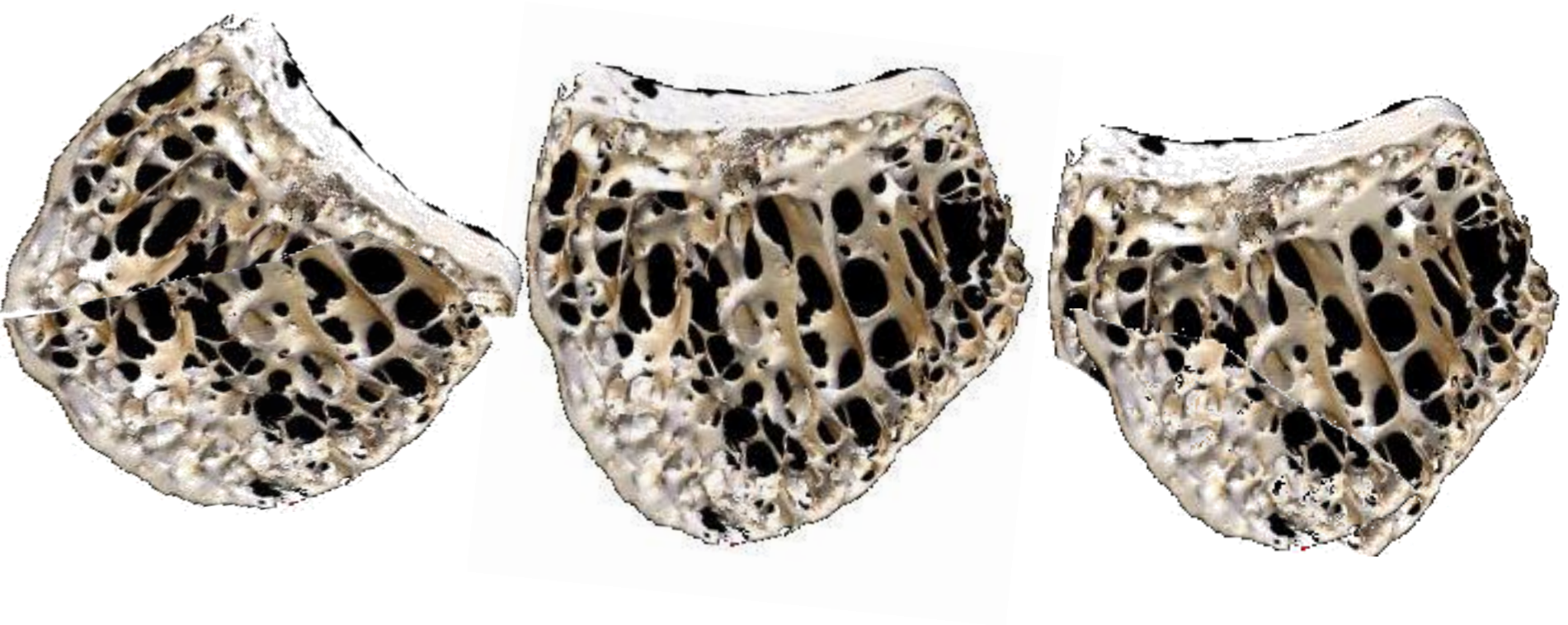
„At risk" patient

- Young
- Active
- Male??
- Particularly manual labor
- Repetitive stress, micro trauma

# Kienböck disease- etiology

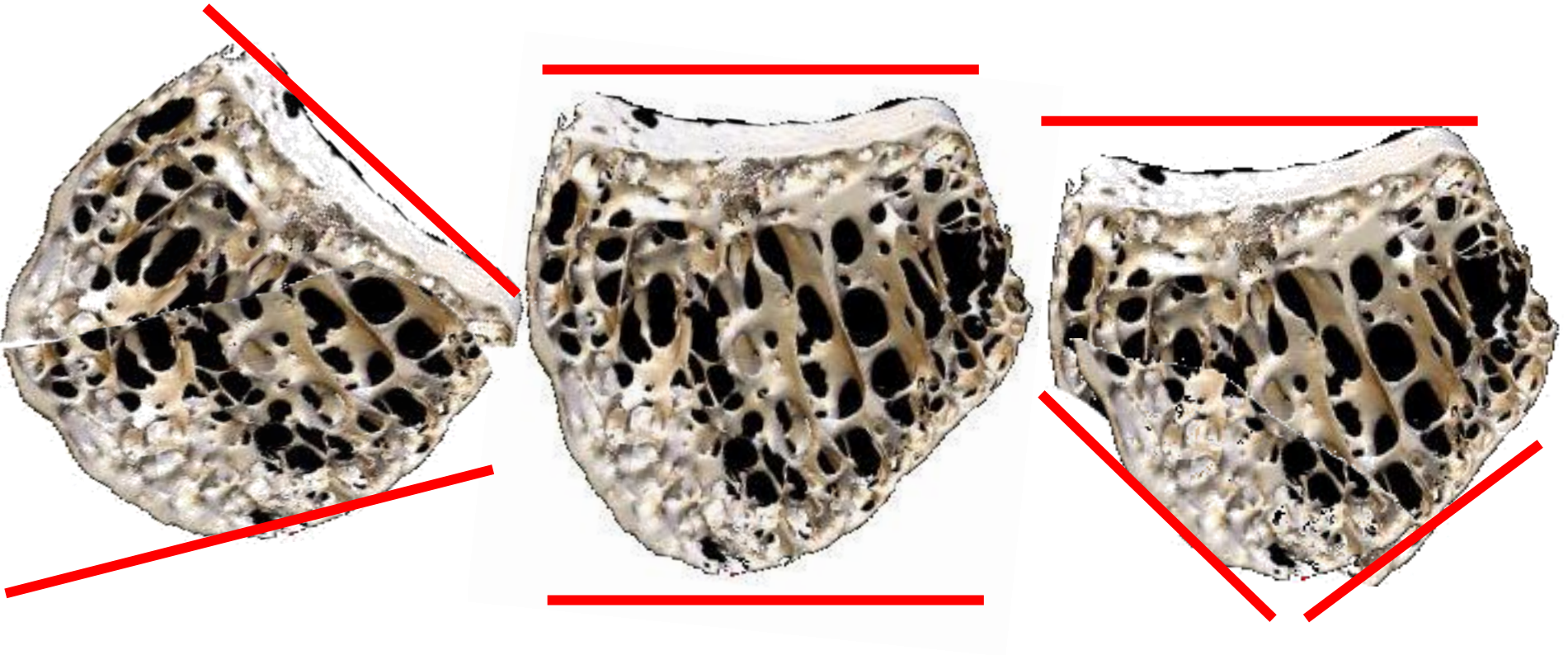
„At risk” lunate

# Zapico type lunate



**Type I 32%** **Type II 50%** **Type III 18%**

# Zapico type lunate



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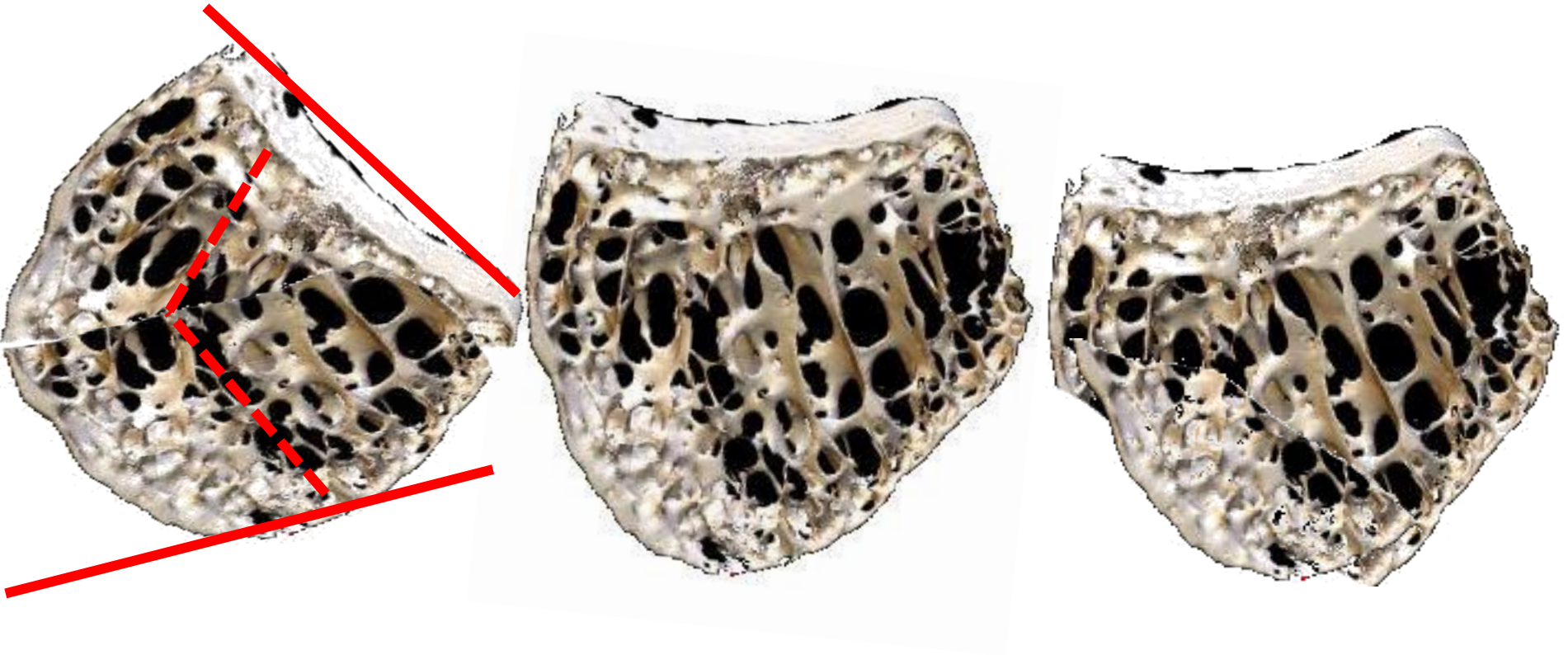
# Zapico type lunate

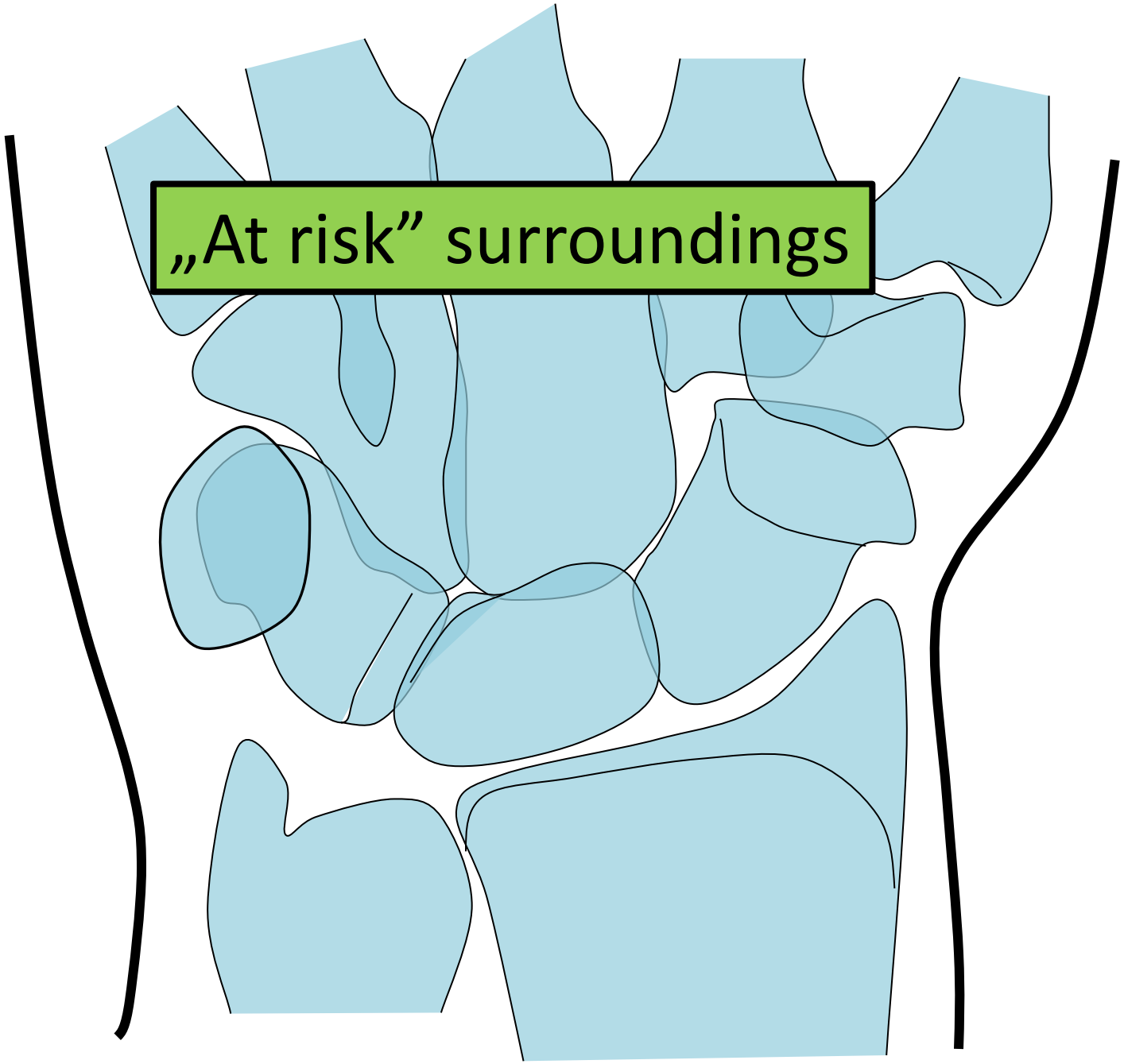


**Type I 32%**

Trabecular pattern weakest

# Kienböck disease- etiology

„At risk” surroundings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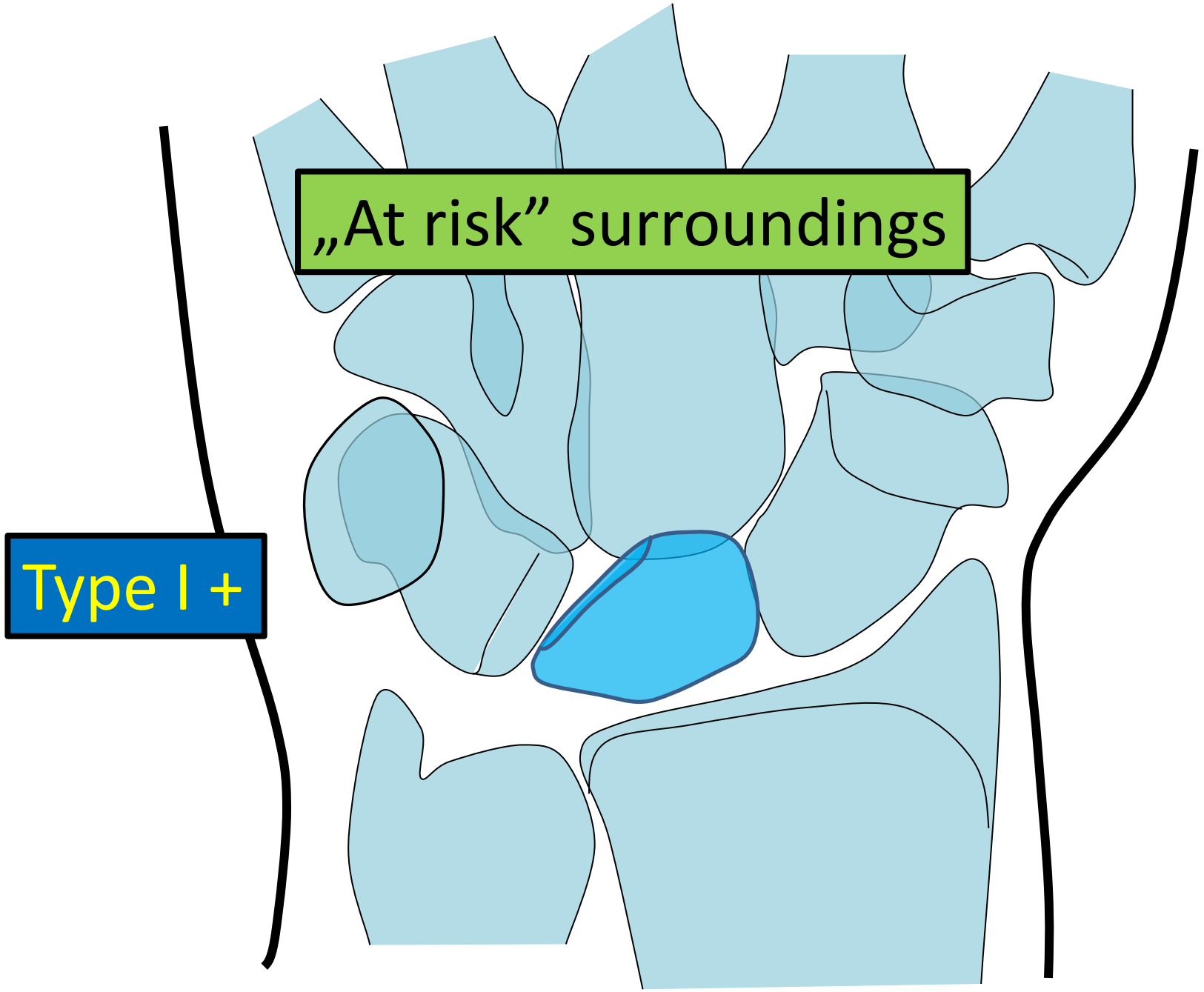
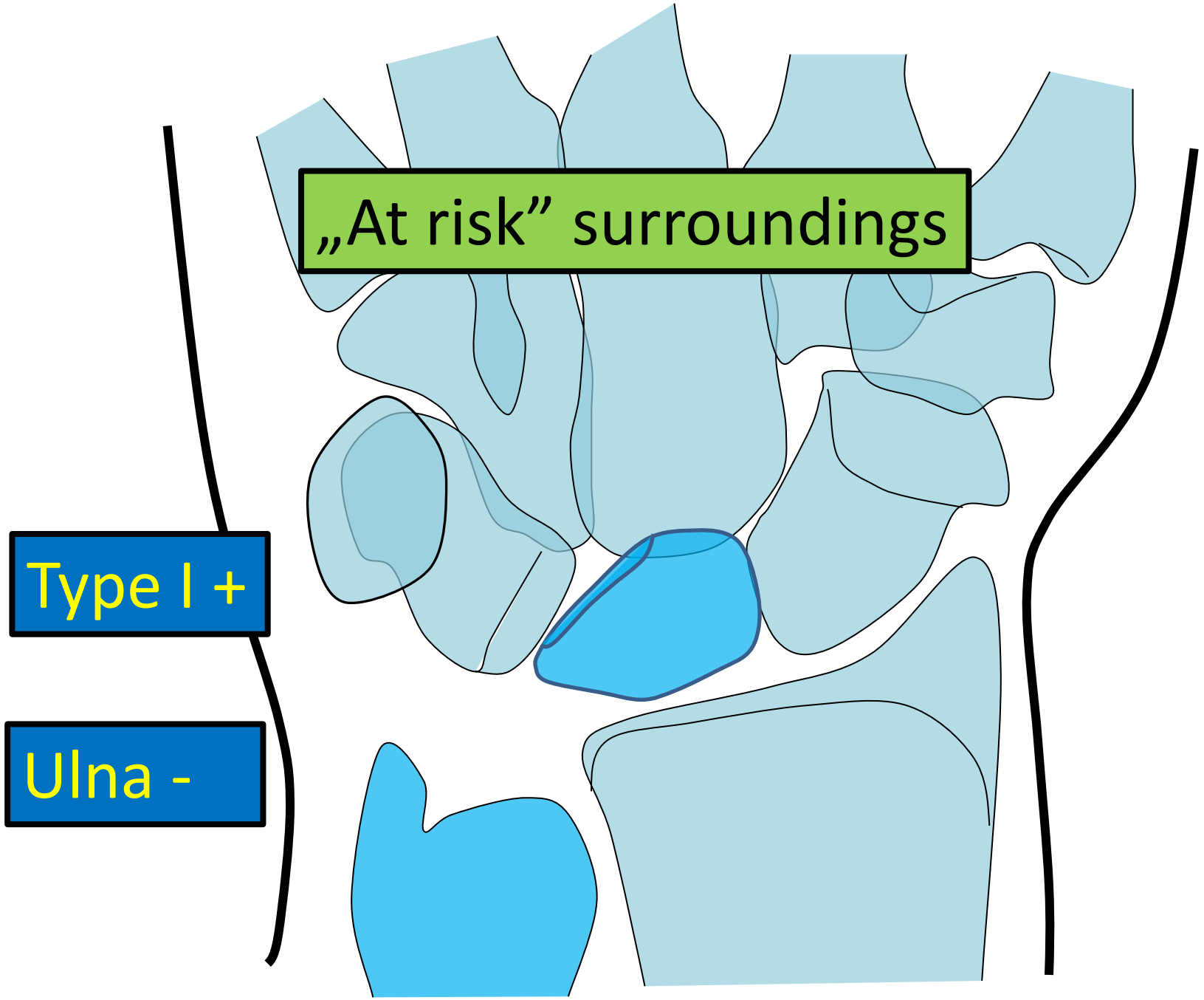
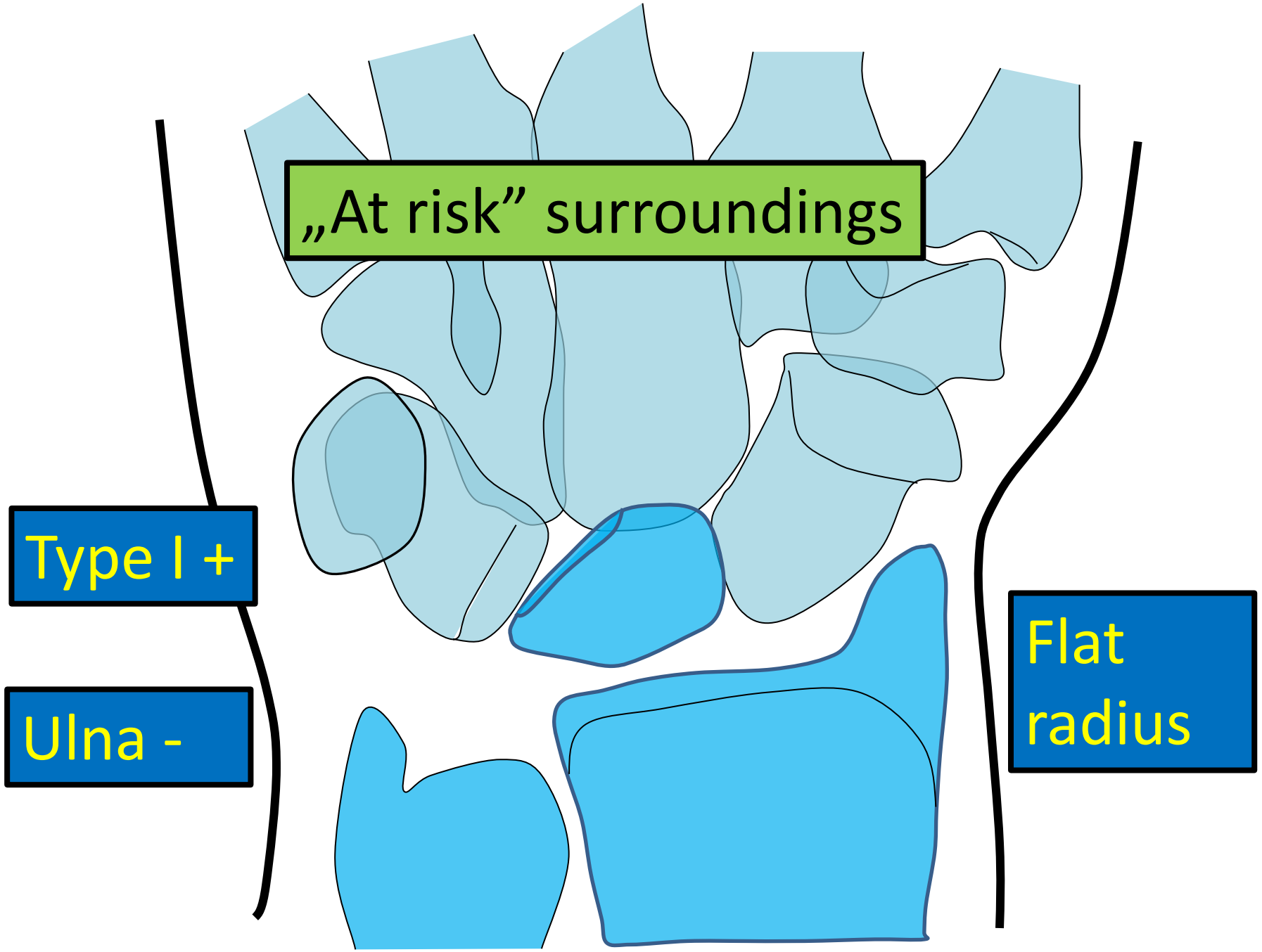
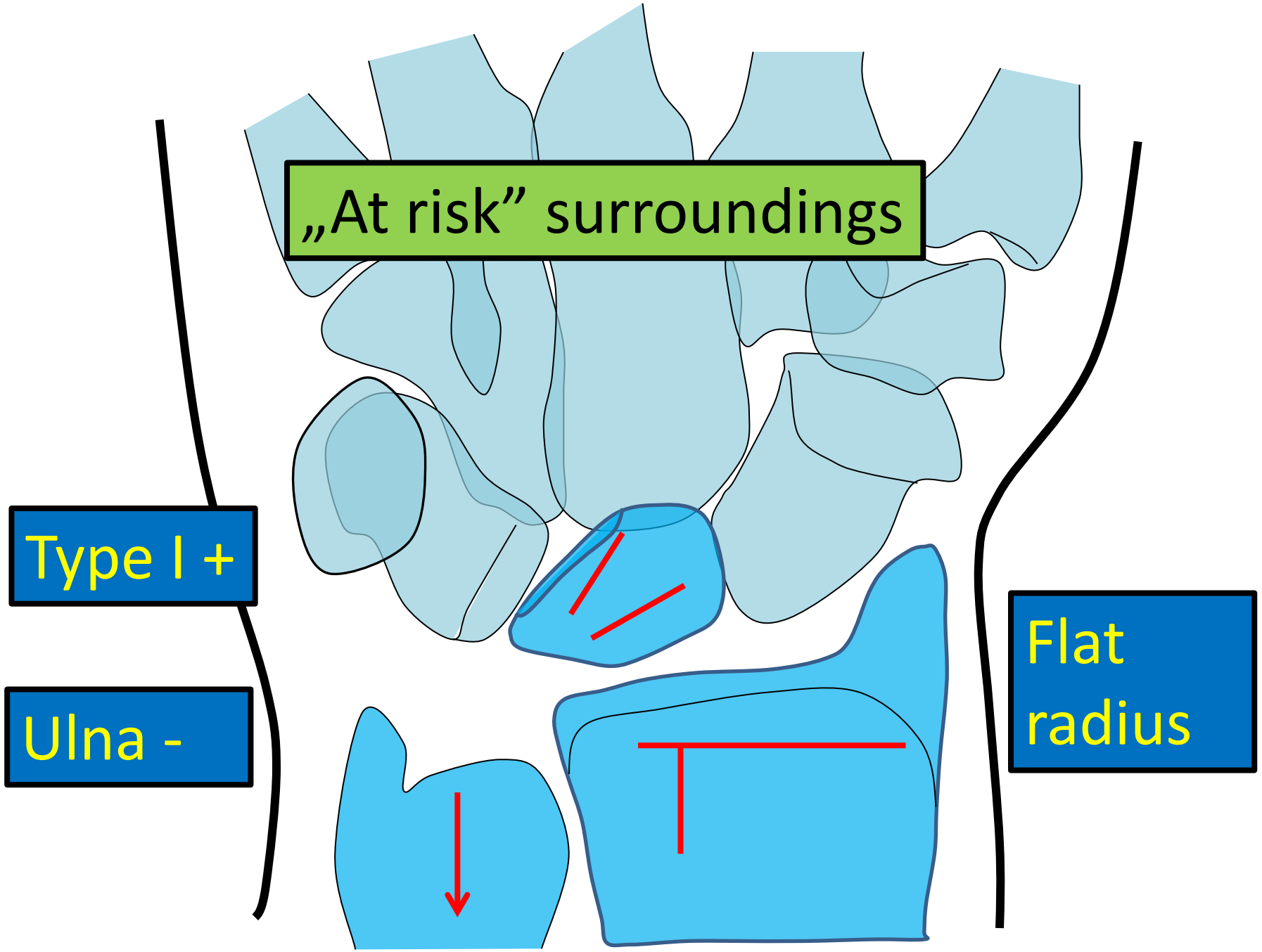

