Treatment of scaphoid nonunion

Ch. Mathoulin

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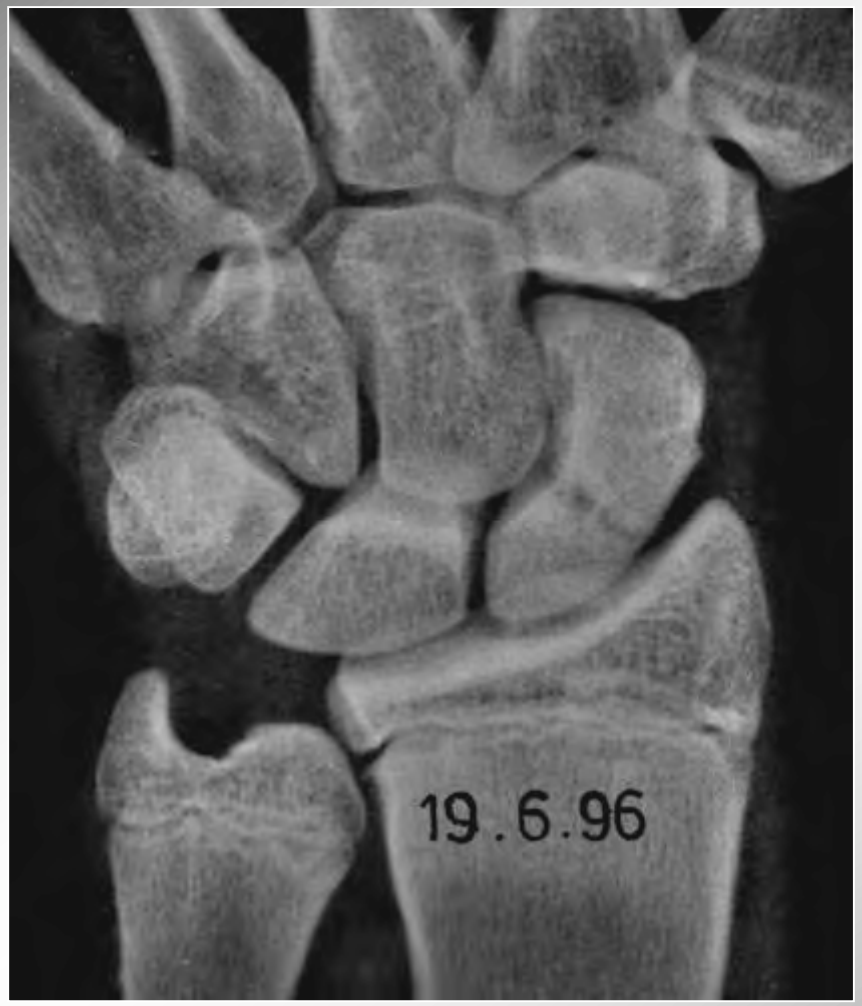
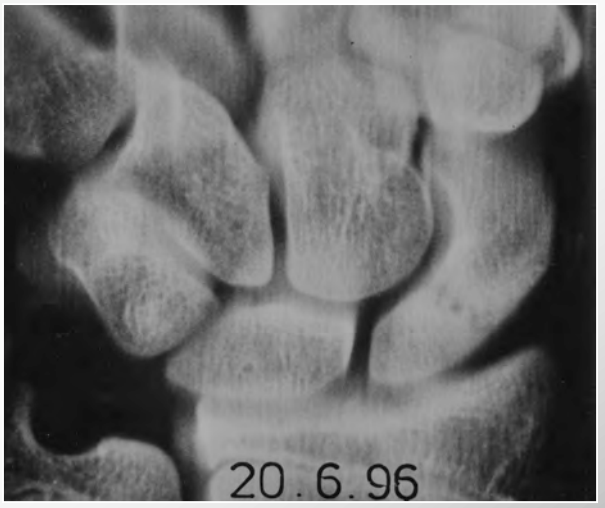
Problèmes