„At risk” surroundings
Type I +


„At risk” surroundings
Type I +
Ulna -


„At risk” surroundings
Type I +
Ulna -
Flat radius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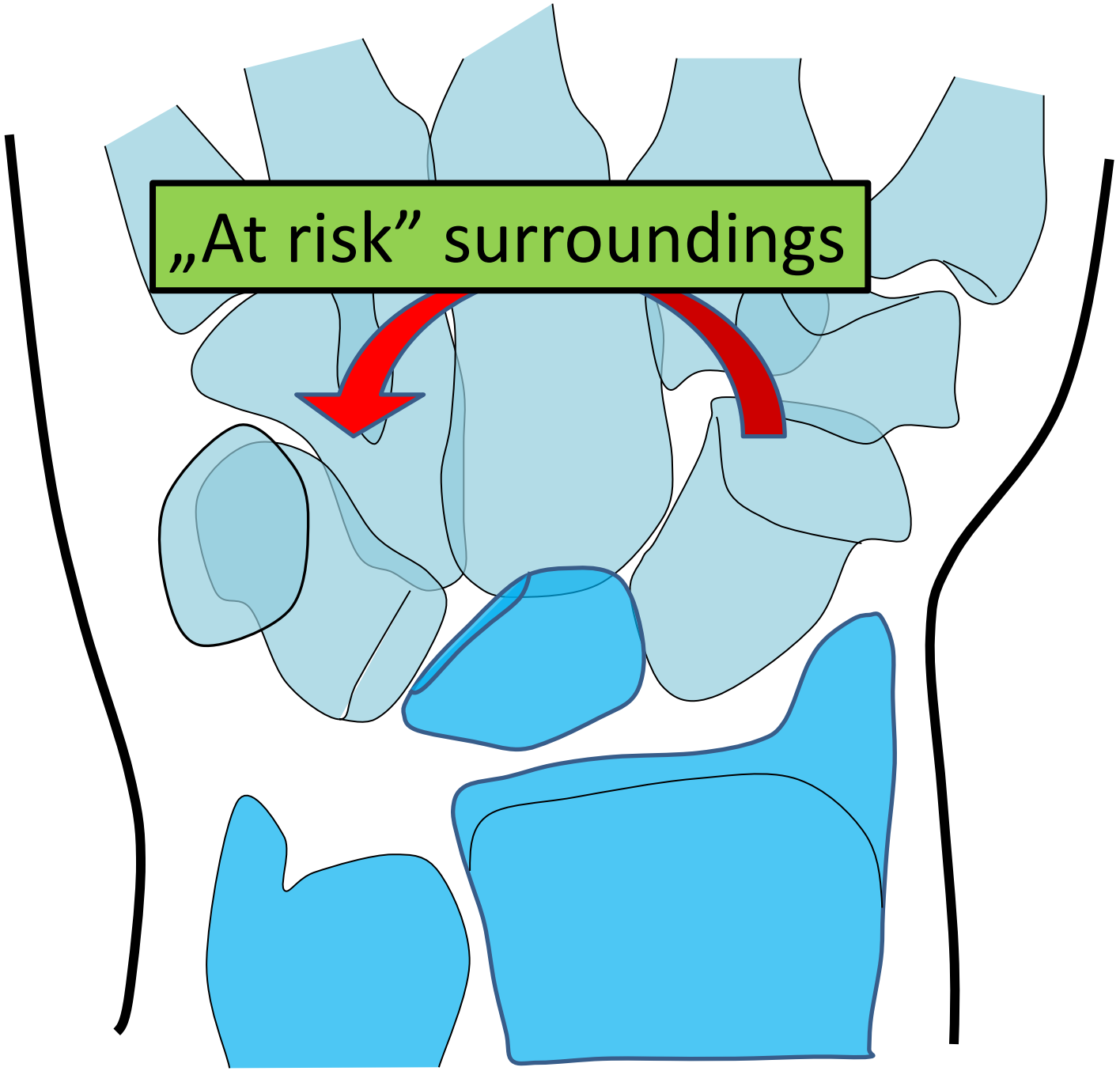
Flat radius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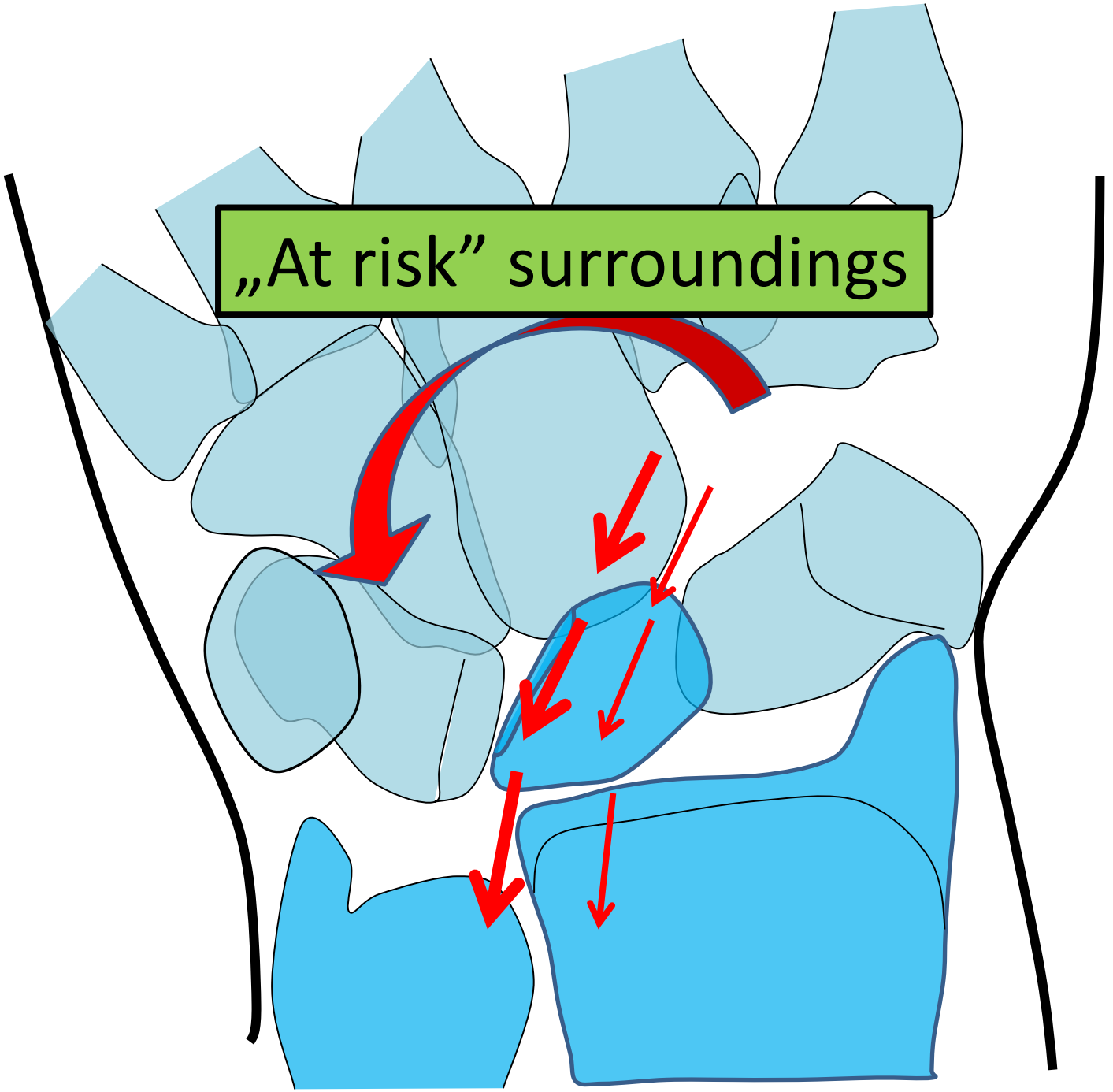
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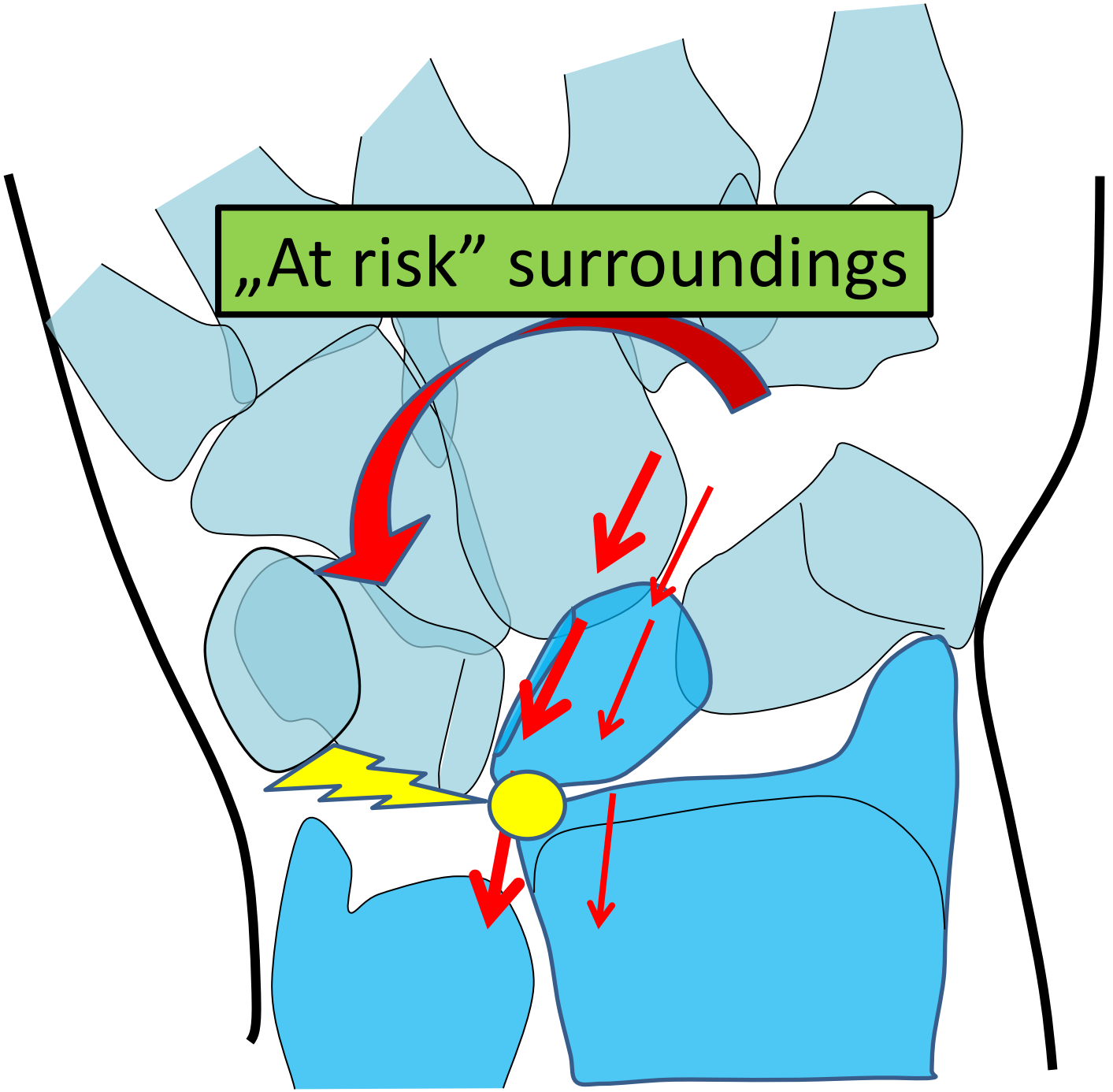
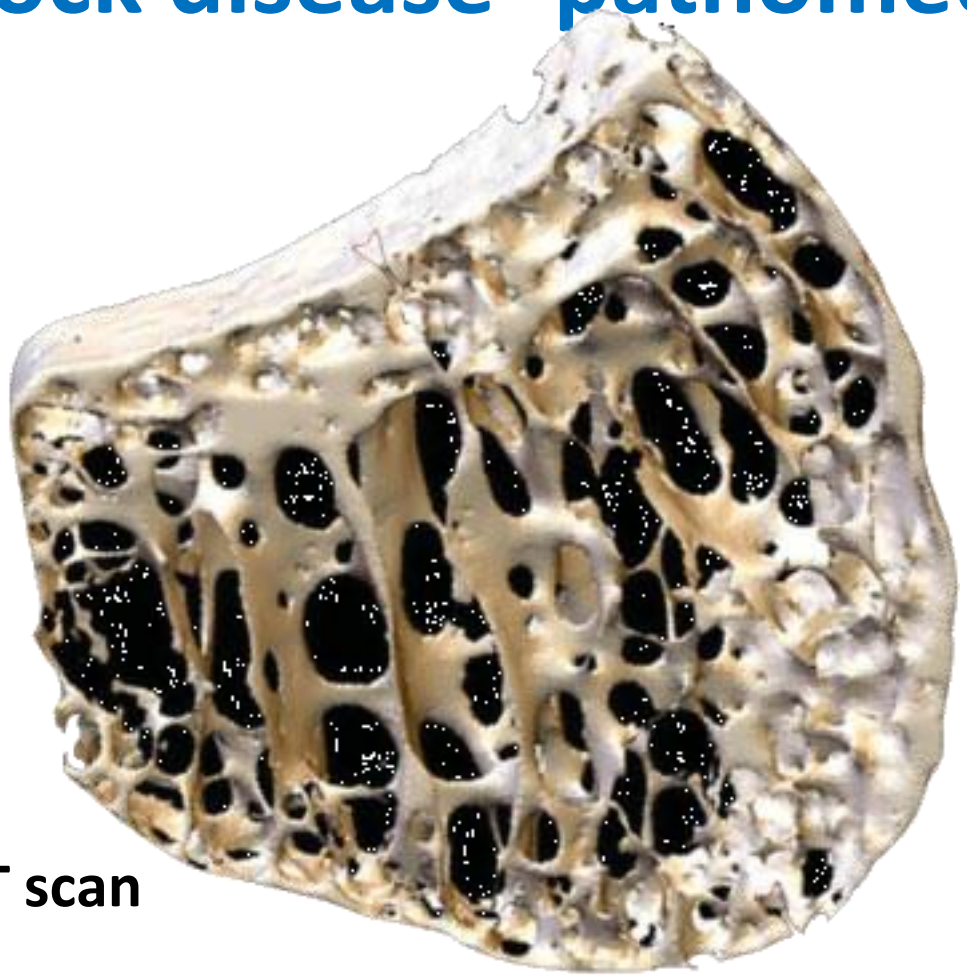

„At risk” surroundings

# Kienböck disease- pathomechanism

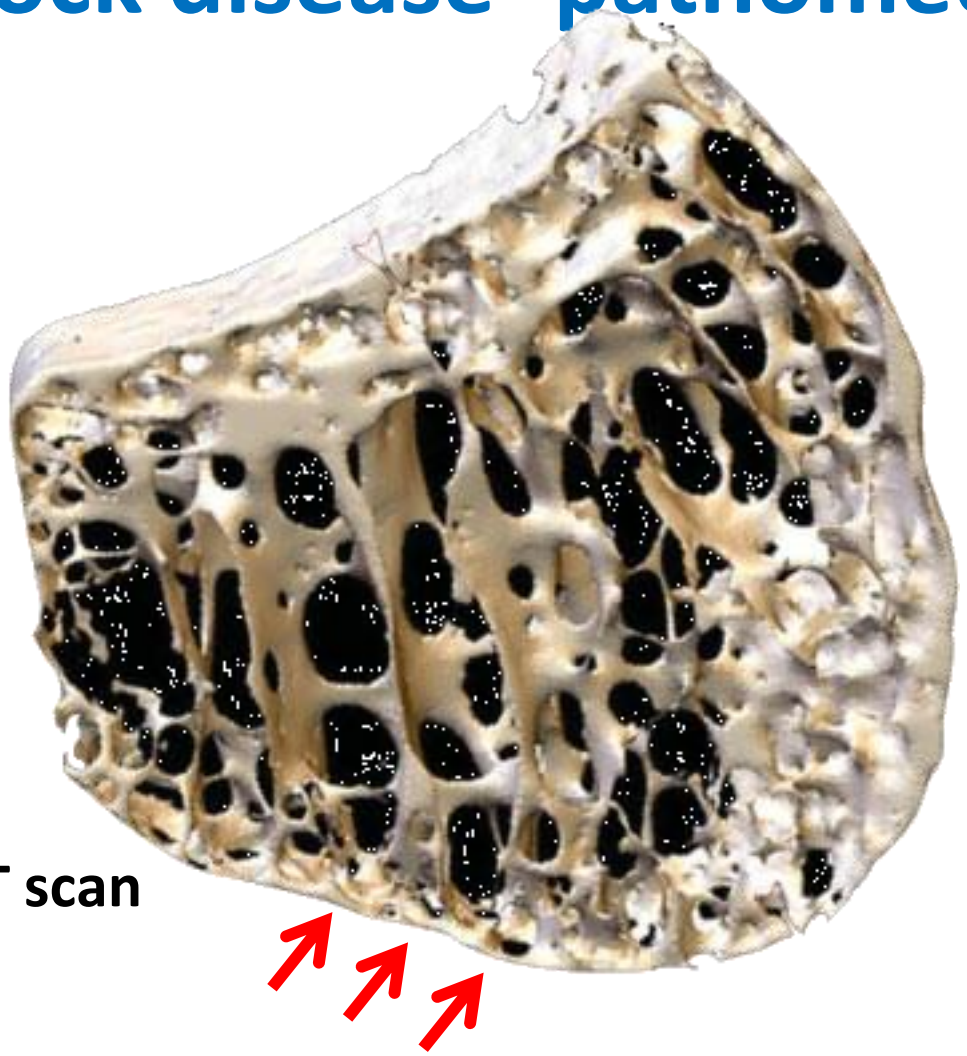


**3D micro-CT scan**

External and internal bone micro-architecture in normal and Kienböck's lunates: A whole-bone micro-computed...

Article in Journal of Orthopaedic Research · June 2014

# Kienböck disease- pathomechanism



**3D micro-CT scan**

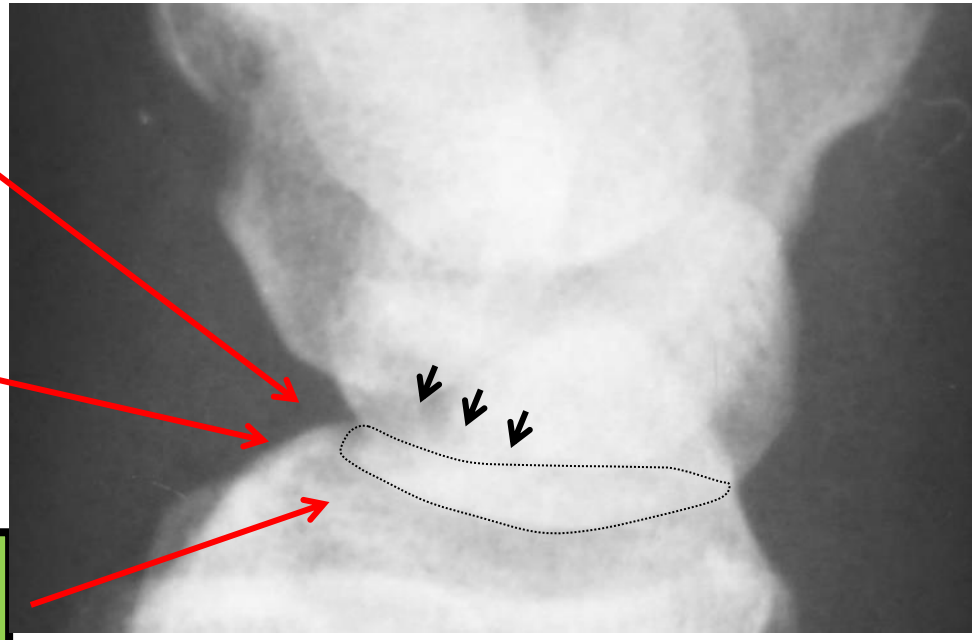
Proximal single layer of subchondral bone – **0,1 mm thick**

# Kienböck disease- pathomechanism

„At risk” patient

„At risk” lunate

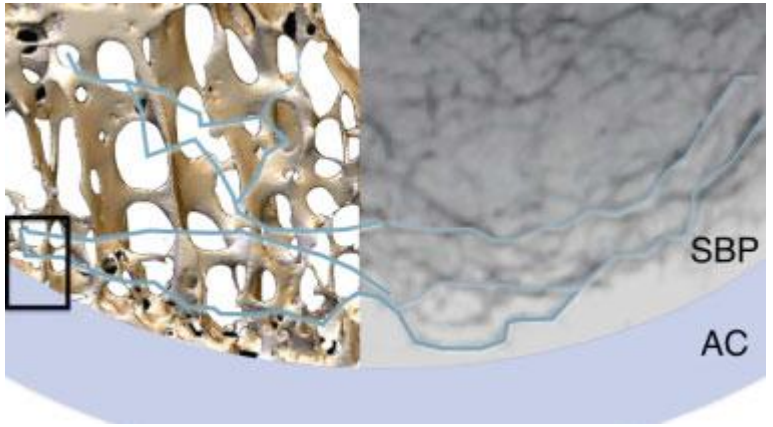
„At risk” surroundings



**Stress fracture at the proximal pole**

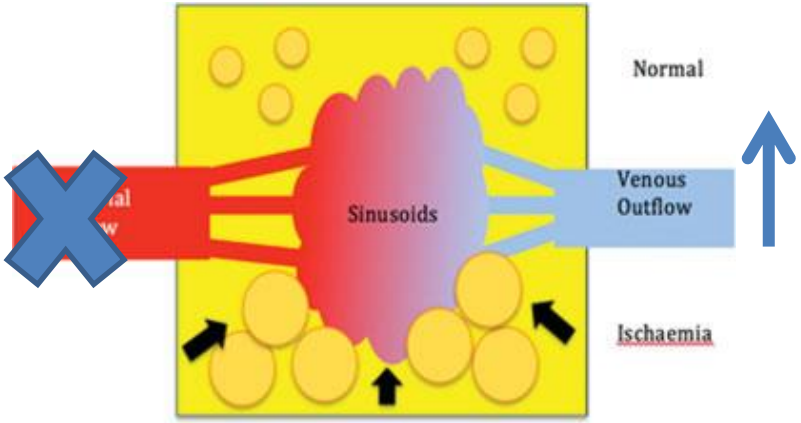
# Kienböck disease- pathomechanism

# Kienböck disease- pathomechanism




**Stress fracture**

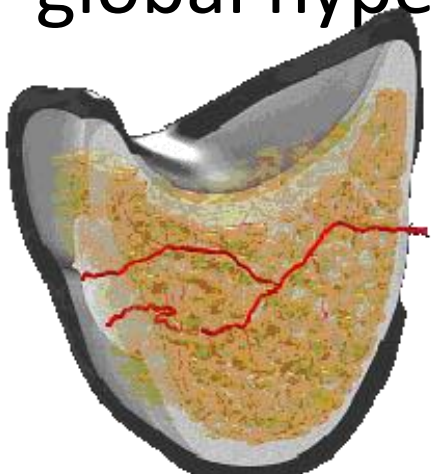
**Impairment of subarticular venous drainage**




**venous hypertension**

# Kienböck disease- pathomechanism

- impairment of venous drainage is critical in the development of AVN in the lunate
- stress fracture of proximal pole = localized lunate phenomenon
- obstruction of the vein that accompanies the single volar artery = global hypertension of the lunate



# Kienböck disease- treatment algorithm

Patient's age

lunate stage – how does the disease affect the lunate?

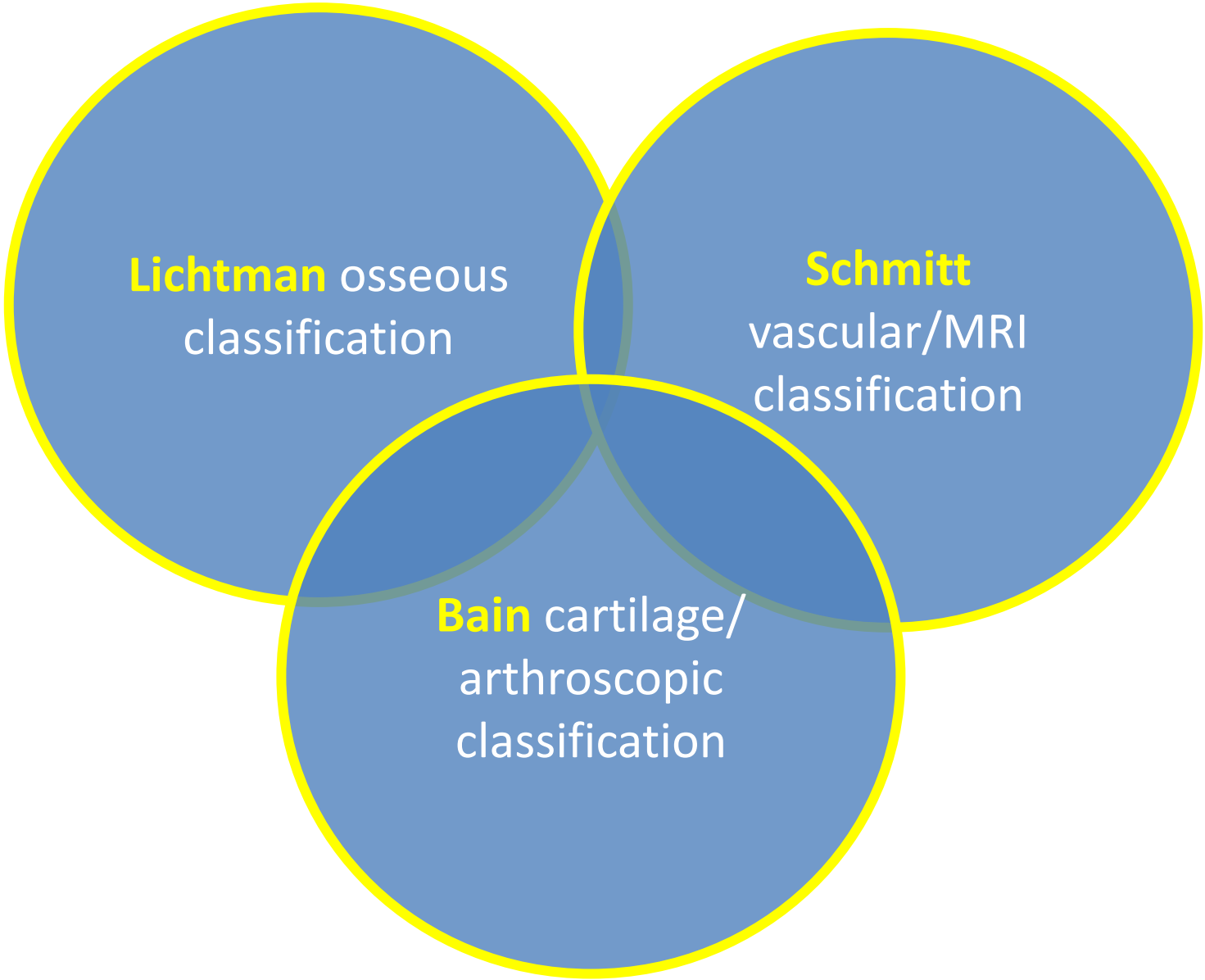
wrist stage – how does the disease affect the wrist?

classification

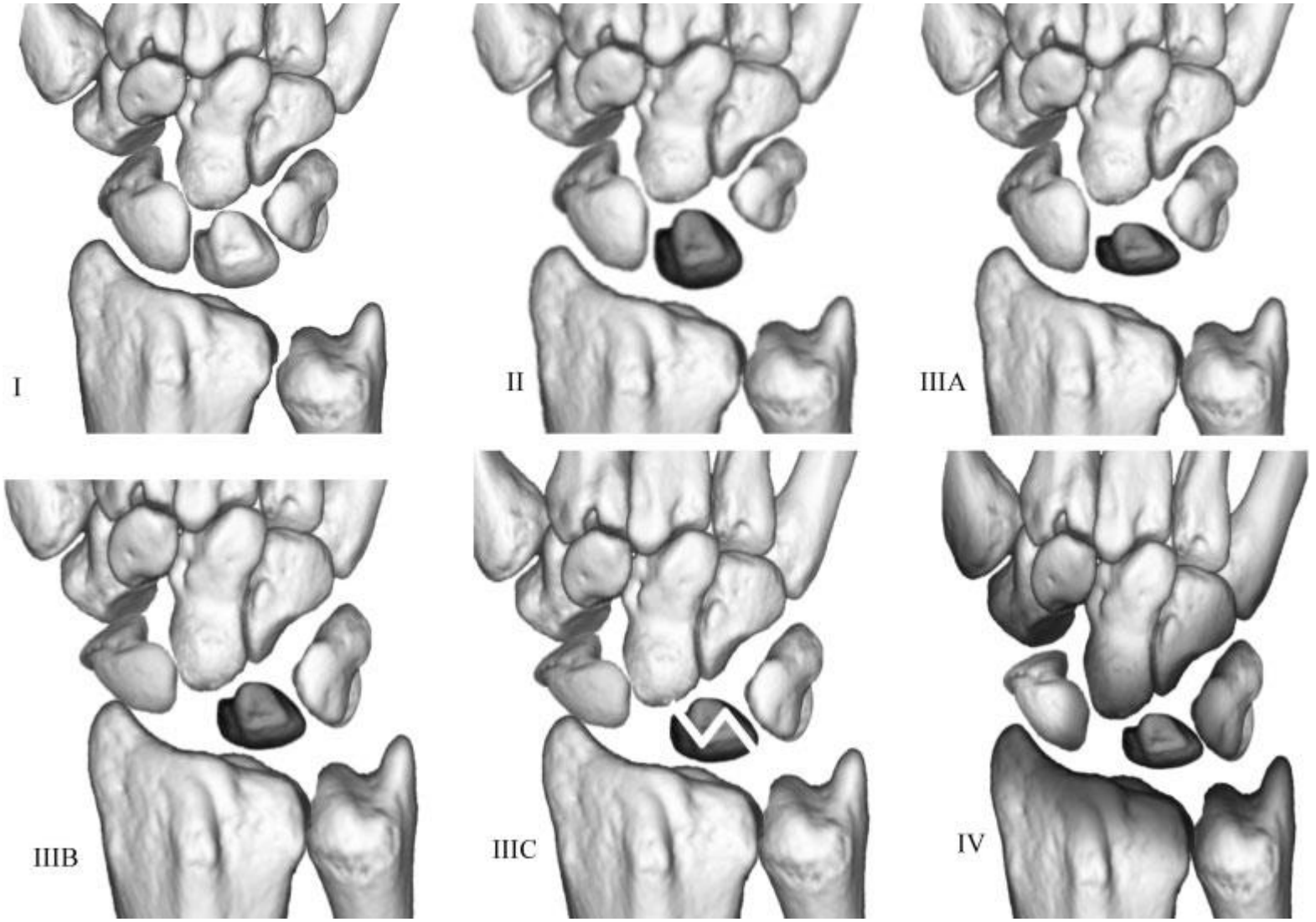
what can the surgeon offer?

what does the patient want?

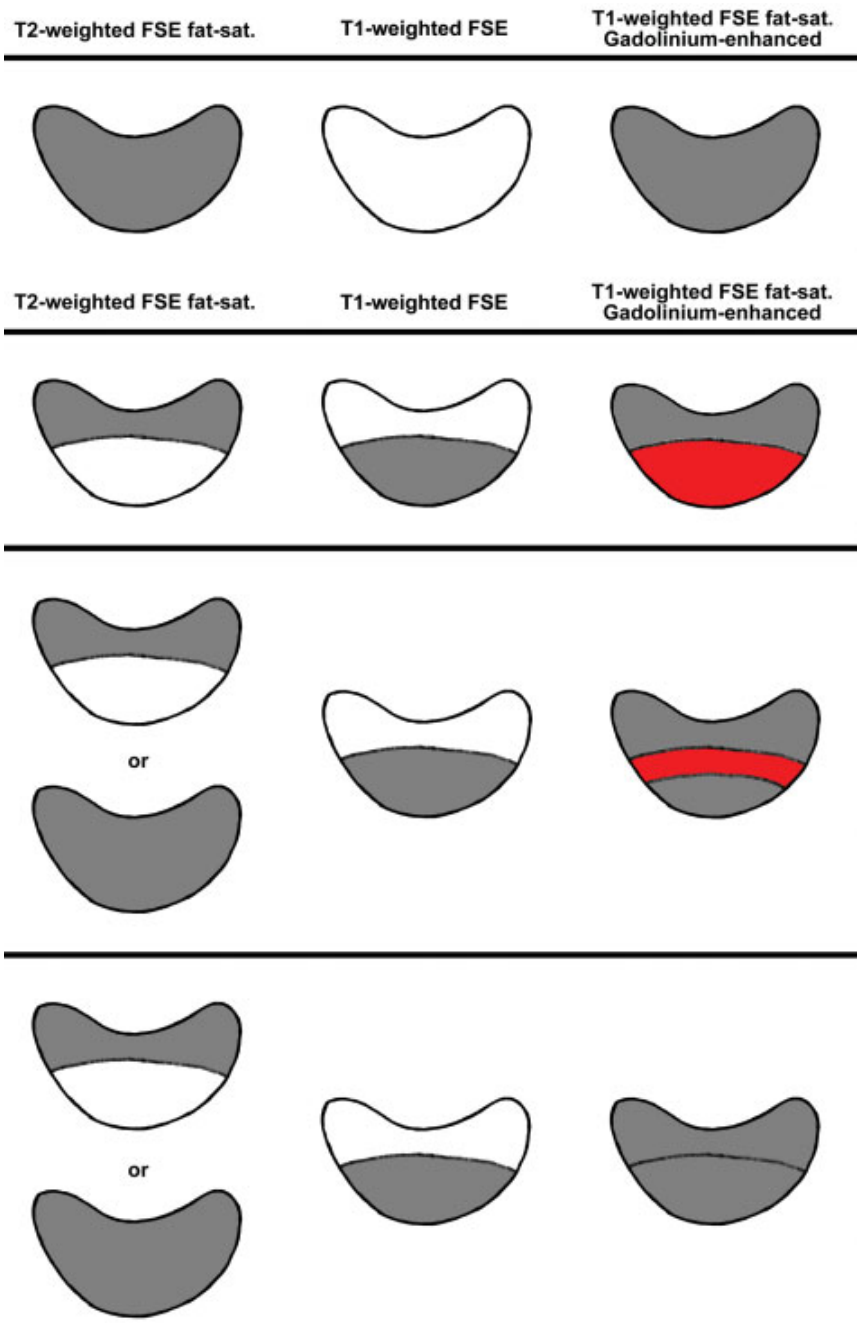
# Kienböck disease- classification



# **Lichtman** osseous classification



Bone marrow




normal

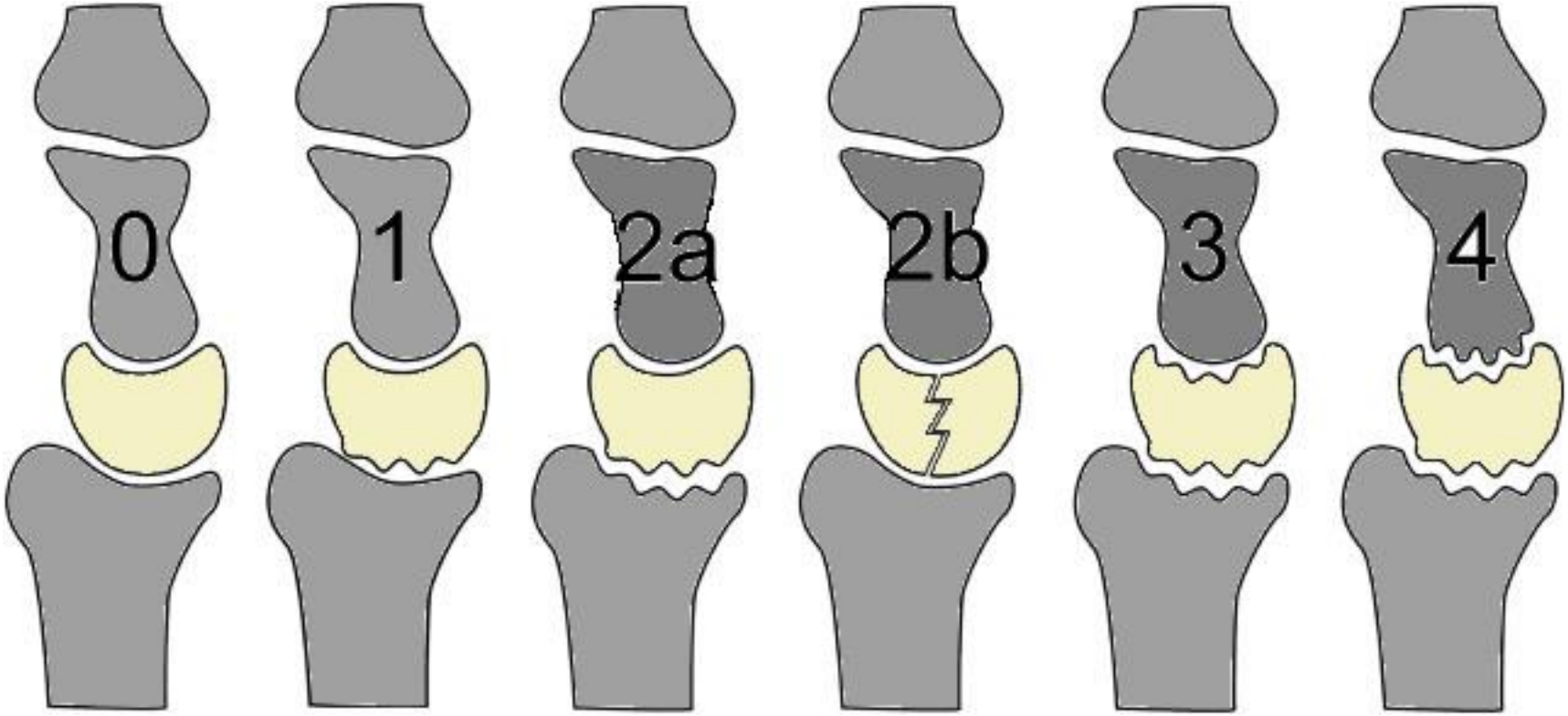
ischemic
MRI **pattern A**

partially necrotic
MRI **pattern B**

completely necrotic
MRI **pattern C**

**Schmitt**
bone marrow
viability in MRI

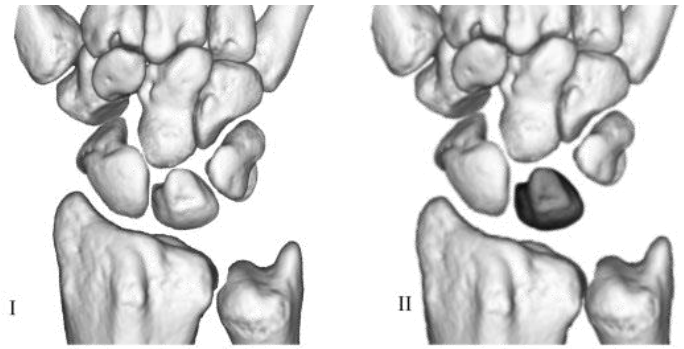
# **Bain** cartilage/arthroscopic classification



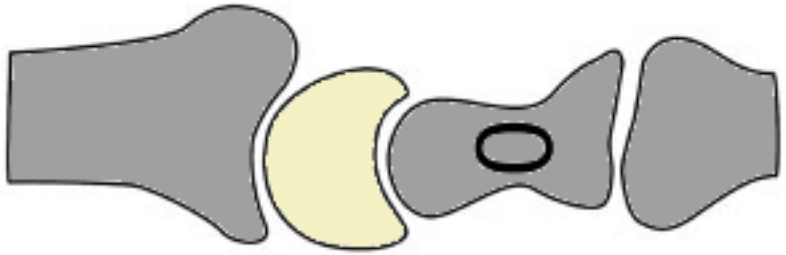

number and location of  nonfunctional articular surfaces

# Kienböck disease- treatment algorithm

## lunate intact



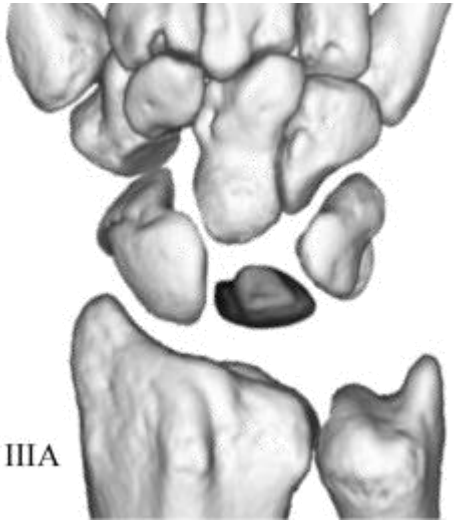

ischemic
MRI **pattern A**



## lunate protection

- immobilization
- unloading procedures
- lunate decompression
- vascularized bone graft

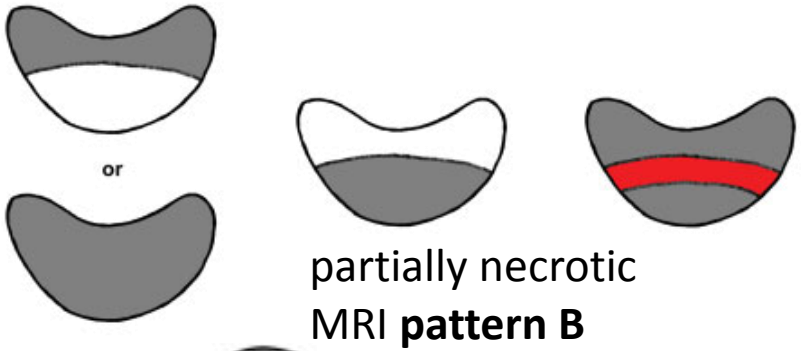
# Kienböck disease- treatment algorithm



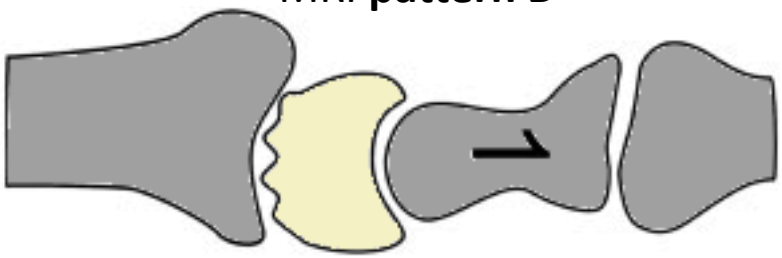

lunate compromised = proximal lunate collapse

lunate reconstruction

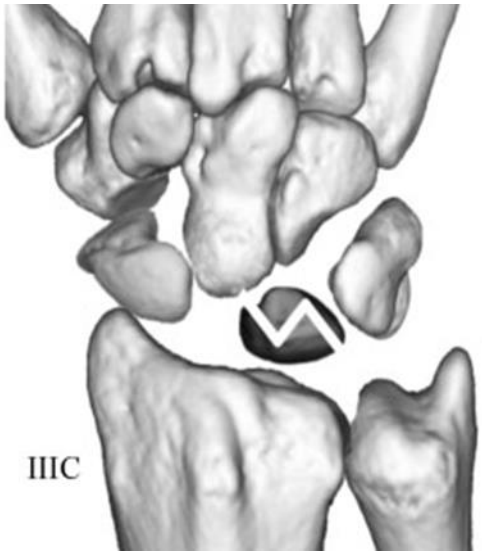
- vascularized bone graft
- VBG + radial shortening
- RSL fusion