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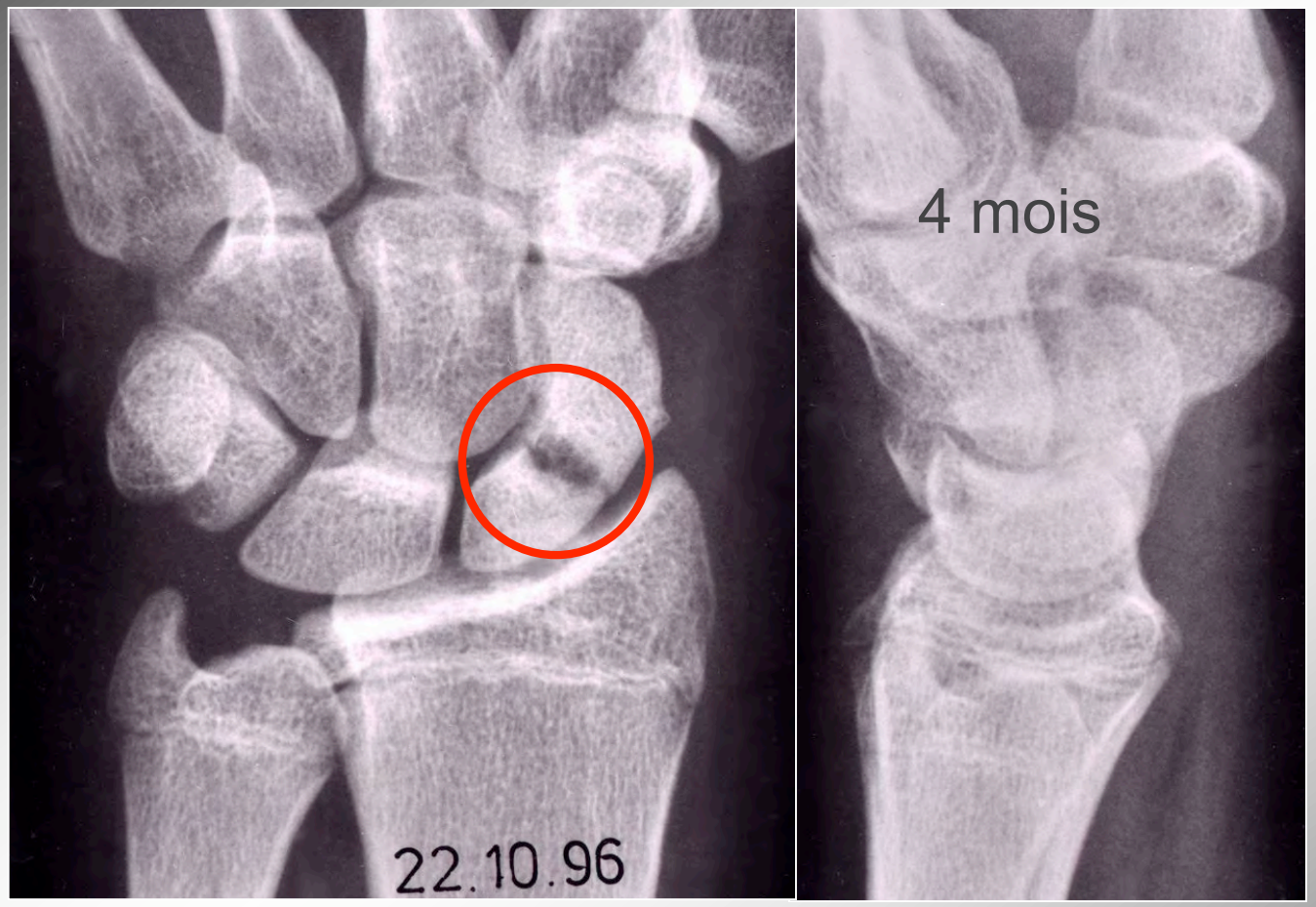

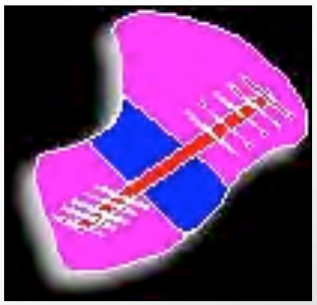

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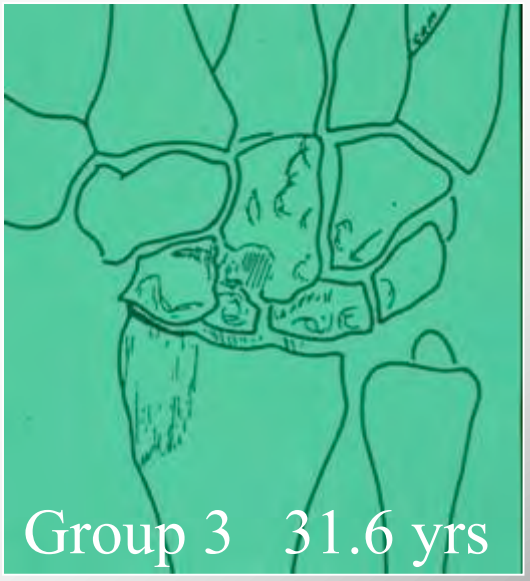
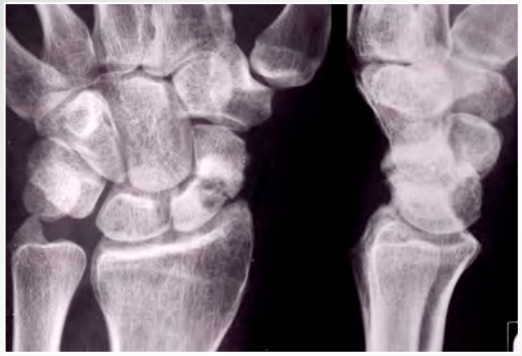
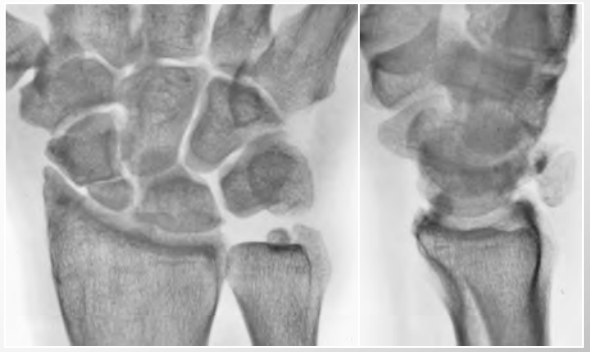
Scaphoid Non-Union: Natural History







Mack G R et al. : JBJS 66A:504-509, 1984

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PSEUDARTHROSES DU SCAPHOÏDE

Classification de J.Y. ALNOT

s'appui sur l'evolution (correspond à l'histoire naturelle de les pseudarthroses non traitées)

Stade I		***récente sans résorption du trait***
Stade II	***A***	***résorption du trait sans DISI***
	B	***résorption du trait avec DISI***
Stade III	***A***	***arthose modérée radio-scaphoïdienne***
	B	***arthrose plus importante médio-carpienne***
Stade IV		***nécrose du pôle proximal***

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Stade I: récente sans résorption du trait

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Stade II A: résorption du trait sans DISI

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Stade II B: résorption du trait avec DISI

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Stade III A: arthose modérée radio-scaphoïdienne

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Stade III B: arthrose plus importante médio-carpienne