partially necrotic
MRI **pattern B**



# Kienböck disease- treatment algorithm

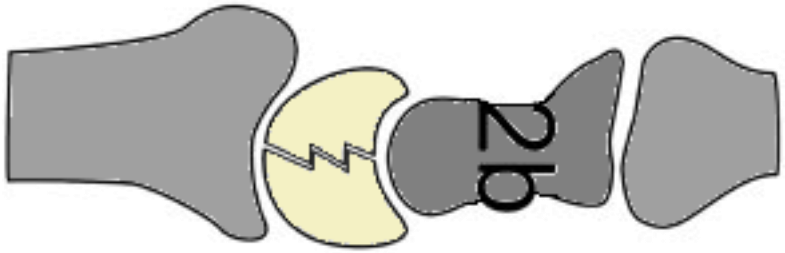



lunate unreconstructable = lunate collapse

lunate excision

- PRC
- capitate shortening
- CL fusion
- lunate replacement

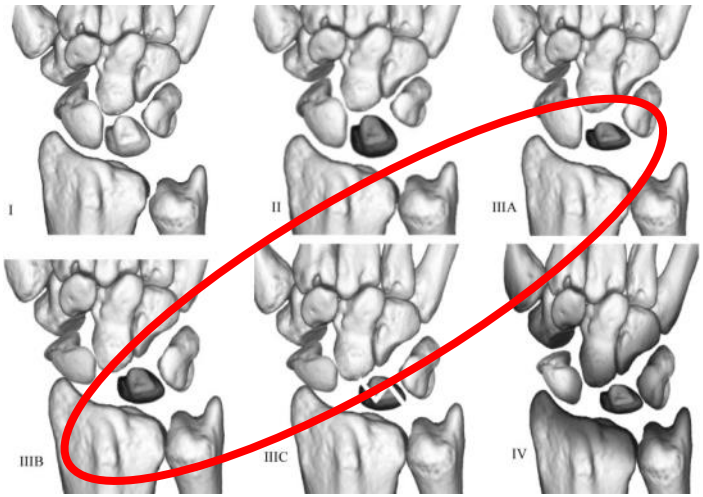

completely necrotic
MRI **pattern C**

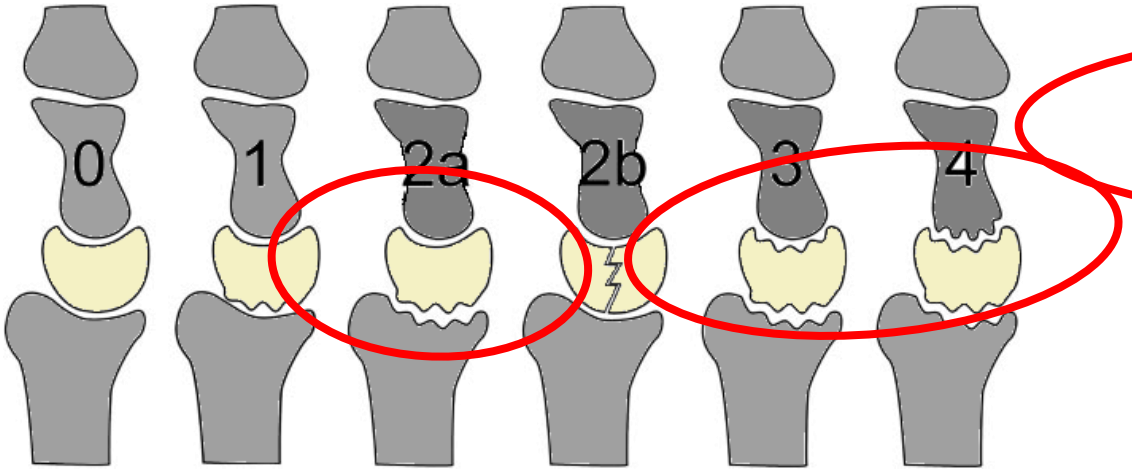


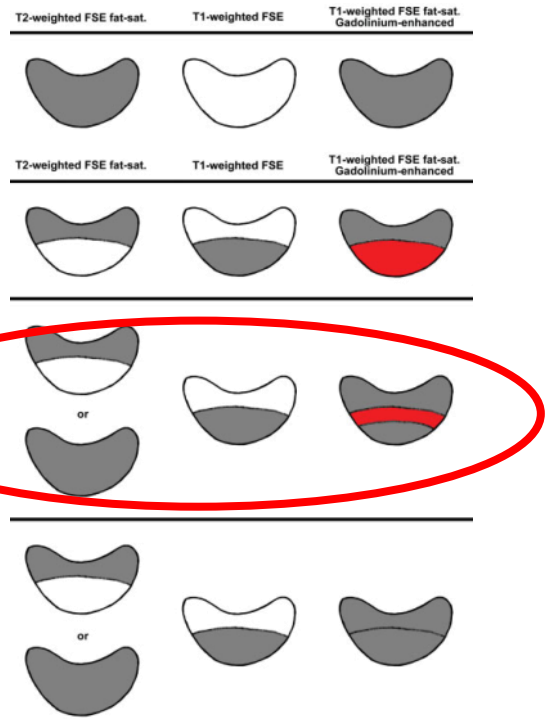
# Kienböck disease- treatment algorithm

wrist compromised

wrist reconstruction



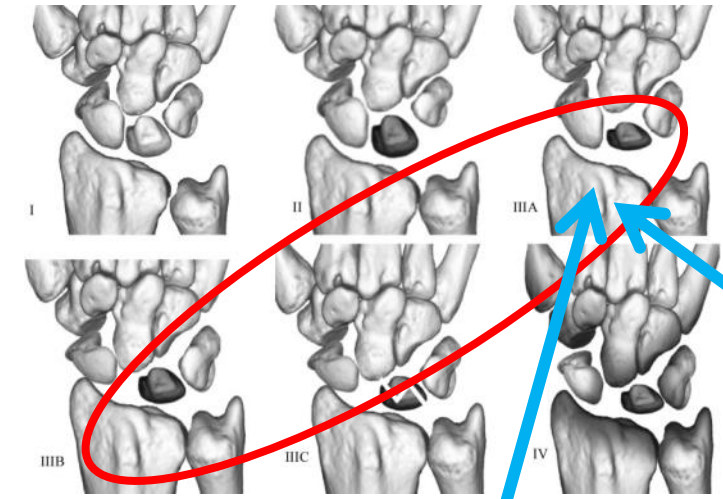



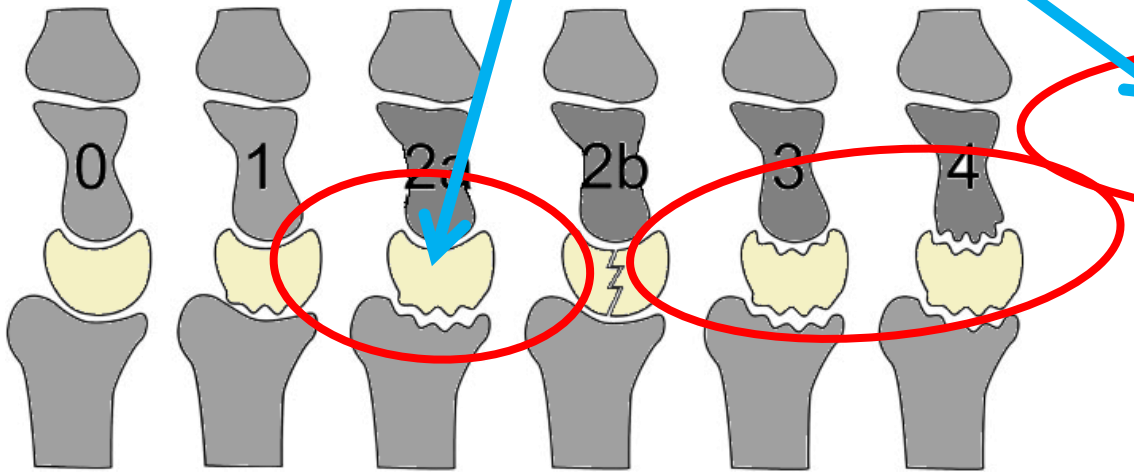
# Kienböck disease- treatment algorithm

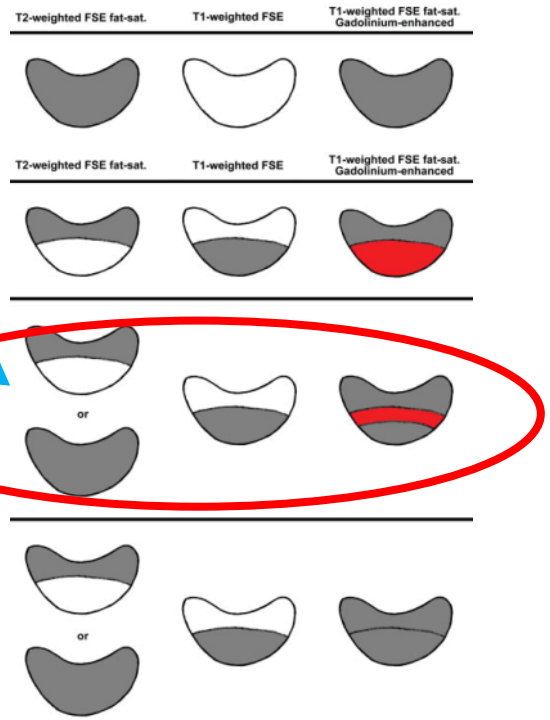
RC joint compromised

fuse or bypass RL joint



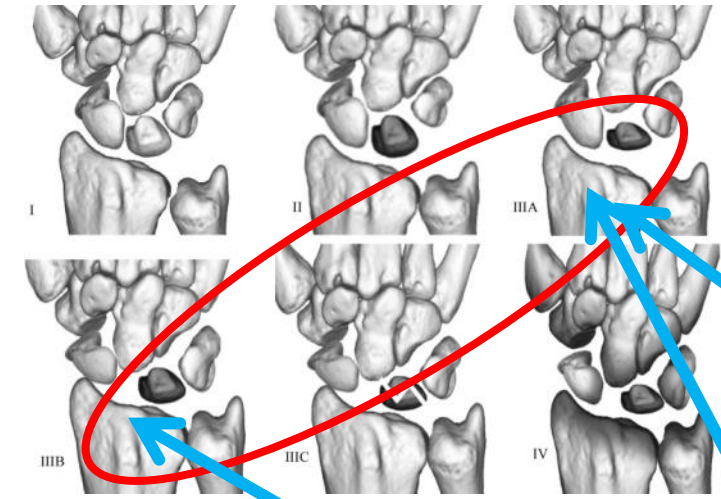

= RSL fusion, SC fusion….

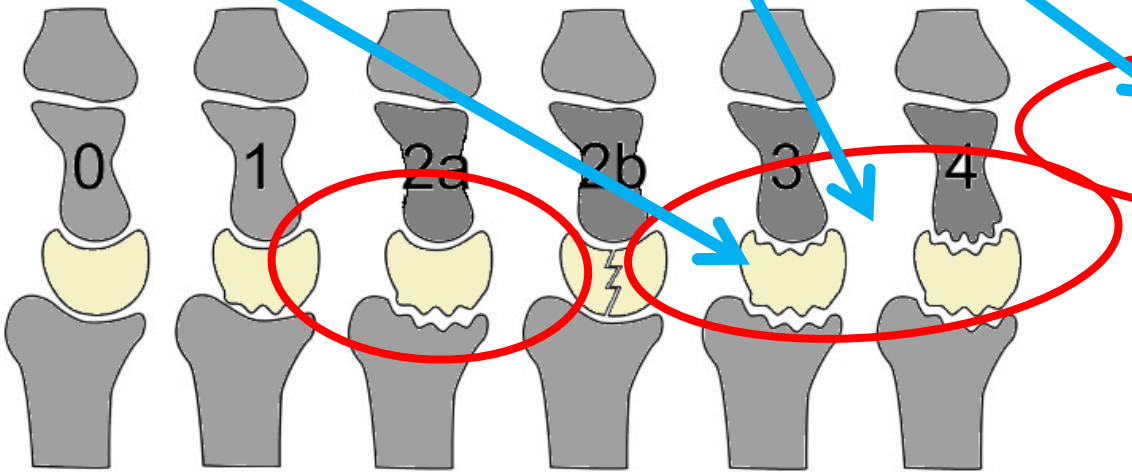


# Kienböck disease- treatment algorithm

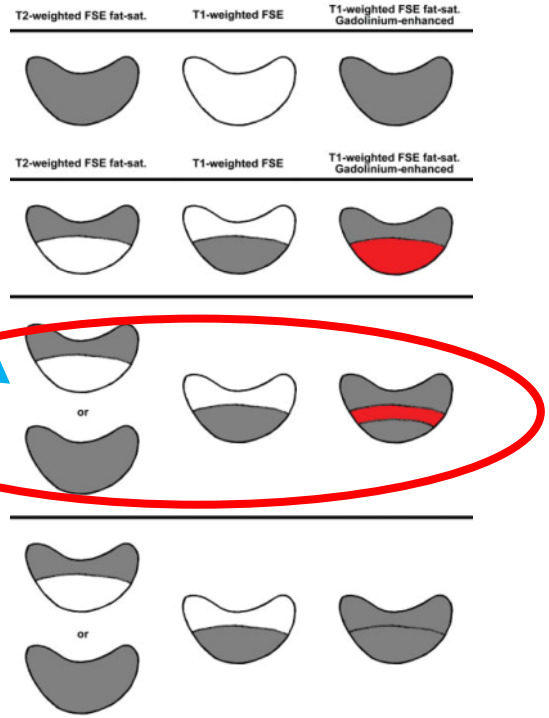
RC and MC joint compromised



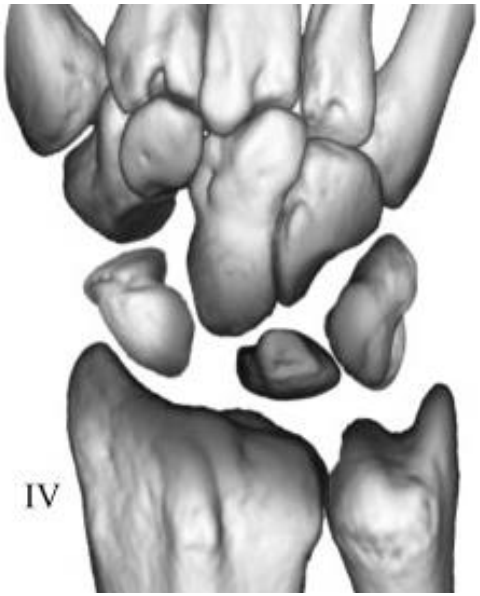




bypass central column

= SC fusion, hemiarthroplasty…



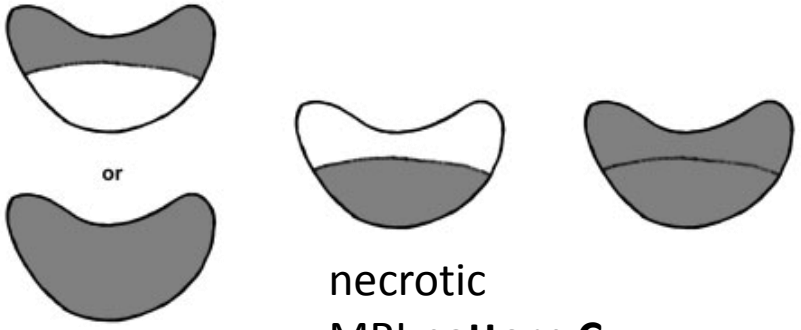
# Kienböck disease- treatment algorithm



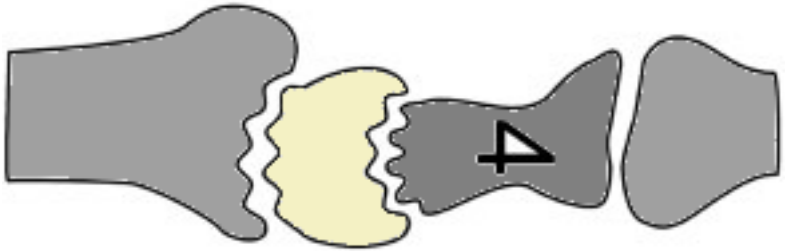

wrist not reconstructable

wrist salvage

- wrist fusion
- wrist arthroplasty
- PRC with arthroplasty




necrotic
MRI **pattern C**



# Kienböck disease- treatment algorithm

is helpful, but…….

# Kienböck disease- treatment algorithm

is helpful, but…….

Patient's age

lunate stage – how does the disease affect the lunate?

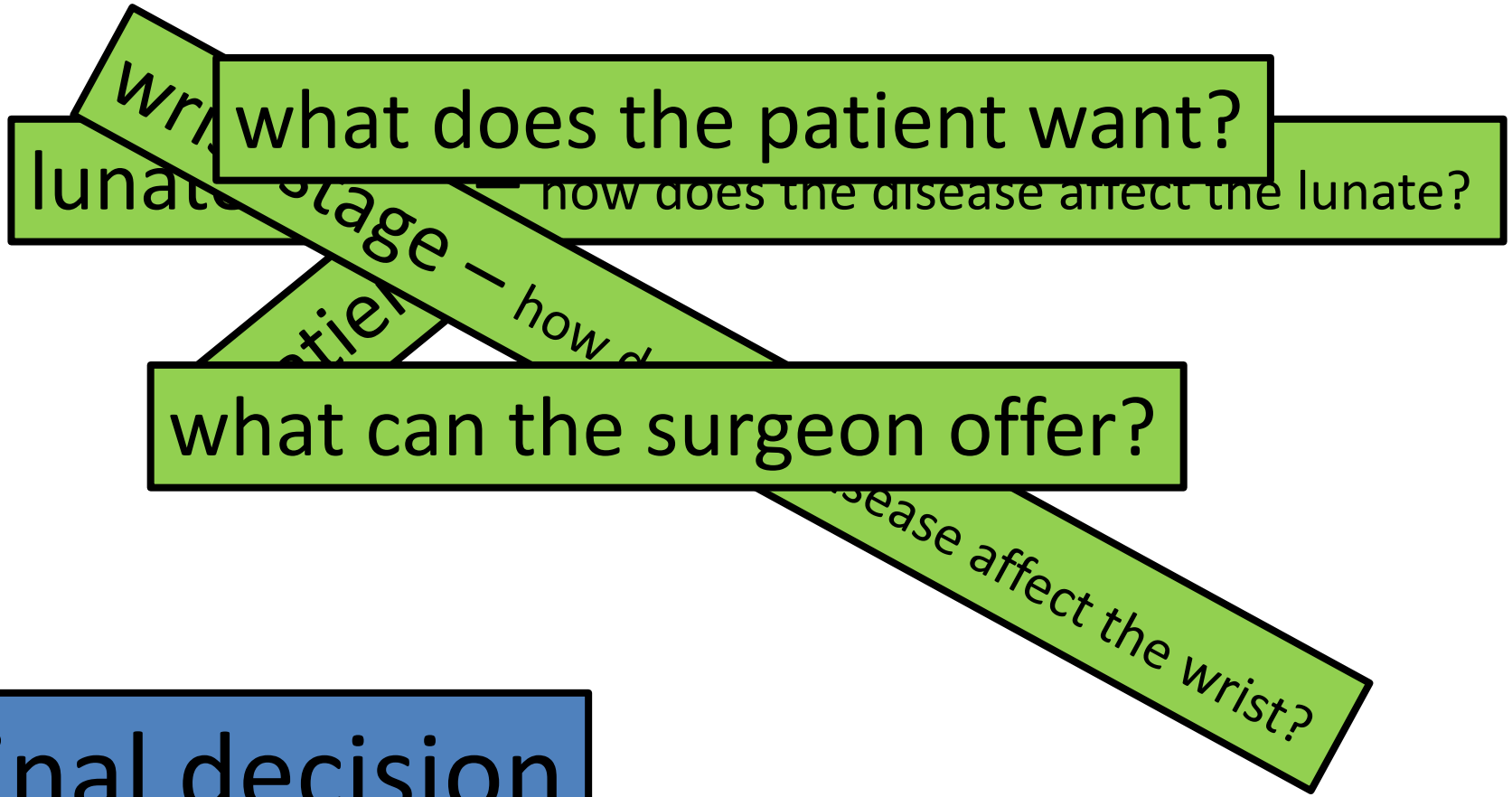
wrist stage – how does the disease affect the wrist?

what can the surgeon offer?

what does the patient want?

# Kienböck disease- treatment algorithm

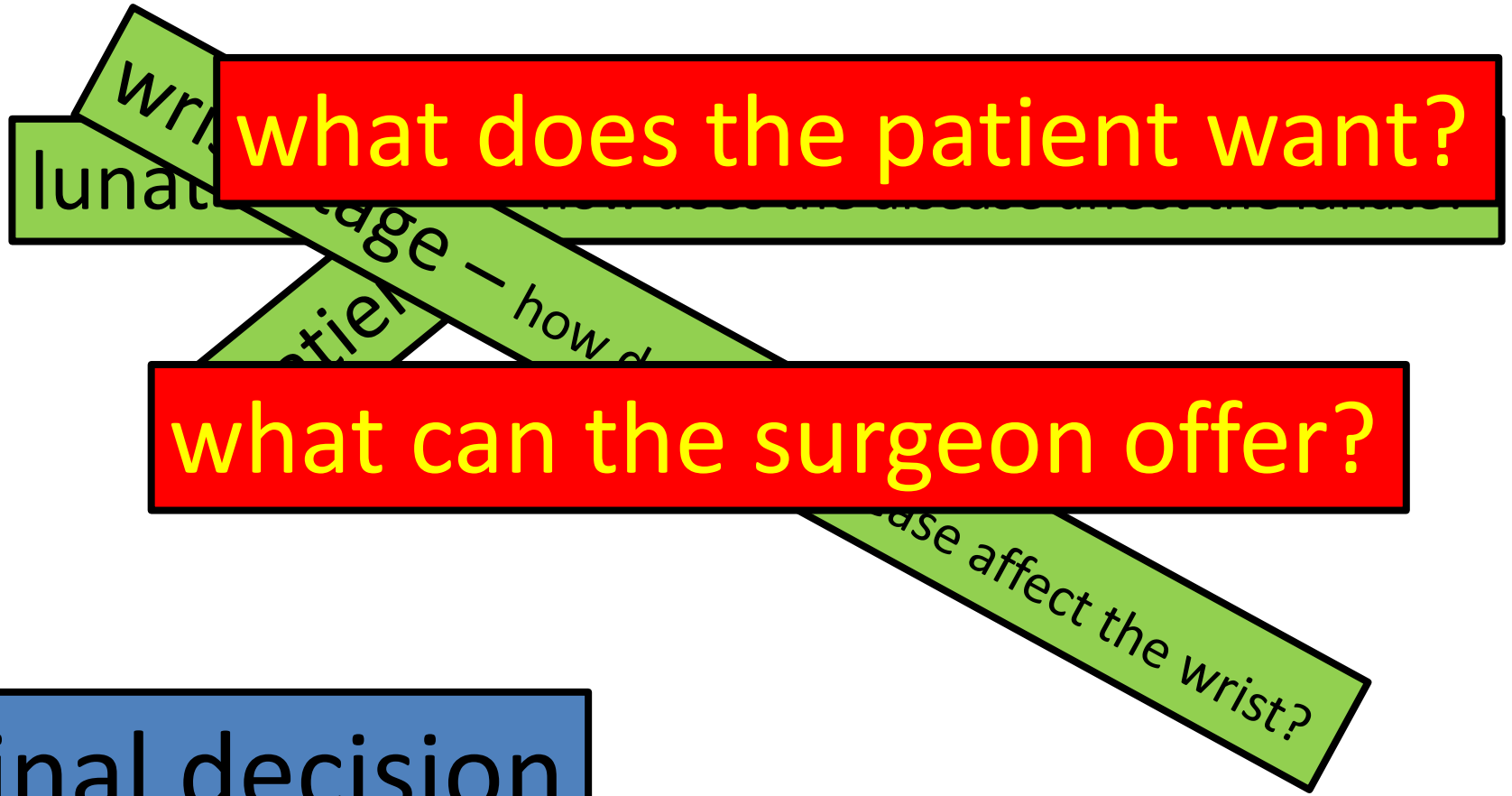
is helpful, but…….




final decision

# Kienböck disease- treatment algorithm

is helpful, but…….



# Kienböck disease- some practical points….

- Even with some lunate collapse – I always try unloading procedures and/or lunate decompression with vessels implantation

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- When lunate is collapsed – it will stay collapsed even if the pain disappears


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# Kienböck disease- some practical points….

- Even with some lunate collapse – I always try unloading procedures and/or lunate decompression with vessels implantation
- When lunate is collapsed – it will stay collapsed even if the pain disappears
- Don’t treat the X-rays

- Vessels implantation
- Vascular bone graft
- Planed 3rd surgery because of collapse

Limited ROM BUT NO PAIN !!!!!!

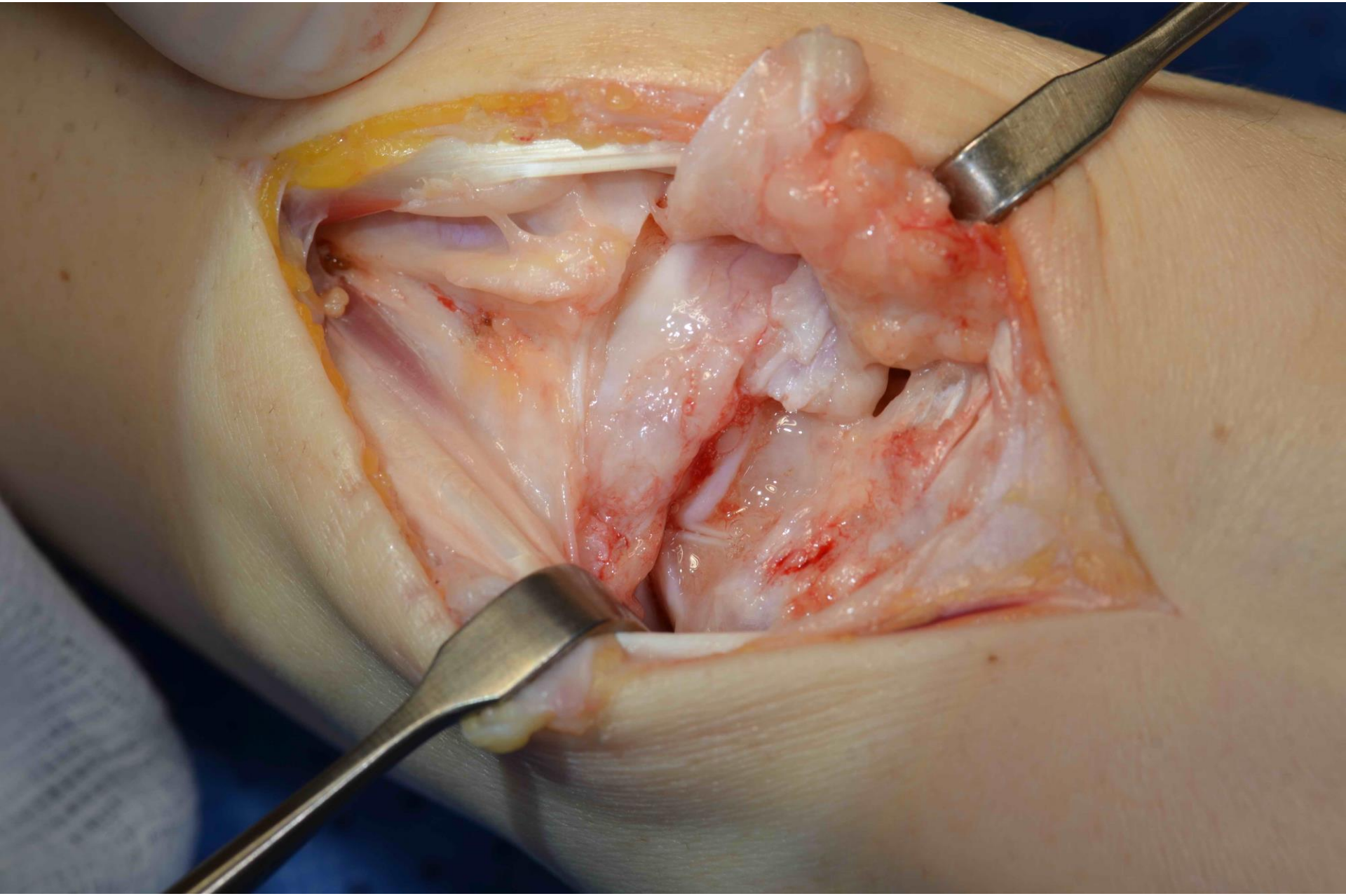
# Kienböck disease- some practical points….

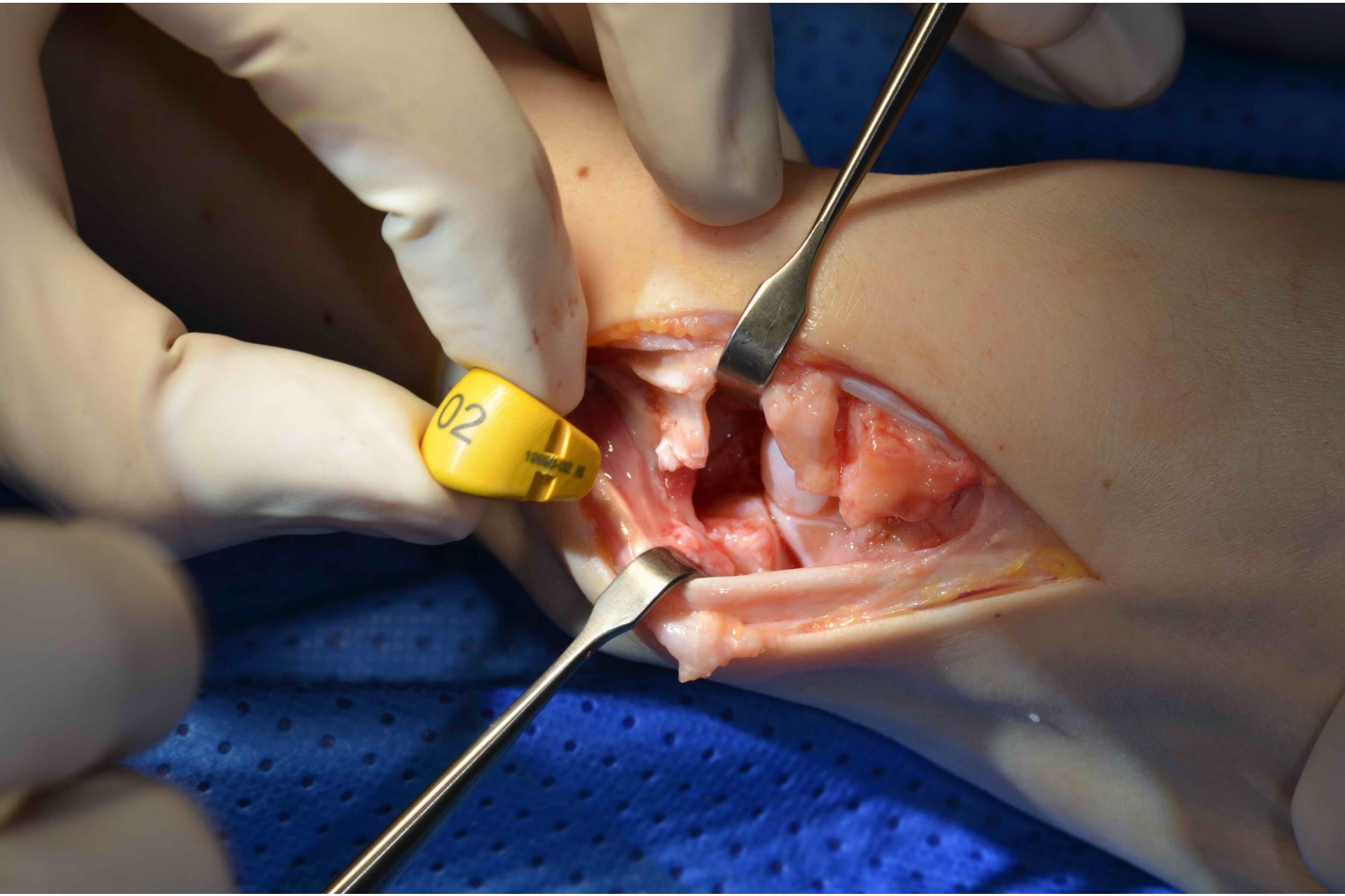
- Even with some lunate collapse – I always try unloading procedures and/or lunate decompression with vessels implantation
- When lunate is collapsed – it will stay collapsed even if the pain disappears
- Don’t treat the X-rays
- Sometimes we have to make a tough decisions in spite of any algorithms

- No unloading procedures possible
- Complete collapse
- Very rapid progression
- Constant pain

July → November

Patient 23 yo

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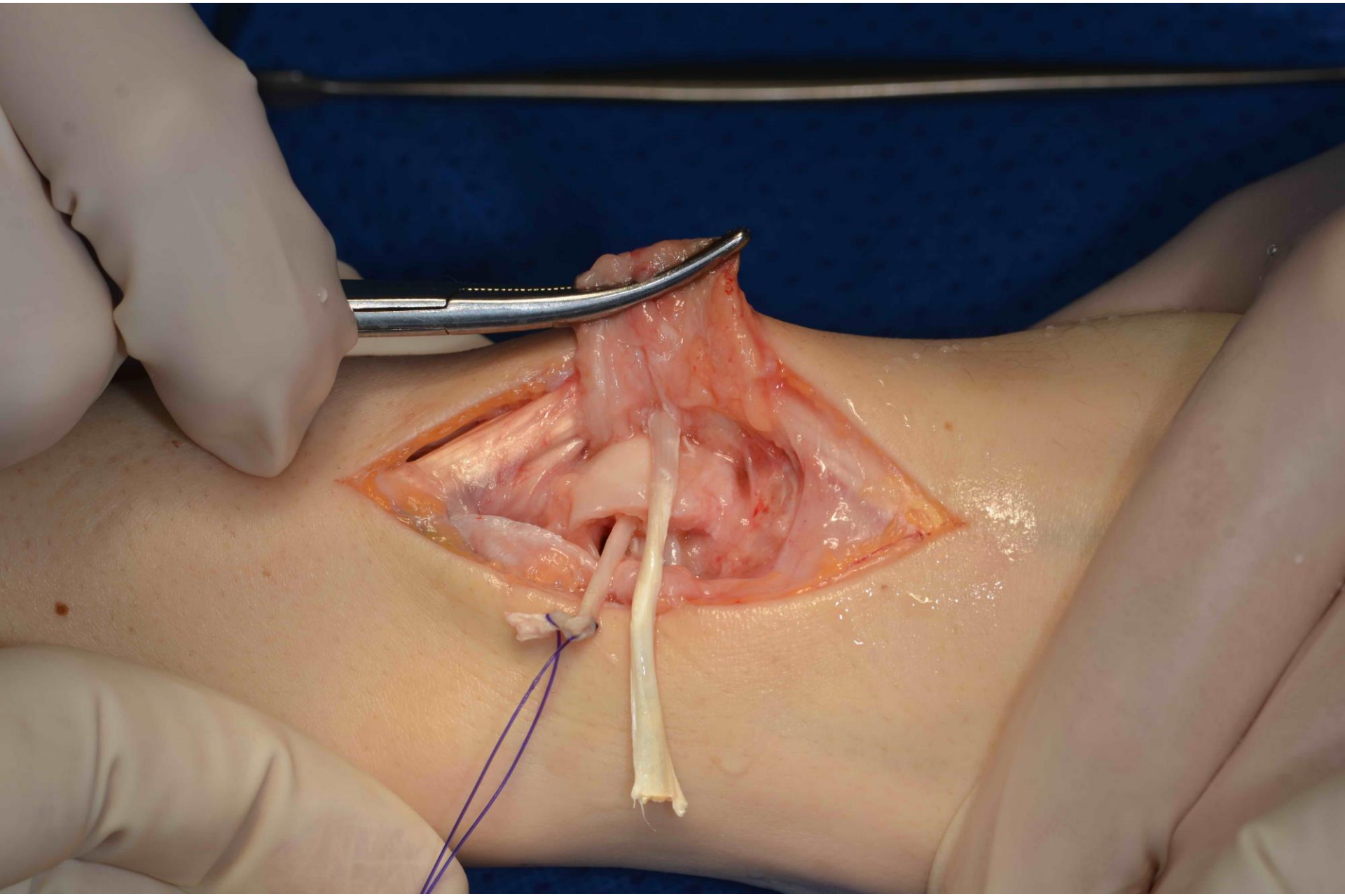

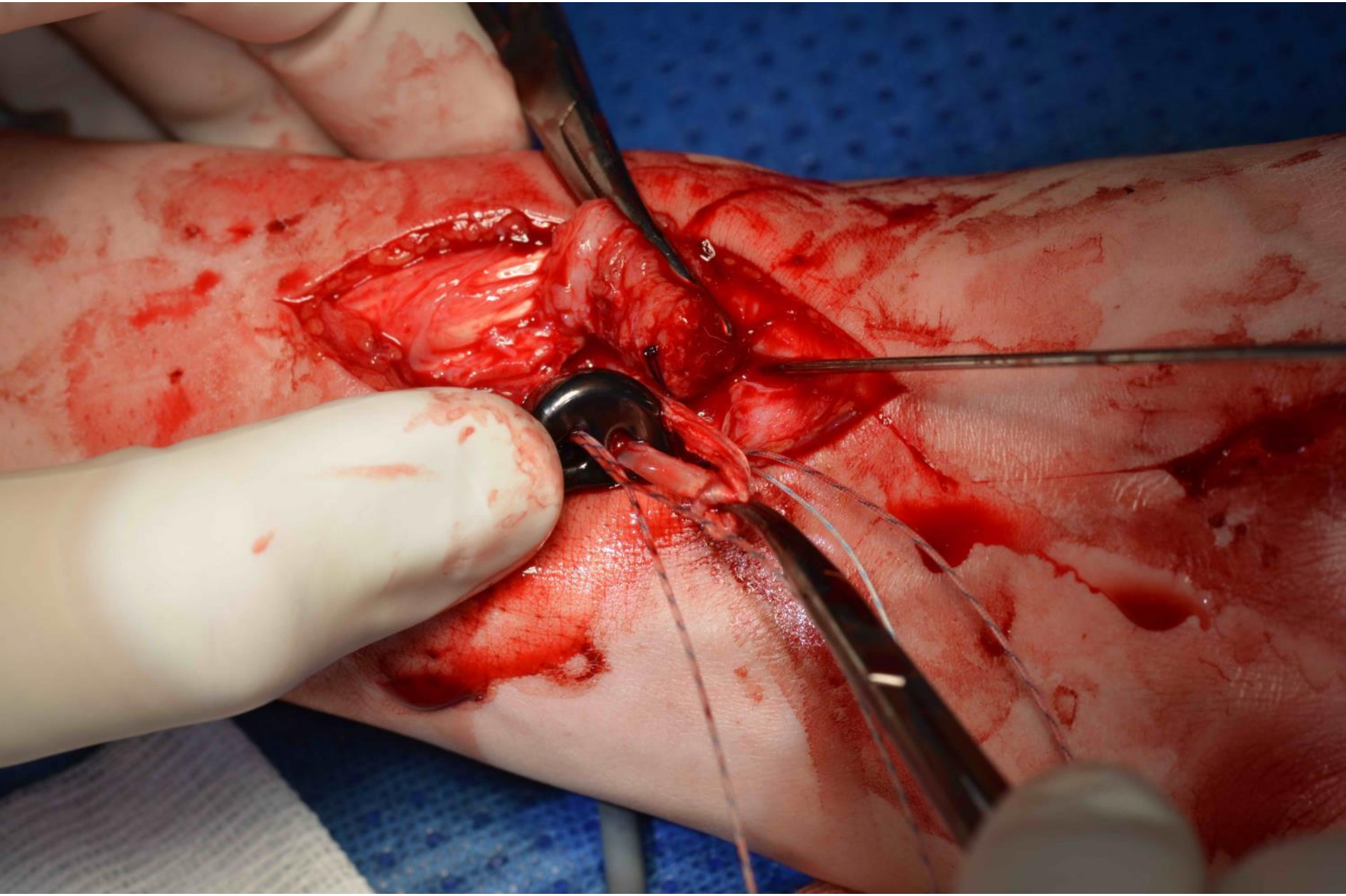

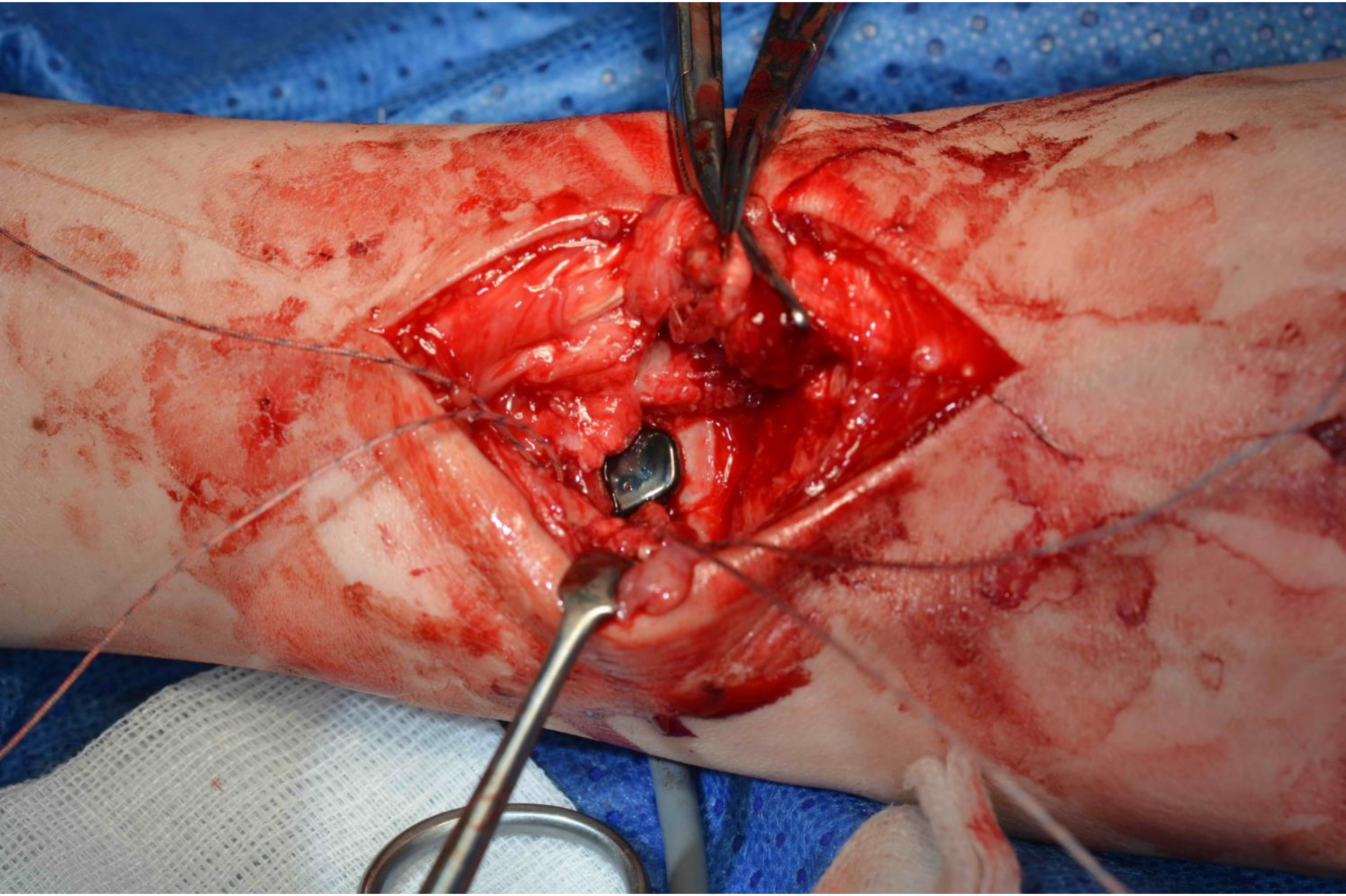

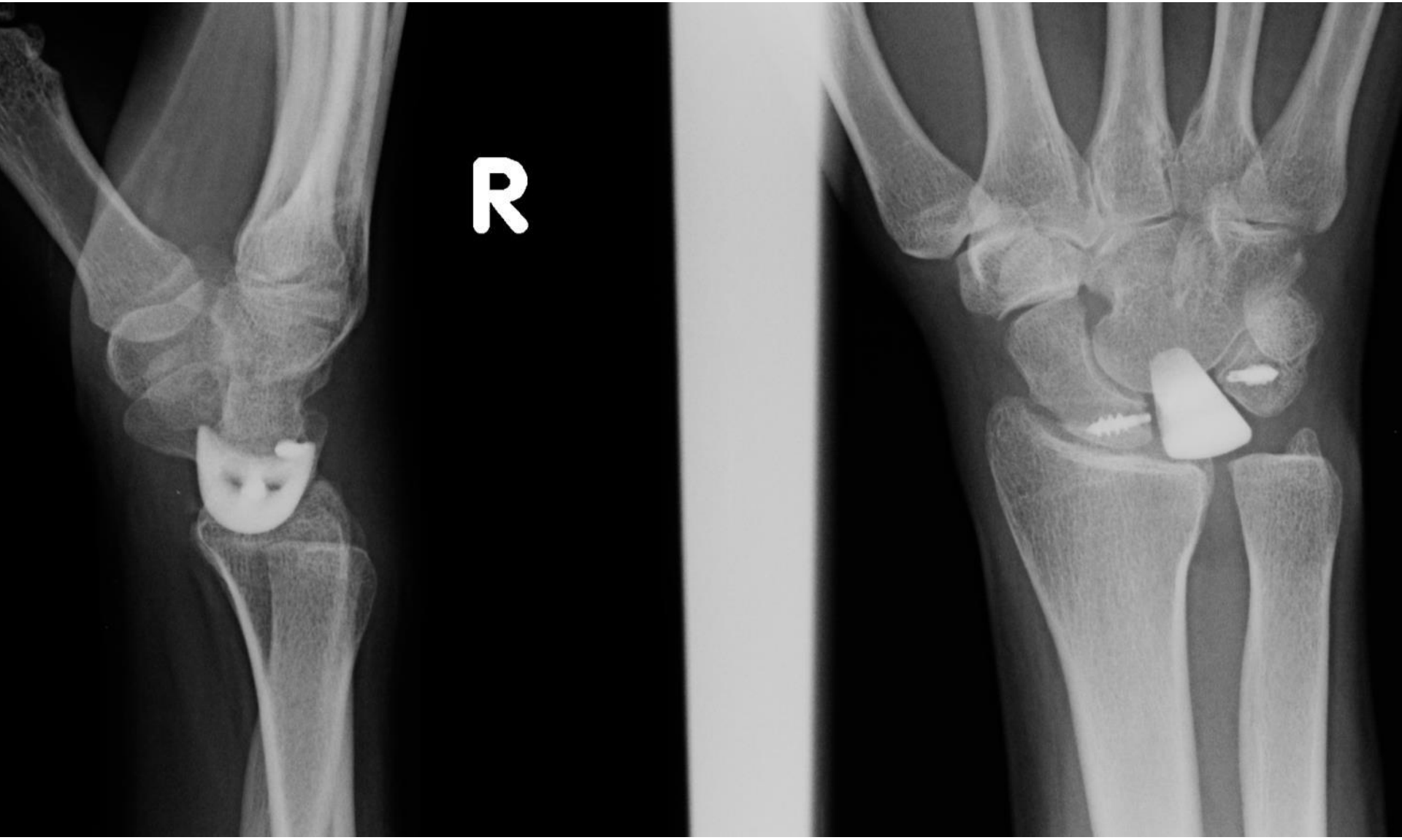
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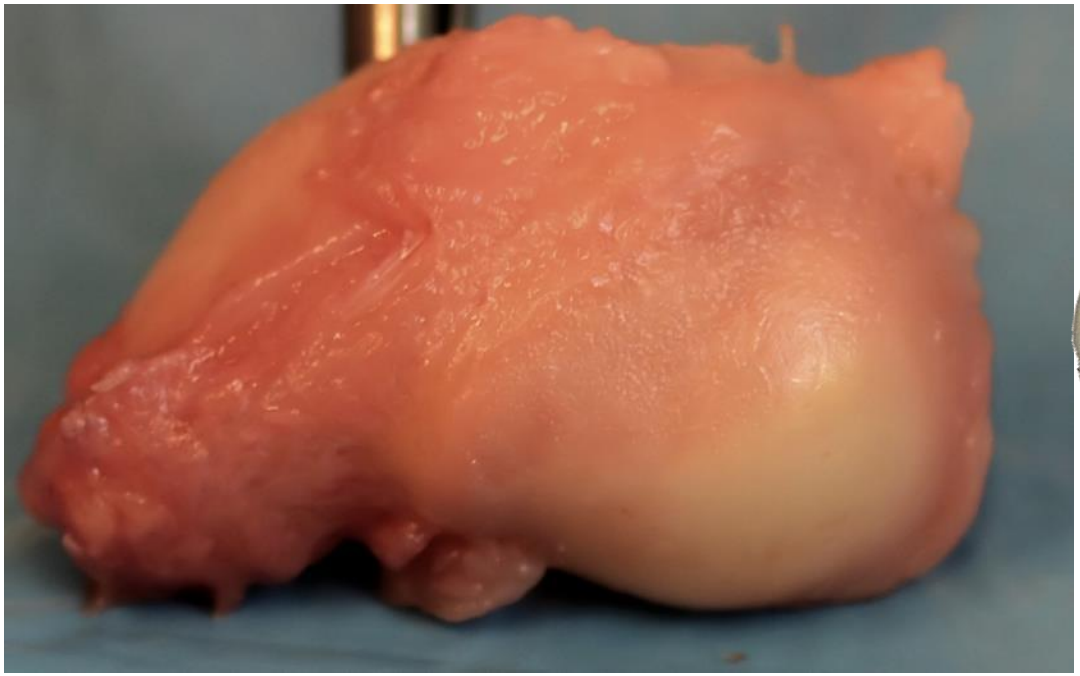
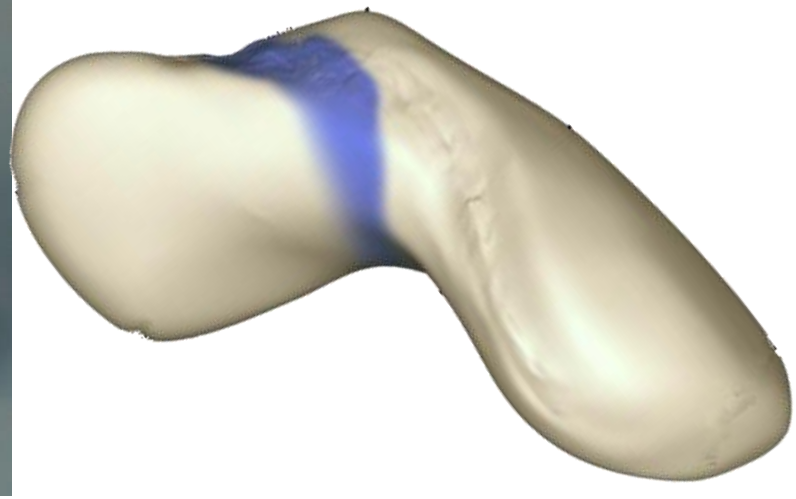
# Kienböck disease- some practical points….