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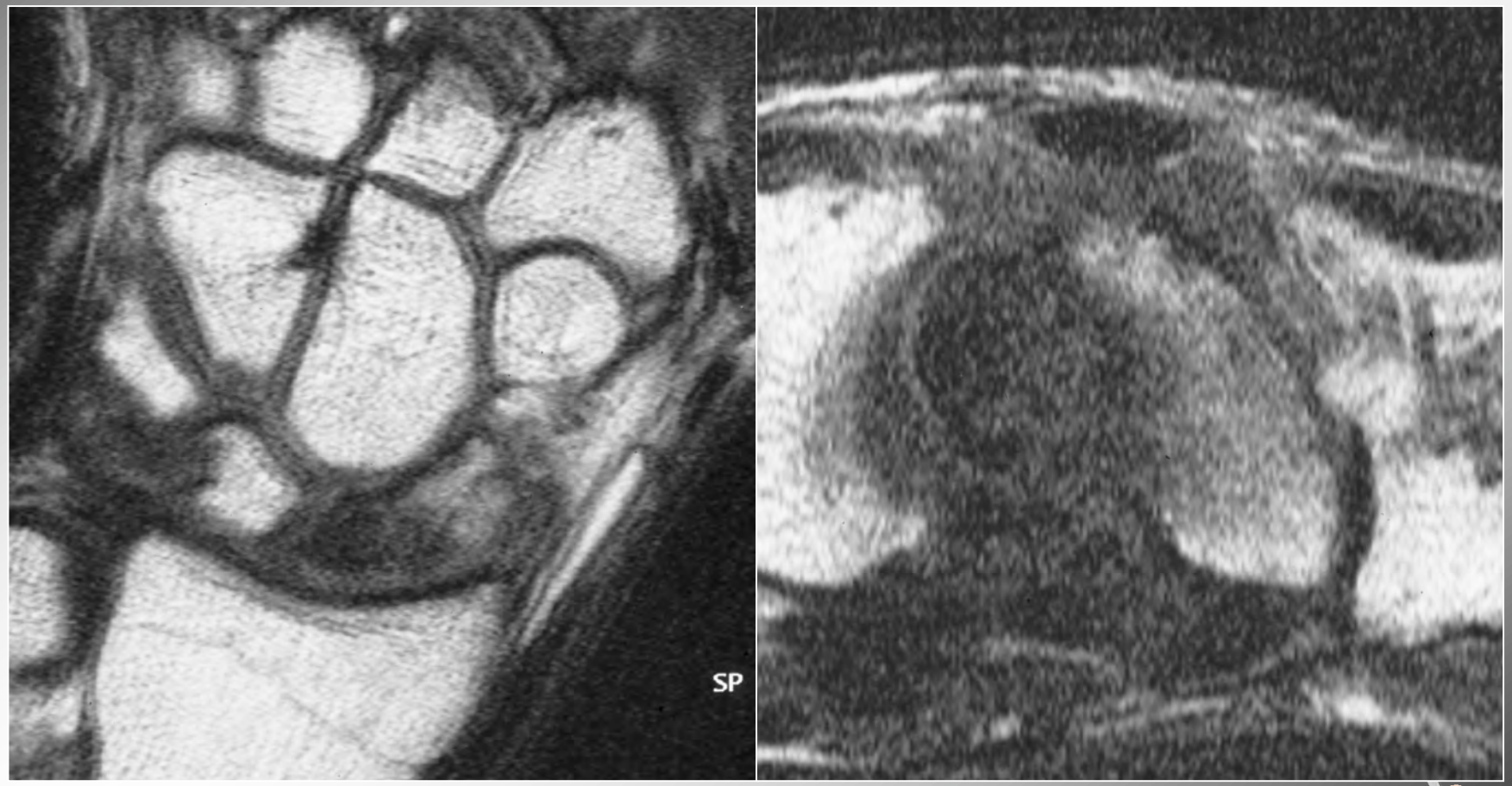
Stade IV: nécrose du pôle proximal