- Even with some lunate collapse – I always try unloading procedures and/or lunate decompression with vessels implantation
- When lunate is collapsed – it will stay collapsed even if the pain disappears
- Don’t treat the X-rays
- Sometimes we have to make a tough decisions in spite of any algorithms
- I always take an x-ray of other wrist

# Scaphoid fractures



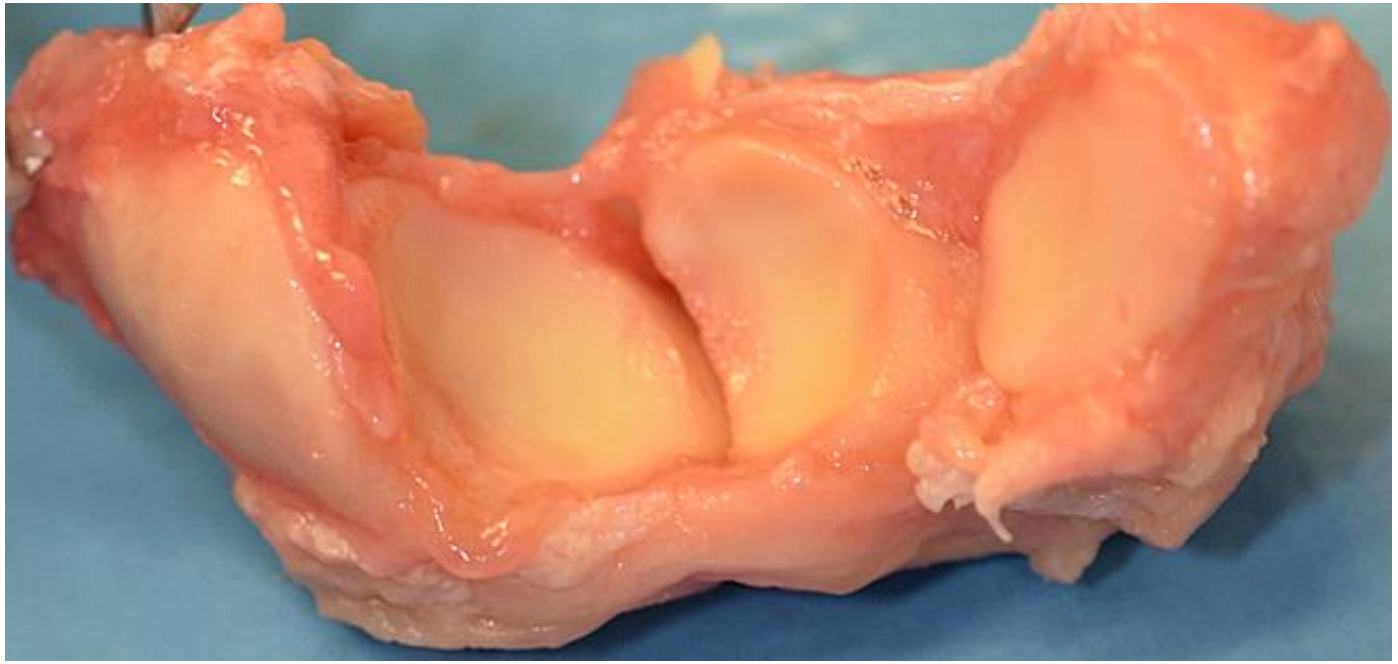


# When does not unite

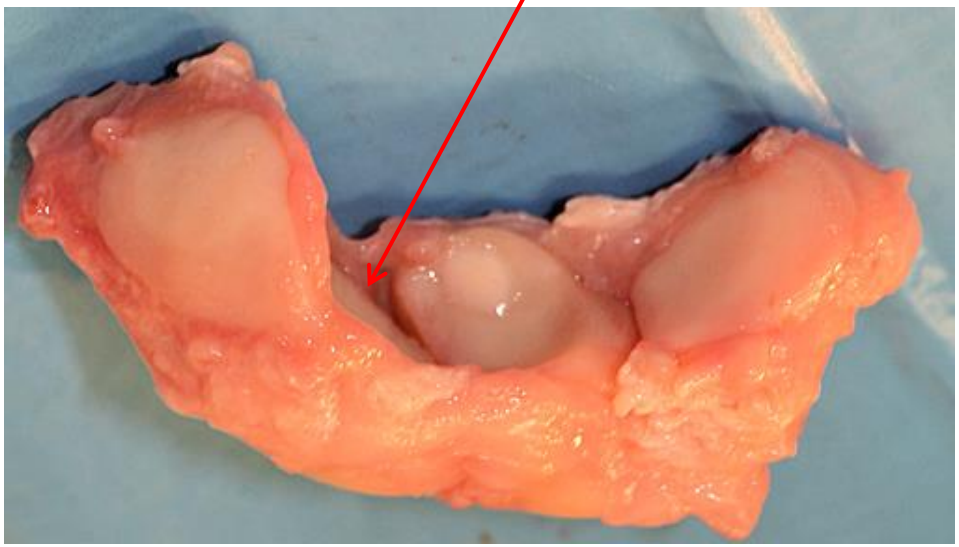
**Factors predicting non union**

# scaphoid

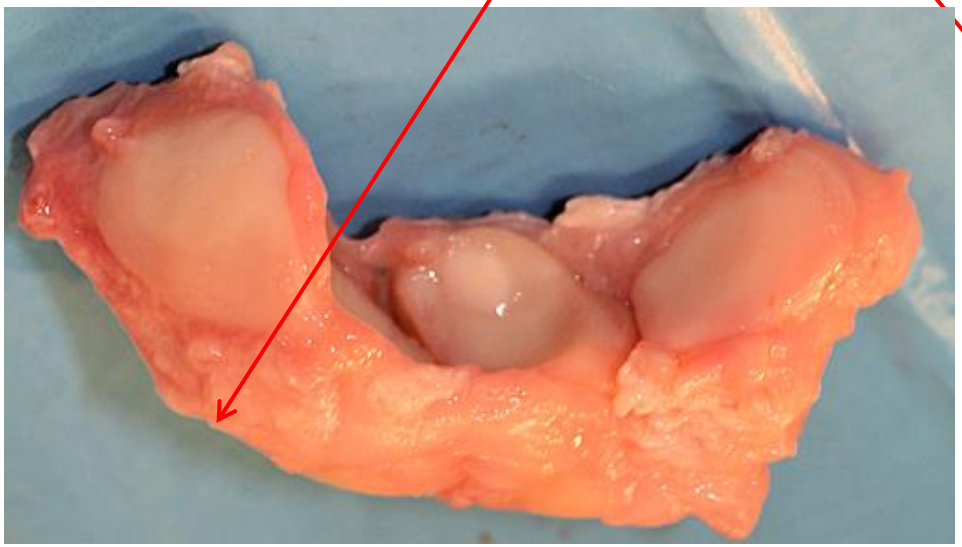
- Critical link in the mechanism of the carpus
- Complex shape which allows to participate in the kinematics of the proximal and distal rows



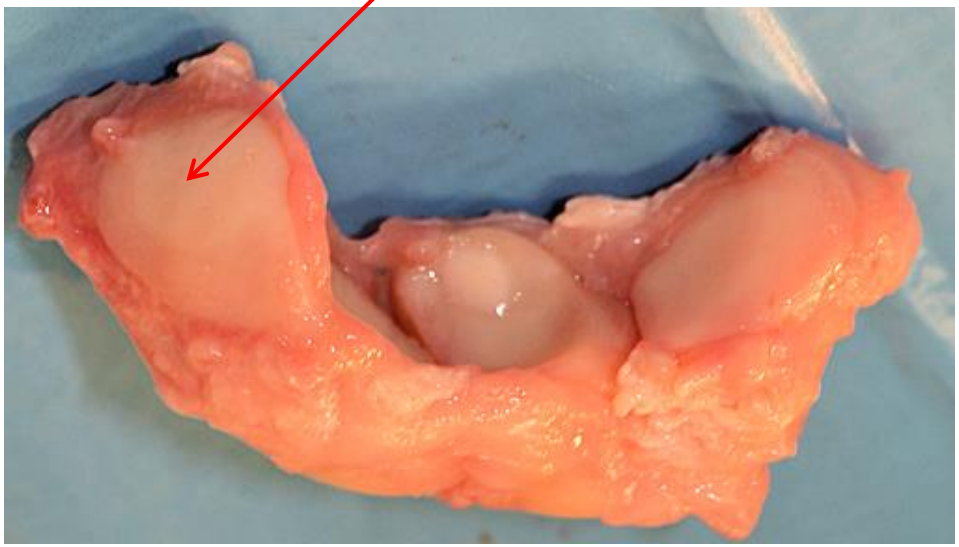
# scaphoid



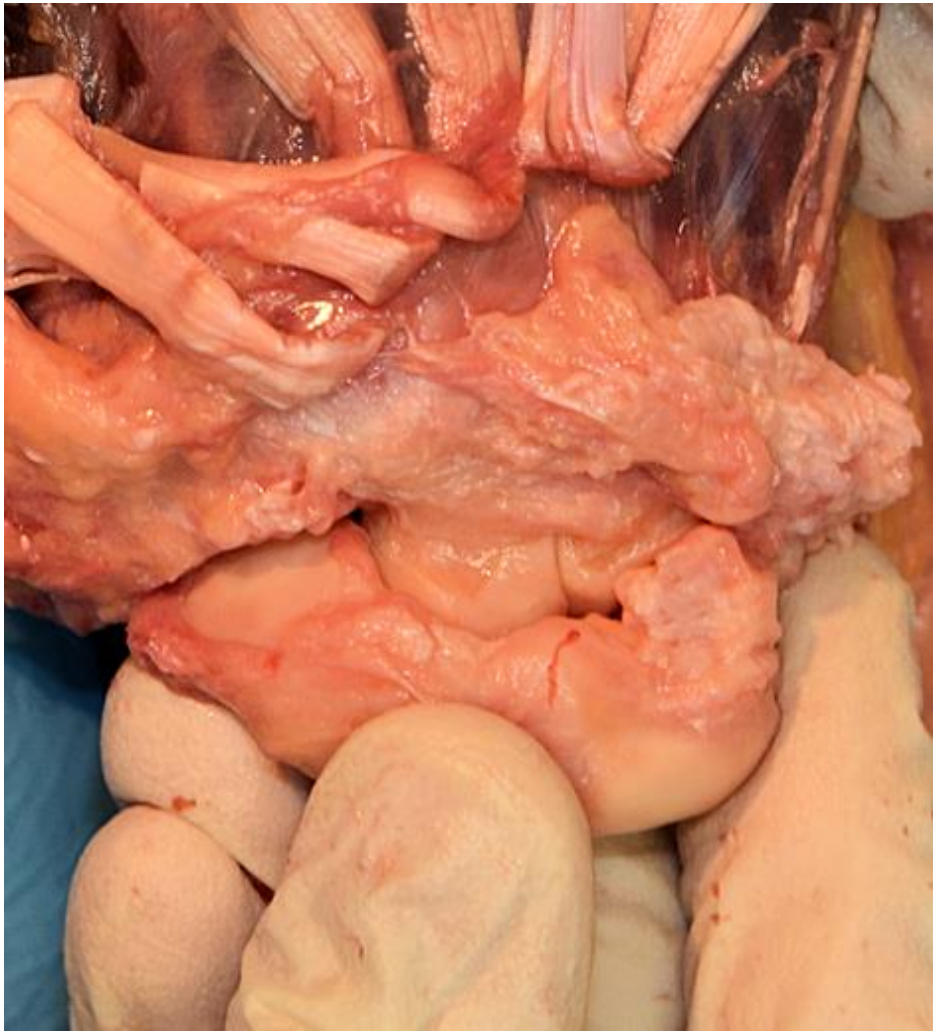
# scaphoid

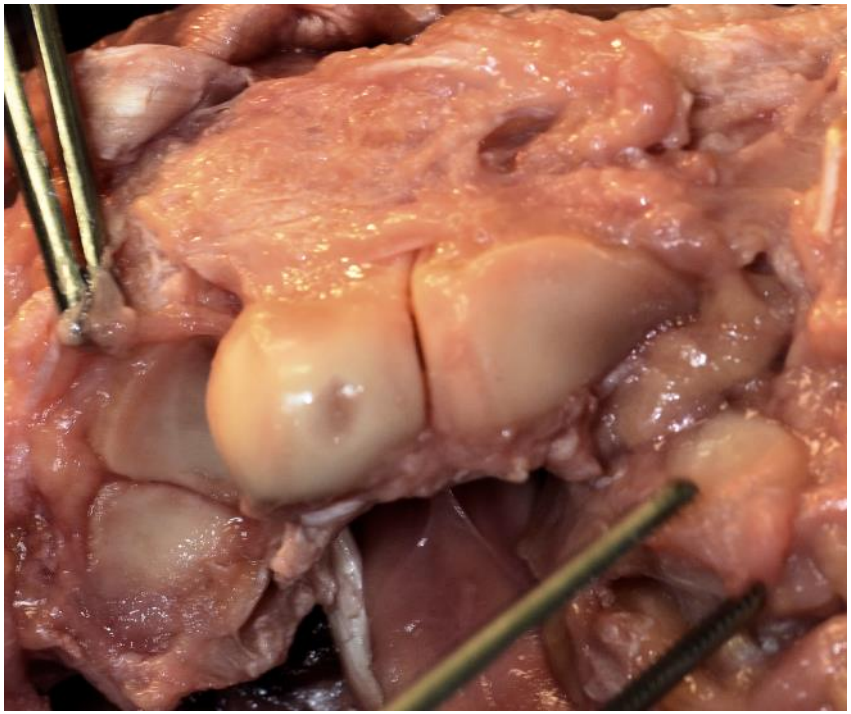


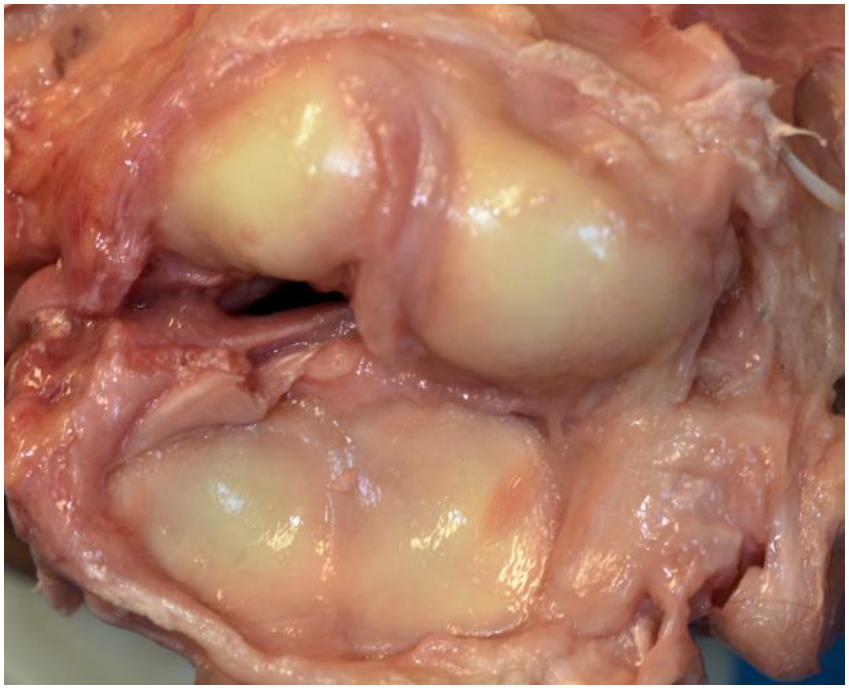
# scaphoid



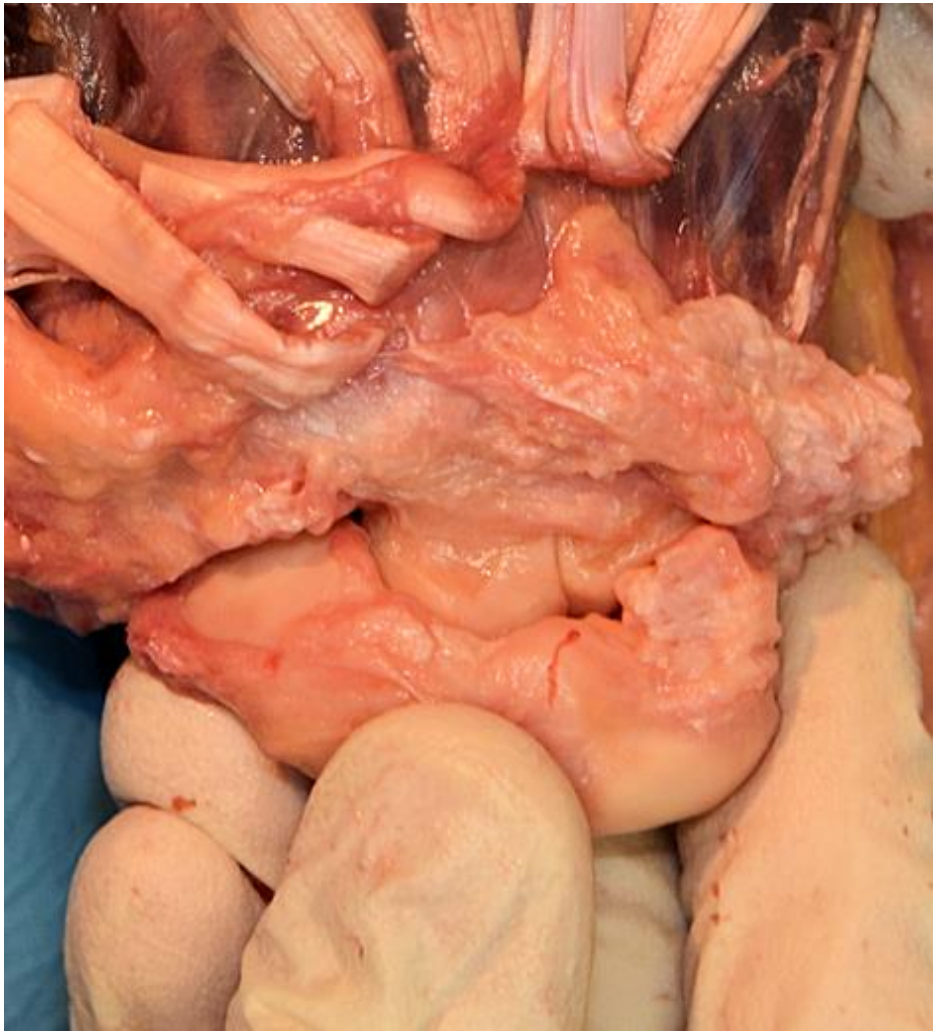
# scaphoid

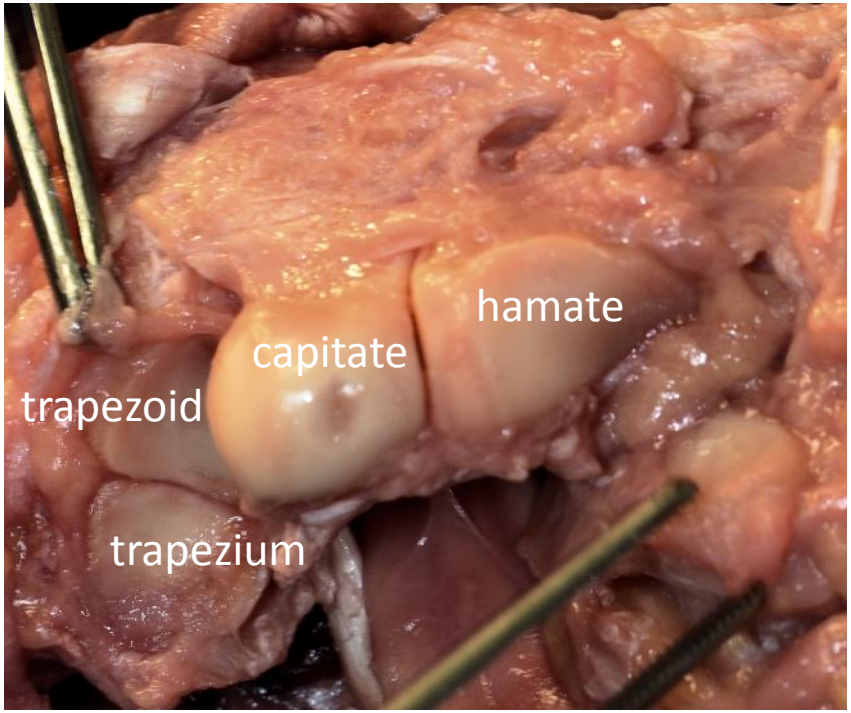


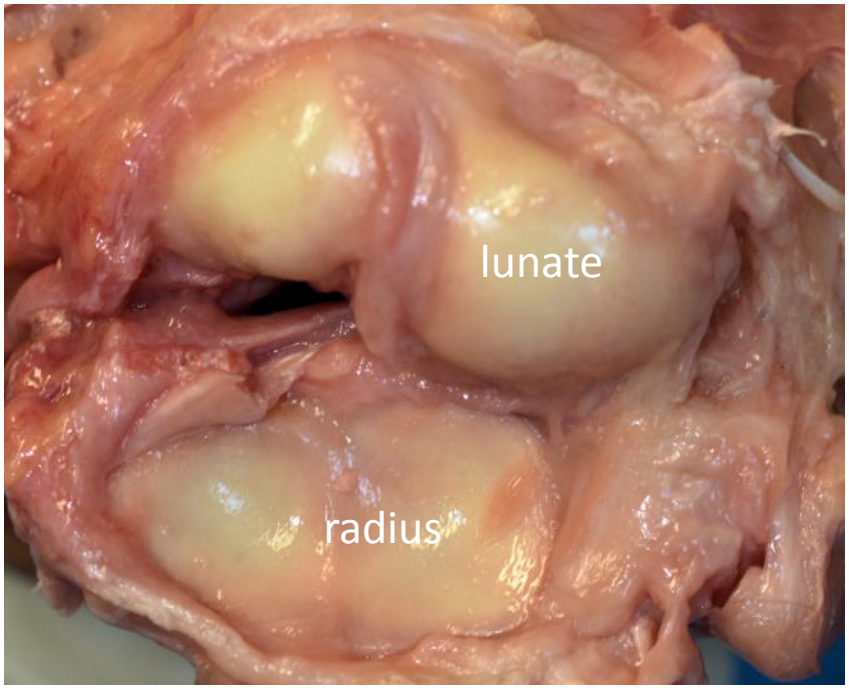




# scaphoid





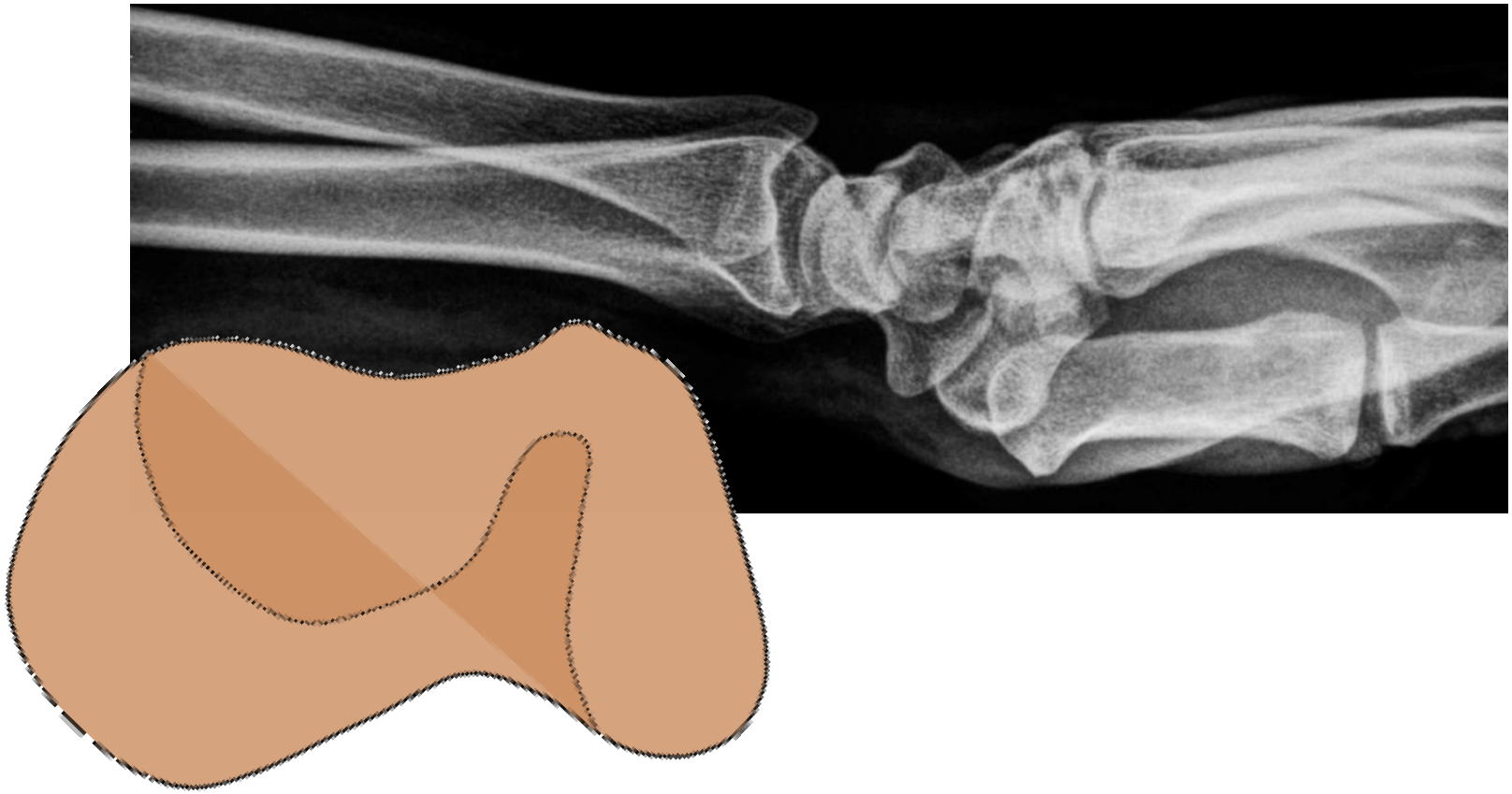



# scaphoid

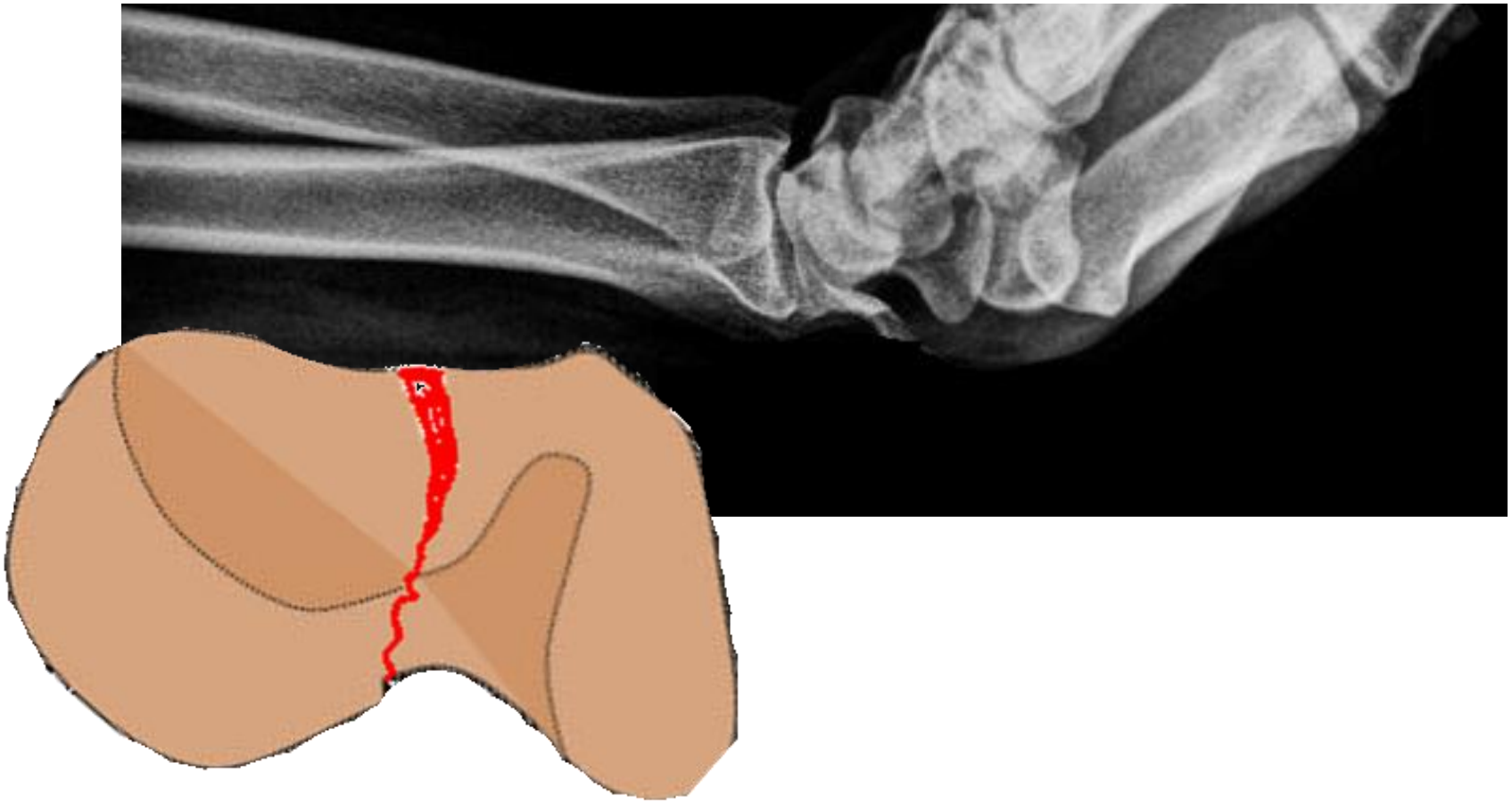
- part of the proximal row *(mobile bones)*
- very strong ligaments attachments
  - no tendon insertions
  - mechanical link with distal row *(almost no motion between the bones)*

**excessive loading and forces**

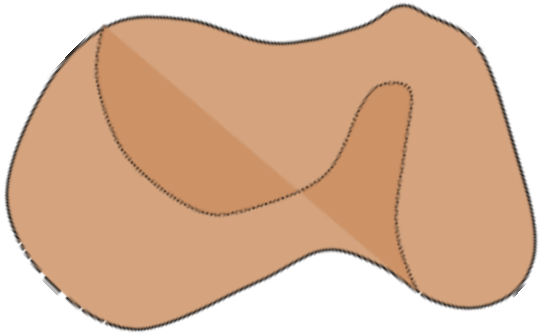
# excessive loading and forces

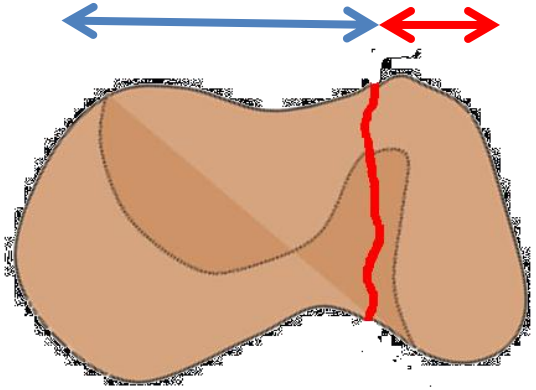


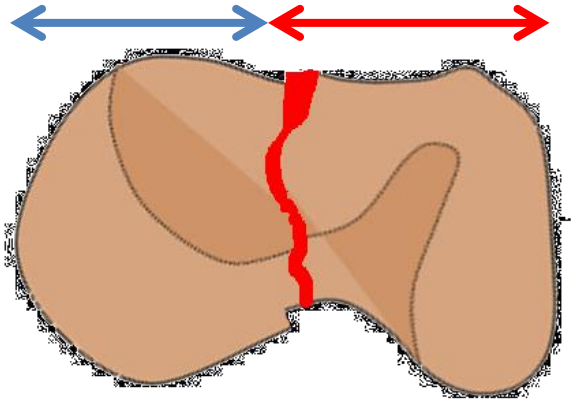
# excessive loading and forces

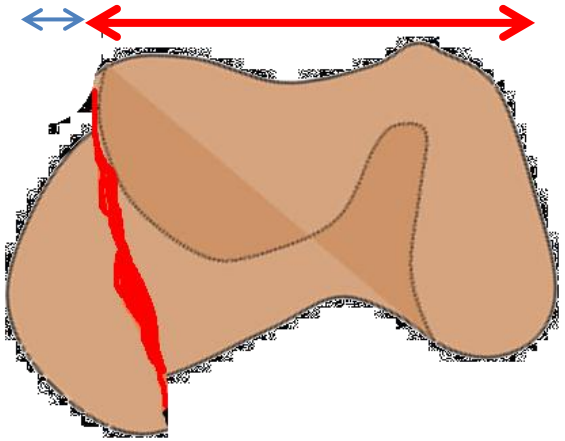


# Mechanism of fracture









more proximal fracture site - more displacement

# Suspected scaphoid fracture?

**Wait 2 weeks, reexamination and x-ray ???**

# Repeated X-ray in suspected fracture

- The value of radiographs and bone scintigraphy in suspected scaphoid fracture. A statistical analysis

  **MMC Tiel-Van Buul et all**: *JHSurg Br. 1993,18:403-406*

- Suspected scaphoid fractures: can we avoid overkill?

  **S. Jakobsen et all**: ***Acta Orthop. Belg 1995, 61:74-78***

Little value in doing the repeated X-ray.
Small minority or none of suspected fractures are visible after a period of immobilization

# Repeated X-ray in suspected fracture

- Can follow-up radiography for acute scaphoid fracture still be considered a valid investigation?

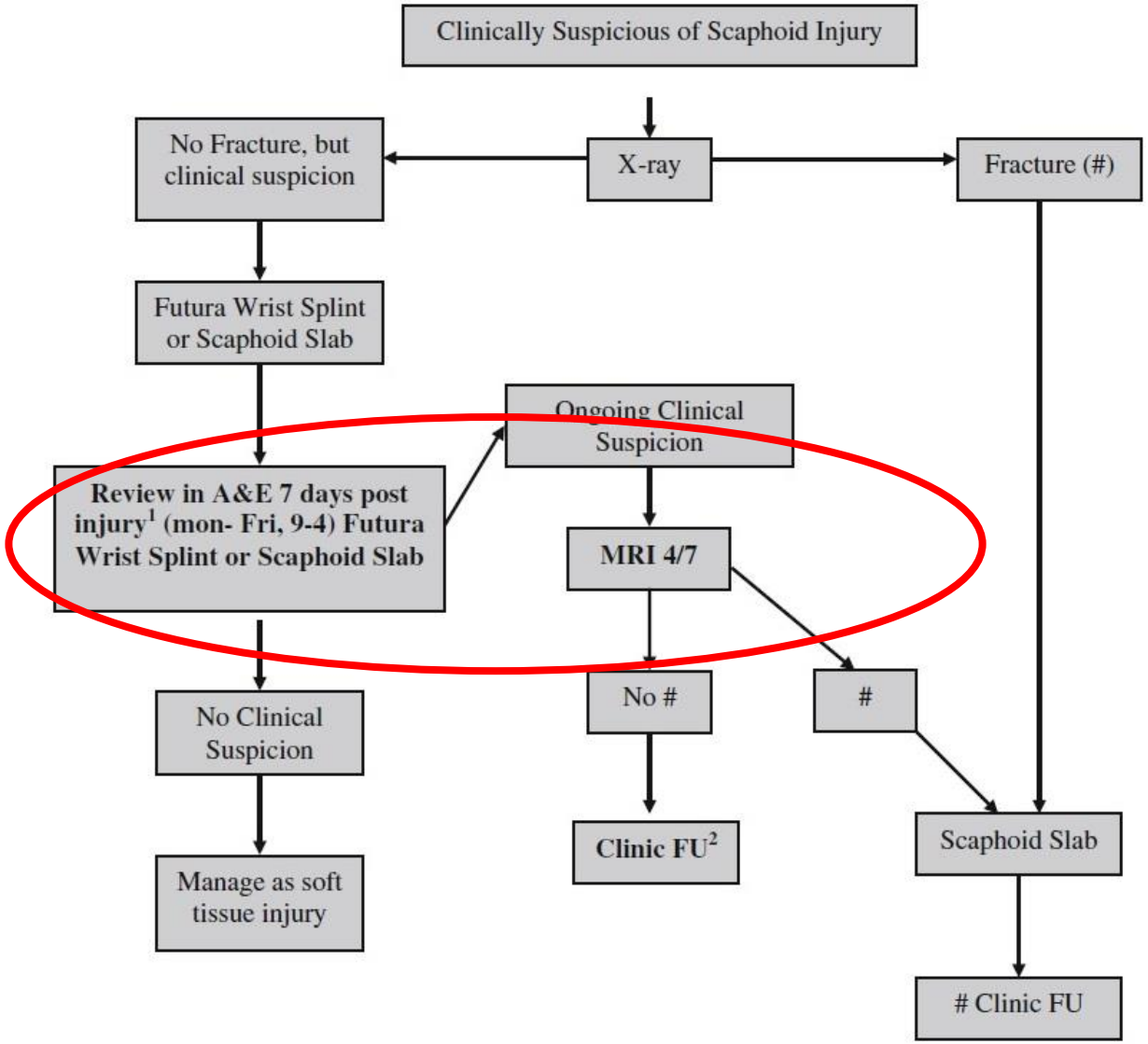
G.Low, N.Raby: *Clinical Radiology 2005;10:1106-1110*

With poor sensitivity, poor negative predictive value and poor reliability, follow-up radiography *cannot be considered a valid* diagnostic examination for the detection of scaphoid fracture in patients with normal initial radiographs.

# Repeated X-ray in suspected fracture

Review of the literature clearly demonstrate the major role that MRI should play In management of clinically suspected scaphoid fracture

# Repeated X-ray in suspected fracture



# Is there any other possibility ?

- Limited access
- Waiting time
- Costs

**Better selection of the patients for MRI?**

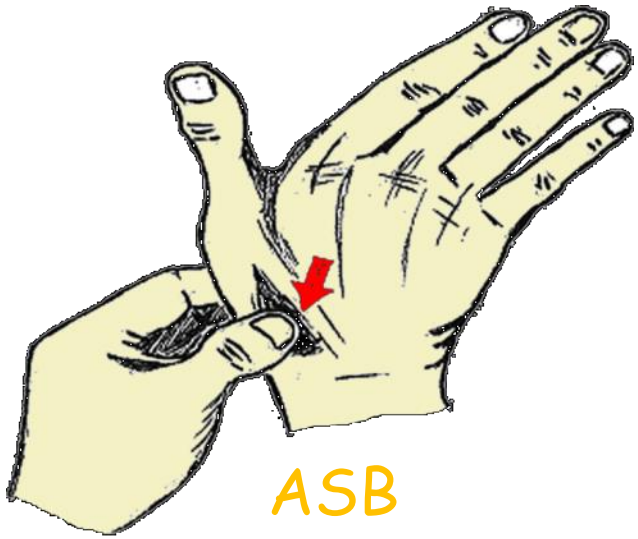
Original article

# Clinical scaphoid score (CSS) to identify scaphoid fracture with MRI in patients with normal x-ray after a wrist trauma

Torbjørn Hiis Bergh,[1,2] Tommy Lindau,[2,3] Lars Atle Soldal,[1] Soosaipillai V Bernardshaw,[1] Mehdi Behzadi,[4] Knut Steen,[1] Christina Brudvik[1,2]

Emerg Med J 2014;31:659–664.

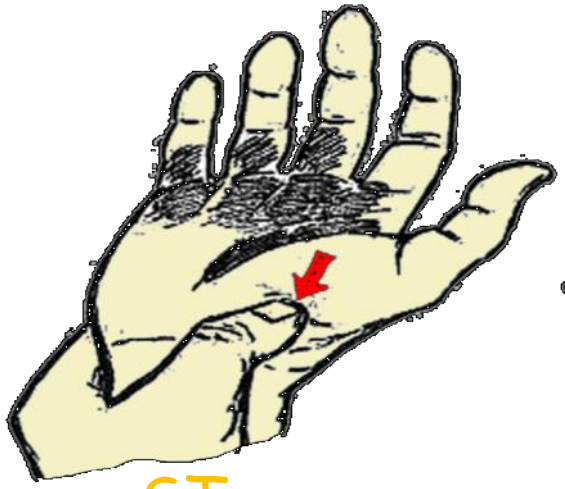
# Clinical scaphoid score ( CSS)



ASB

Tenderness in the anatomical snuffbox (ASB) with the wrist in ulnar deviation

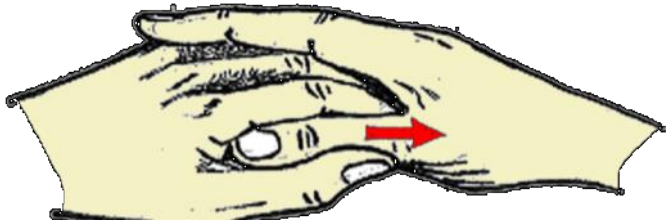
3



ST

Tenderness on palpation over the scaphoid tubercle (ST) with the wrist in slight extension

2



LC

Pain on the longitudinal compression (LC) of the thumb.

1

Emerg Med J 2014;31:659–664.

# Clinical scaphoid score ( CSS)

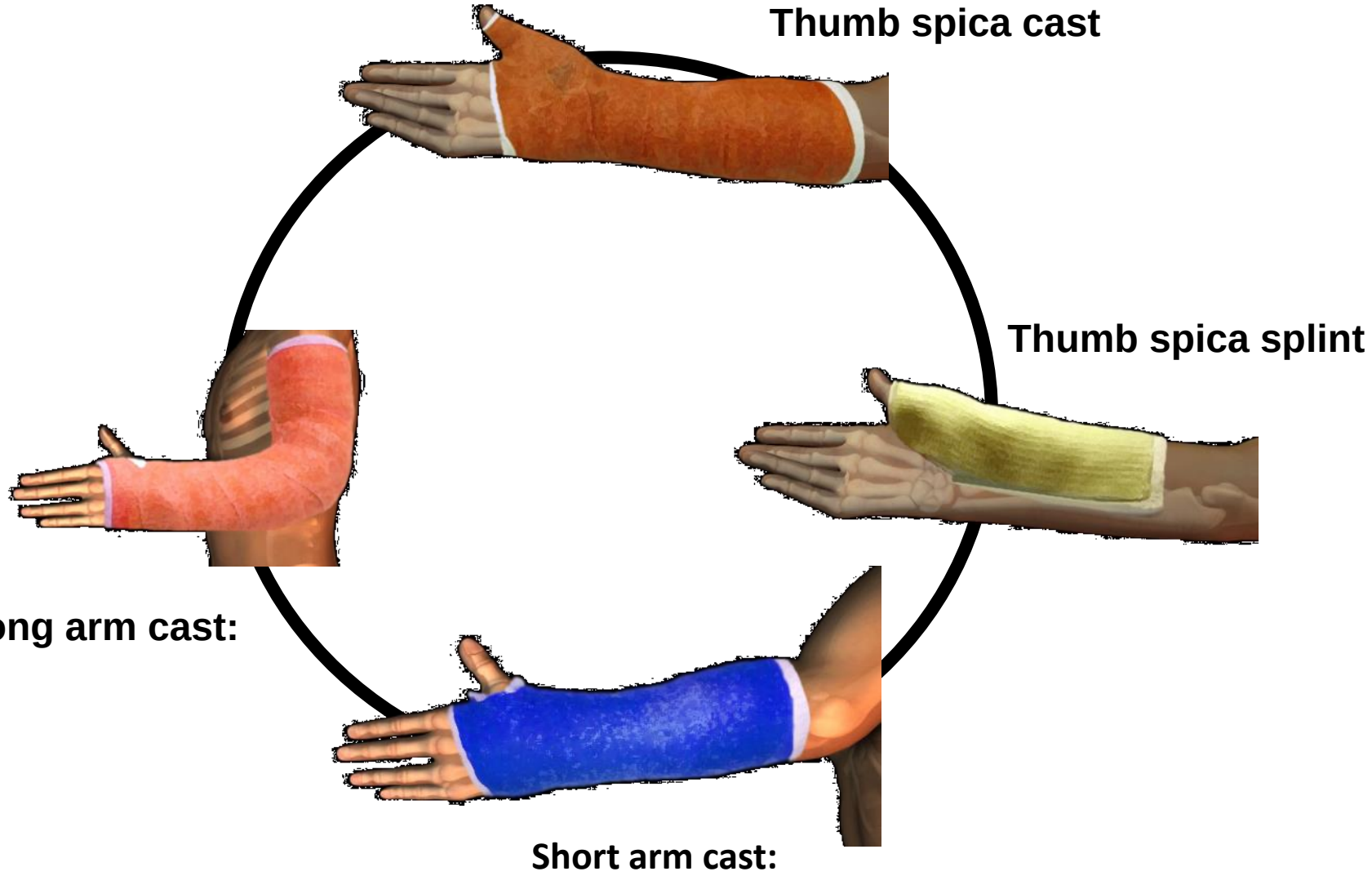
CSS≥4 was the only statistically significant 'cut-off ' value to identify scaphoid fracture defined as

occult scaphoid fracture

Emerg Med J 2014;31:659–664.

# Immobilization ?

# scaphoid fracture



# scaphoid fracture

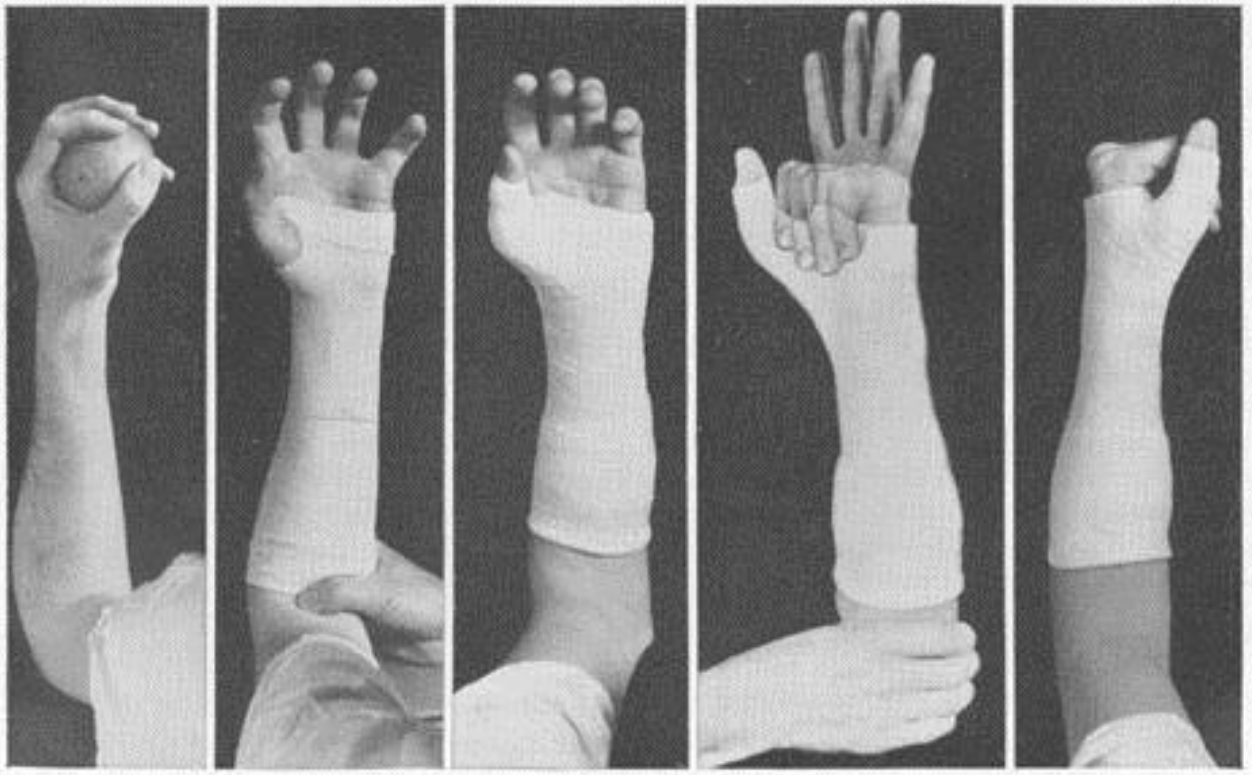


FIGURE 35.—Type of plaster cast used for immobilization in fractures of carpal scaphoid bone. Note so-called grasping pose. Note also possible range of motion of metacarpophalangeal joints.

# *J Bone Joint Surg [Br]* 1991 ; 73-B : 828-32

## NEED THE THUMB BE IMMOBILISED IN SCAPHOID FRACTURES?

### A RANDOMISED PROSPECTIVE TRIAL

NIGEL R. CLAY, JOSEPH J. DIAS, P. S. COSTIGAN, P. J. GREGG, N. J. BARTON

- 292 fractures – spica and Colles cast ( with or without thumb)
- Both types of cast were **equally** well in bone healing
- the scaphoid cast is clearly **more inconvenient** for the patient and has the further disadvantage
- For fresh, undisplaced fractures of the waist of the scaphoid, the simpler Colles plaster would appear to be equally effective.