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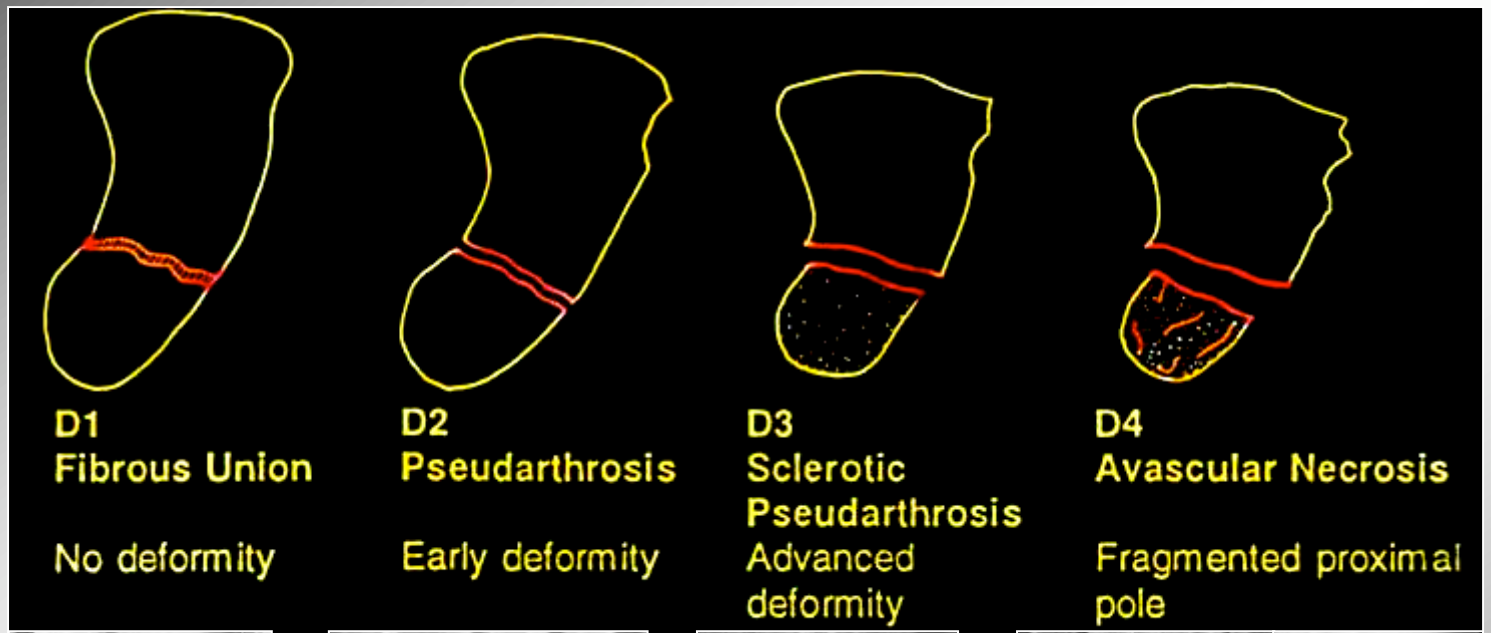
Scaphoid Non-union: Herbert Classification



Fibrous
(I Alnot)

Cystic
(IIA Alnot)

Sclerotic
(IIB Alnot)

Avascular
(IV Alnot)

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SCAPHOID NON-UNION : Treatment Algorithm

Fibrous non-union: stable, no deformity, no collapse excellent prognosis, repair all. Grafting not always necessary. Percutaneous fixation possible.

Mobile non-union: unstable, early collapse, DISI good prognosis. Anterior wedge grafting.

Sclerotic non-union: unstable,moderate to marked collapse and OA, ischaemic proximal pole, fair prognosis. Treat according to age and symptoms.

Avascular non-union: fragmented proximal pole, poor prognosis, not reconstructable.
Salvage?
Revascularization trial?