# 2012

## Cast Immobilization with and without Immobilization of the Thumb for Nondisplaced Scaphoid Waist Fractures: A Multi-center Randomized Controlled Trial

Level 2 Evidence


- **Geert A. Buijze, MD**

J. Carel Goslings, MD, PhD
Steven Rhemrev, MD
Alexander Weening, MD
Bart Van Dijkman, MD

- David C. Ring, MD, PhD

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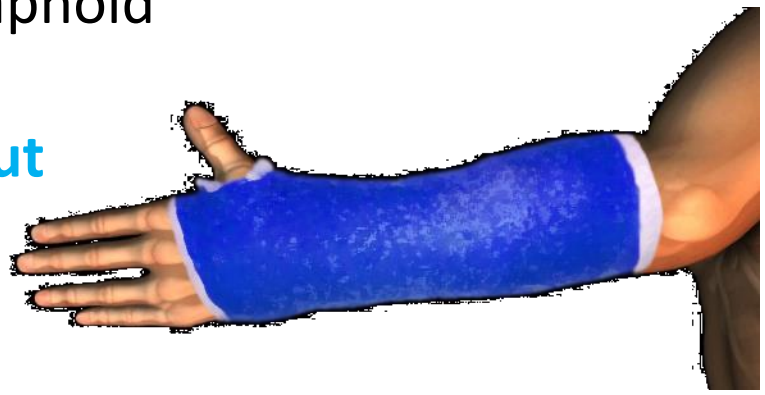
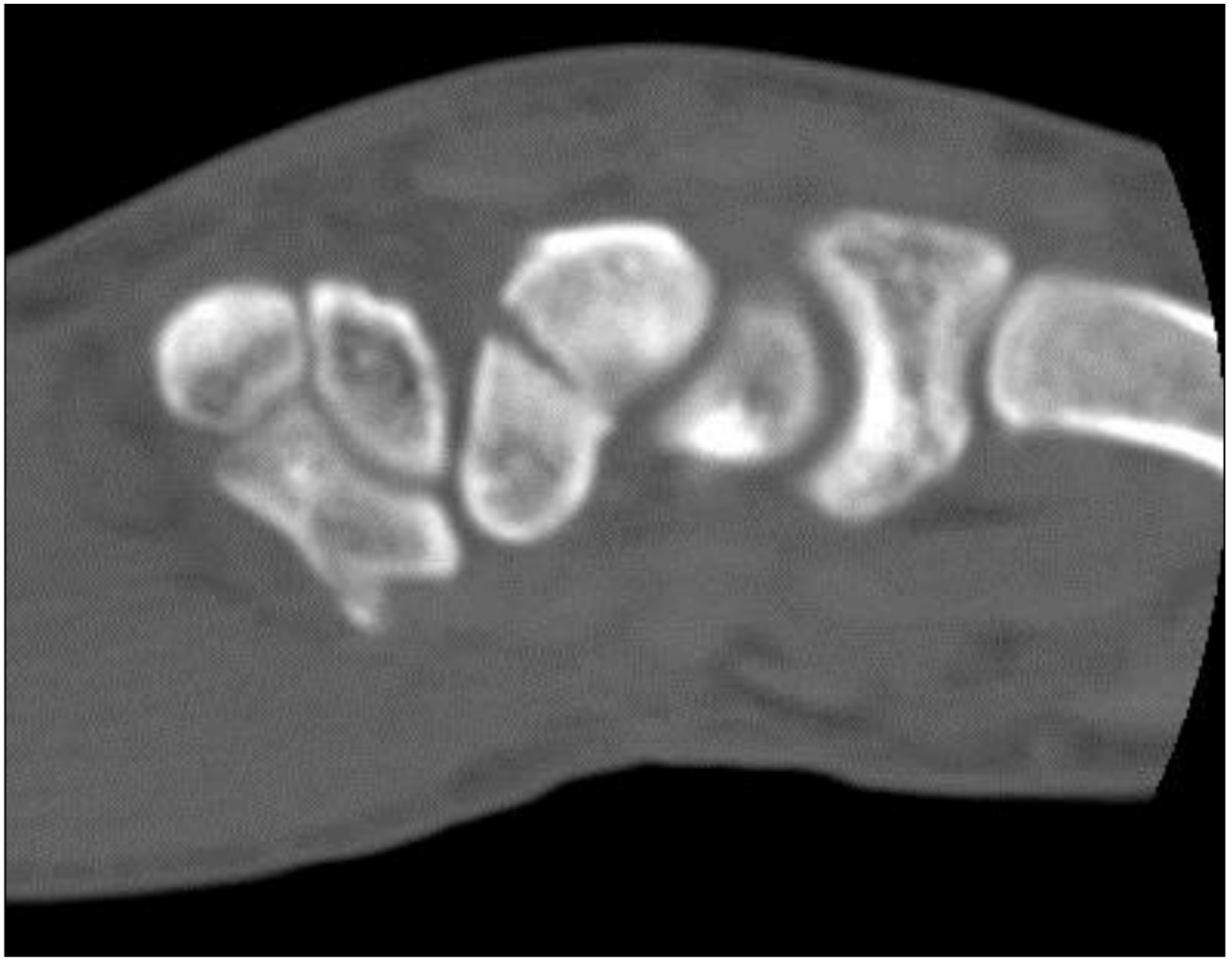
- **SUMMARY POINTS**
- · Treatment with a below-elbow cast **without immobilization of the thumb** results in **a higher extent of union** on CT at ten weeks.
- · There was no difference in arm-specific disability
- · Nondisplaced fractures of the scaphoid waist can be adequately

treated in below-elbow cast **without** immobilization of the thumb.



# How to assess displacement?



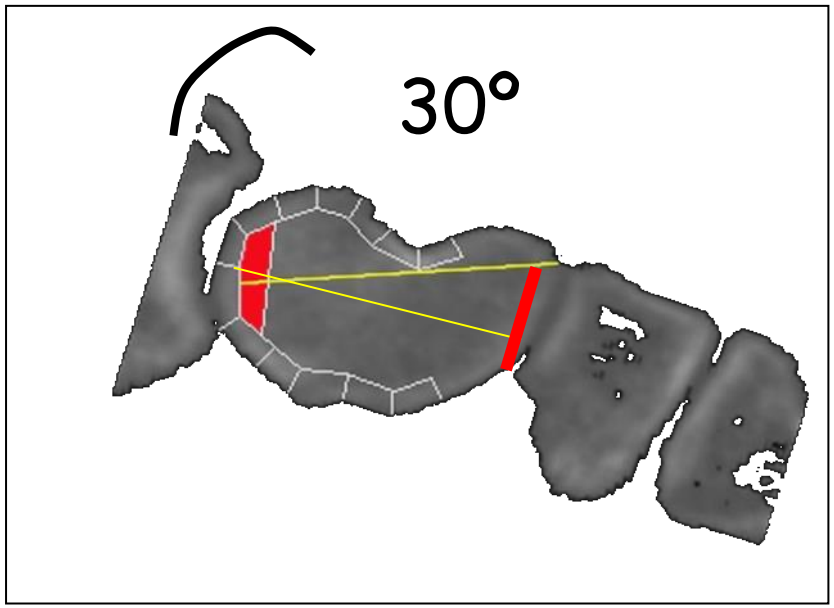
# displacement

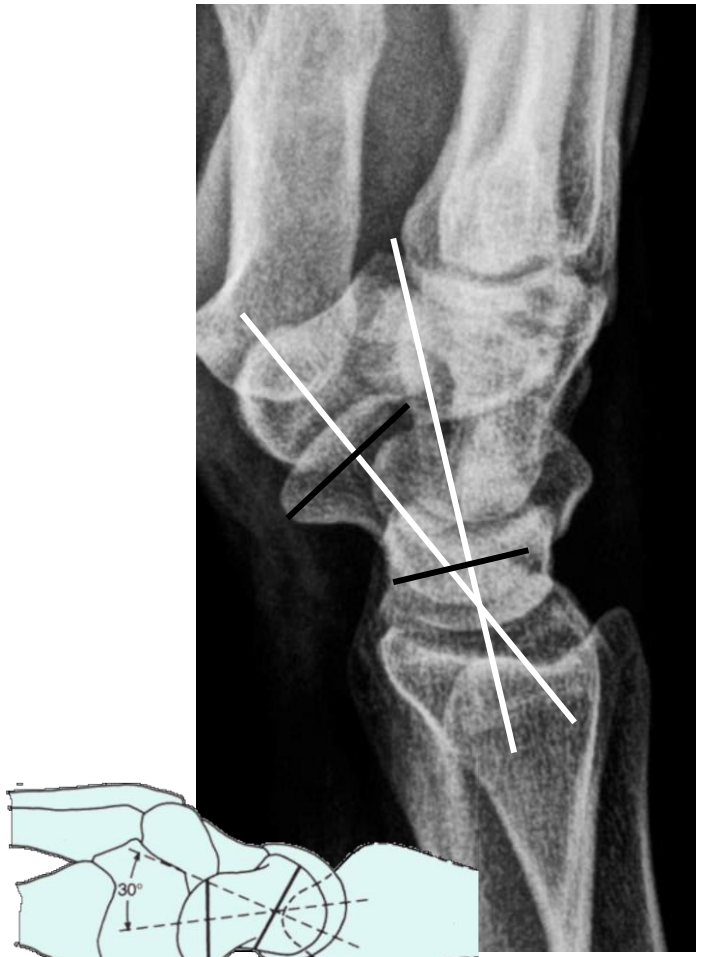
*(Amadio et al, J Hand Surg 1989)*

lateral intrascaphoid angle

## No displacement:

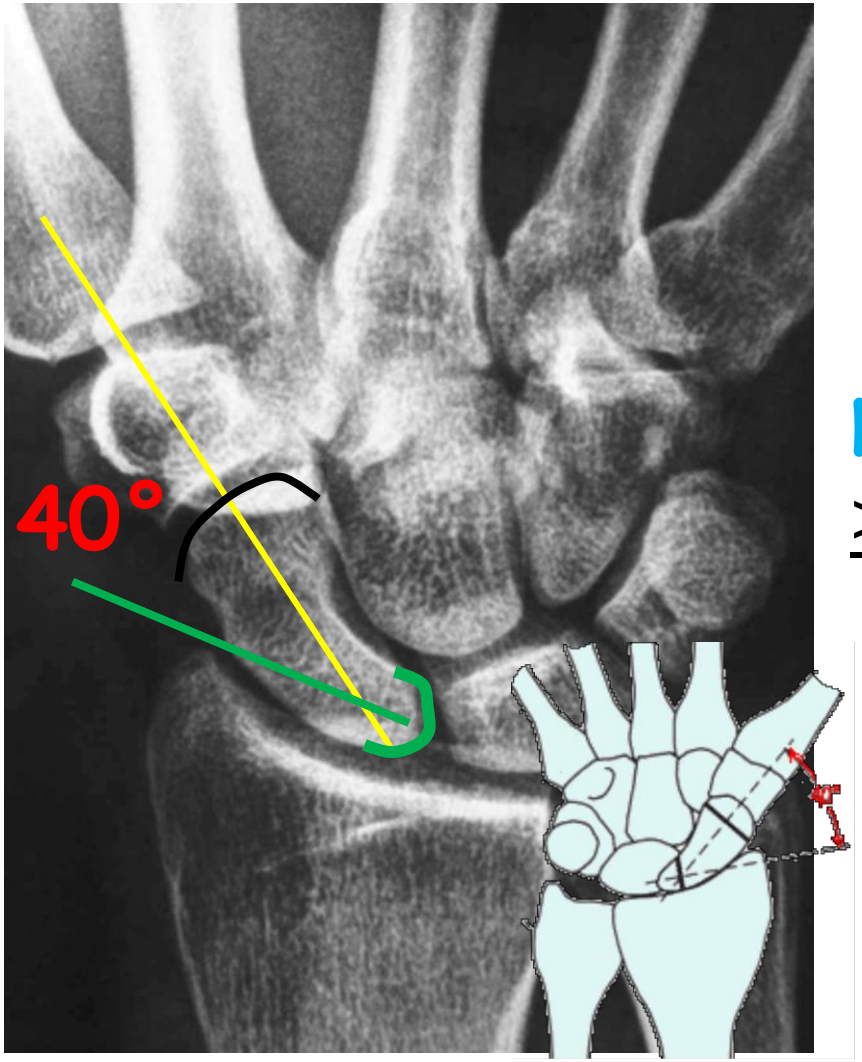
≤ 35° on CT sagittal cuts



# displacement

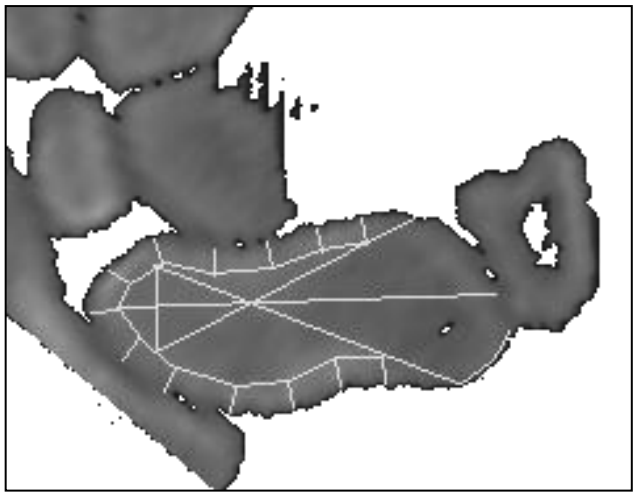
*(Amadio et al, J Hand Surg 1989)*




anteroposterior (AP) intrascaphoid angle

**No displacement:**

≥ 35°



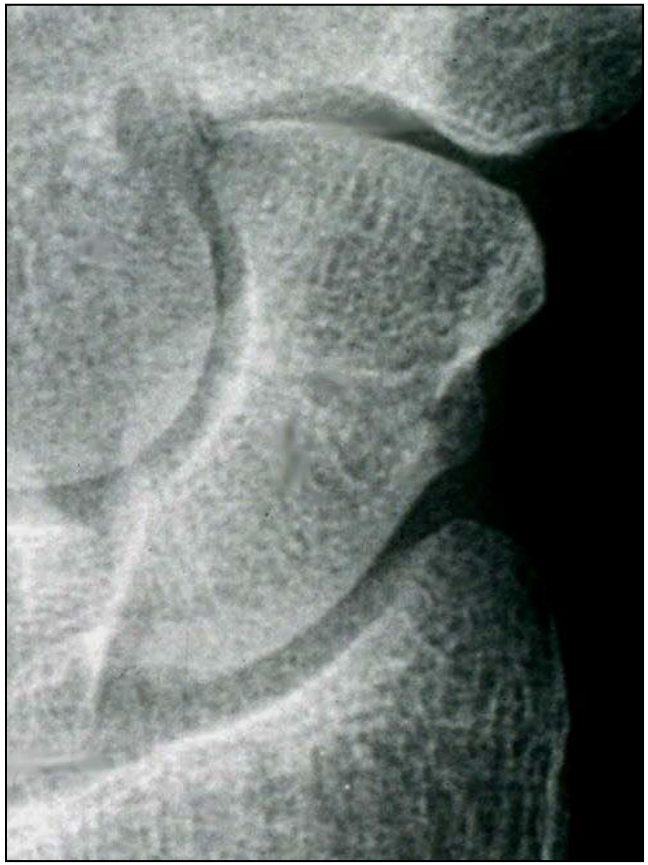
# Delayed Dx-1 month

1. Cast
2. Percutaneous screw
3. Open screw


L7


L

# Scaphoid - can we predict the heeling ?



# Scaphoid - can we predict the heeling ?

Very difficult

# Scaphoid - can we predict the heeling ?

- Difficult to predict fracture union based on radiographic feature
- More acurate assessment of displacemenmt ( CT) may predict the likelihood of union
- Initial poor vascular supply of the proximal fragment?


## Scaphoid blood flow and acute fracture healing

A DYNAMIC MRI STUDY WITH ENHANCEMENT WITH GADOLINIUM

J. S. Dawson, A. L. Martel, T. R. C. Davis

*From the University Hospital, Nottingham, England*

JBJS 83 B:809-814,2001

The lack of correlation between poor proximal vascularity in the acute stage and eventual non-union DOES NOT SUPPORT THE HYPOTHESIS that ischemia of the proximal fragment predisposes to non-union.

# Scaphoid - can we predict the heeling ?

- Difficult to predict fracture union based on radiographic feature
- More acurate assessment of displacemenmt ( CT) may predict the likelihood of union
- **Initial poor vascular supply of the proximal fragment….is not a determinant of non-union**

**If it still difficult to identify fractures with a poor prognosis….**

…that better treat them with screw fixation?

# Scaphoid - can we predict the heeling ?

FURTHER ISSUES THAT DIRECTLY INFLUENCE OUTCOME ARE:

- delay in diagnosis and treatment
- instability, associated ligament disruption, soft tissue interposition
- adequacy of treatment

# Scaphoid - can we predict the heeling ?

FURTHER ISSUES THAT DIRECTLY INFLUENCE OUTCOME ARE:

- delay in diagnosis and treatment
- instability, associated ligament disruption, soft tissue interposition
- adequacy of treatment

*J Hand Surg 2011;36A:1471–1474.*

SCIENTIFIC ARTICLE

# Delays and Poor Management of Scaphoid Fractures: Factors Contributing to Nonunion

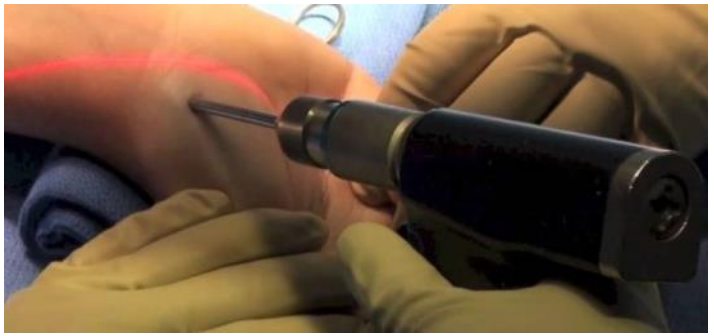
King Wong, MB BCh, Herbert P. von Schroeder, MD

**Purpose** Scaphoid fracture nonunion remains prevalent, and it was our purpose to examine the initial care, fracture site, and patient gender and age to determine factors contributing to fracture nonunion.

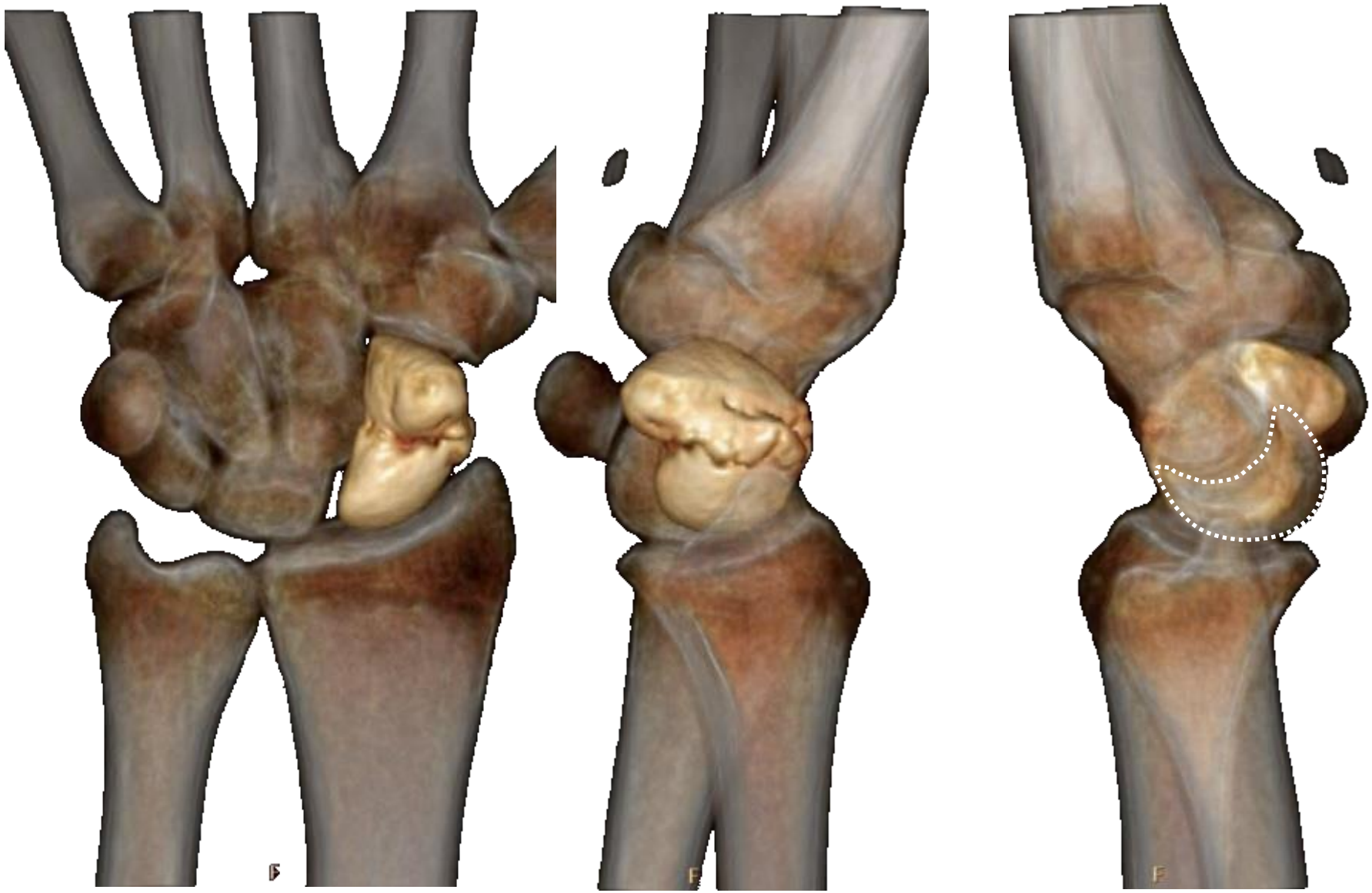
- No clinical examination
- No initial x- rays
- No adequate immobilization
- No follow up

# management decision

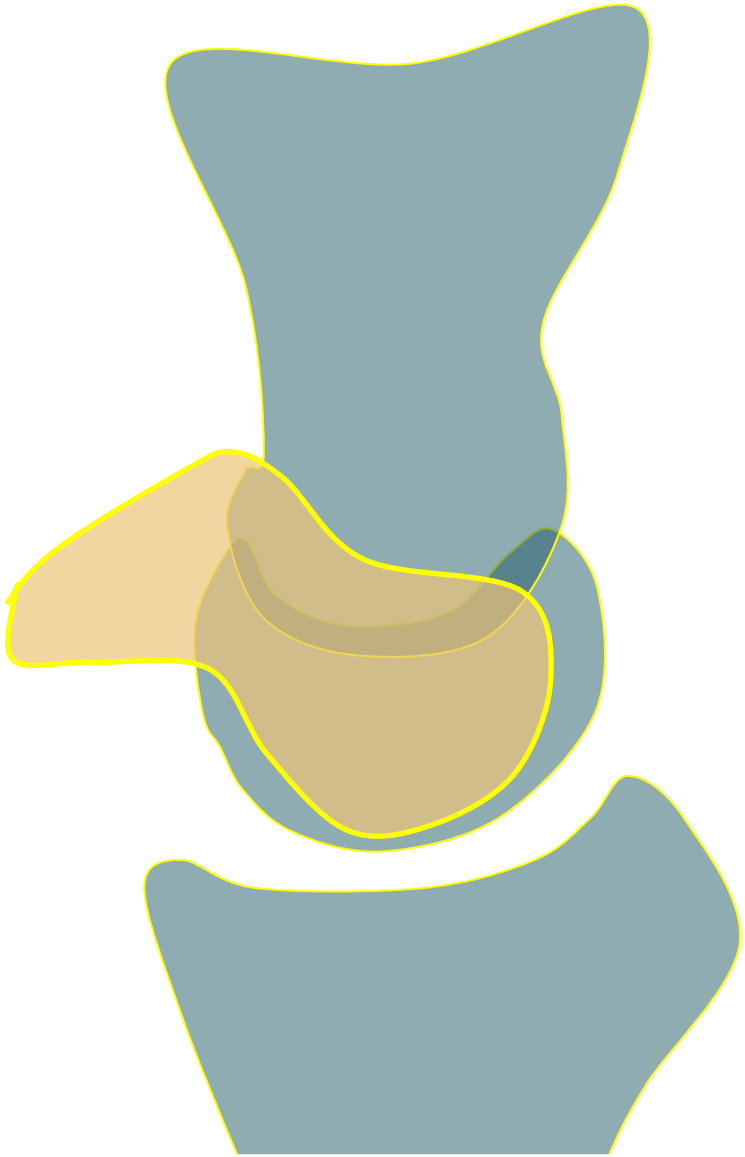
- stability
- ease of reduction
- associated ligament disruption
- patient's needs
- technical abilities of surgeon



percutaneous fixation has clearly shifted management from conservative to surgical!



# FLEXION (humpback)



# FLEXION (humpback)