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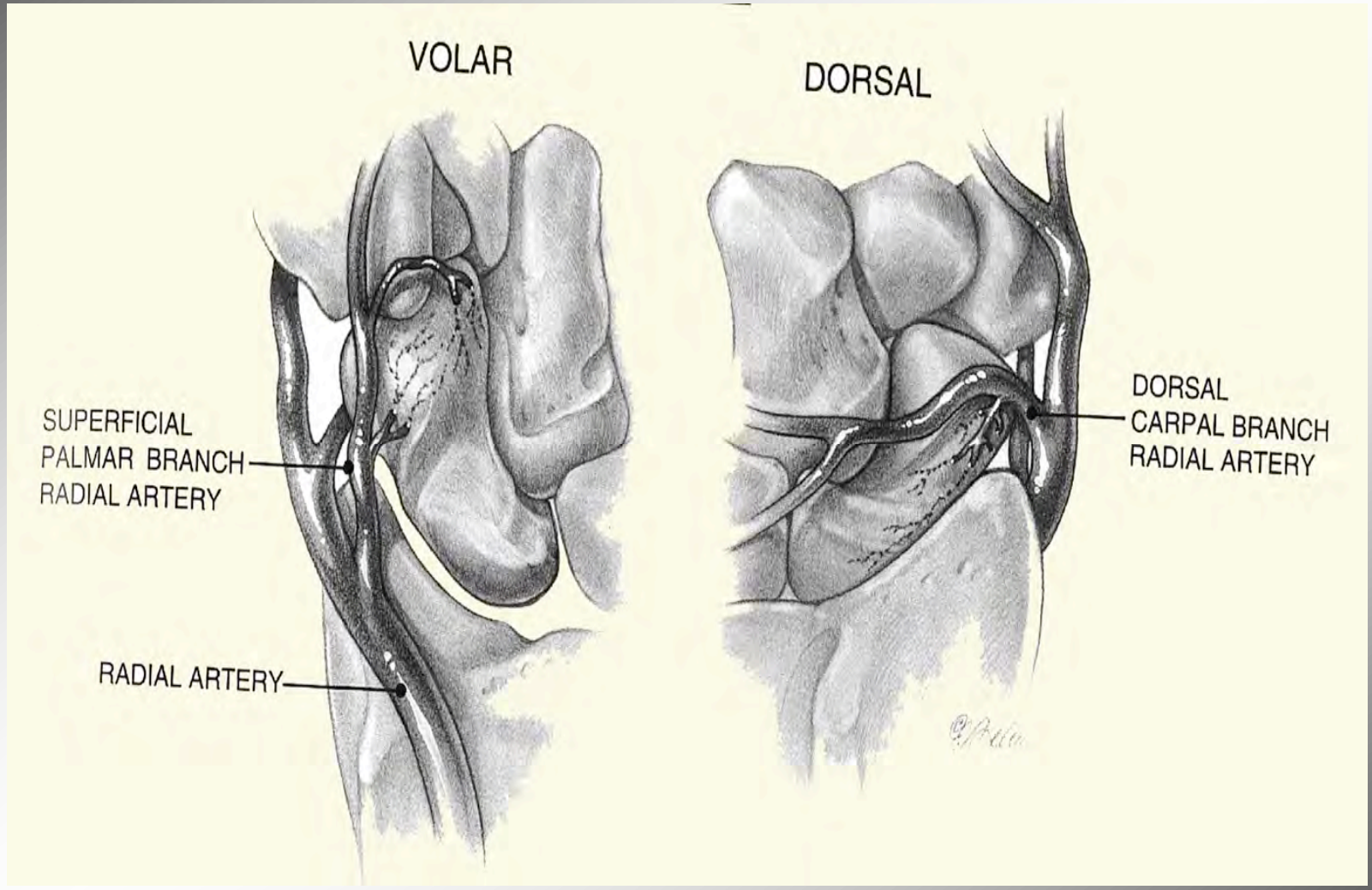
VASCULARISATION



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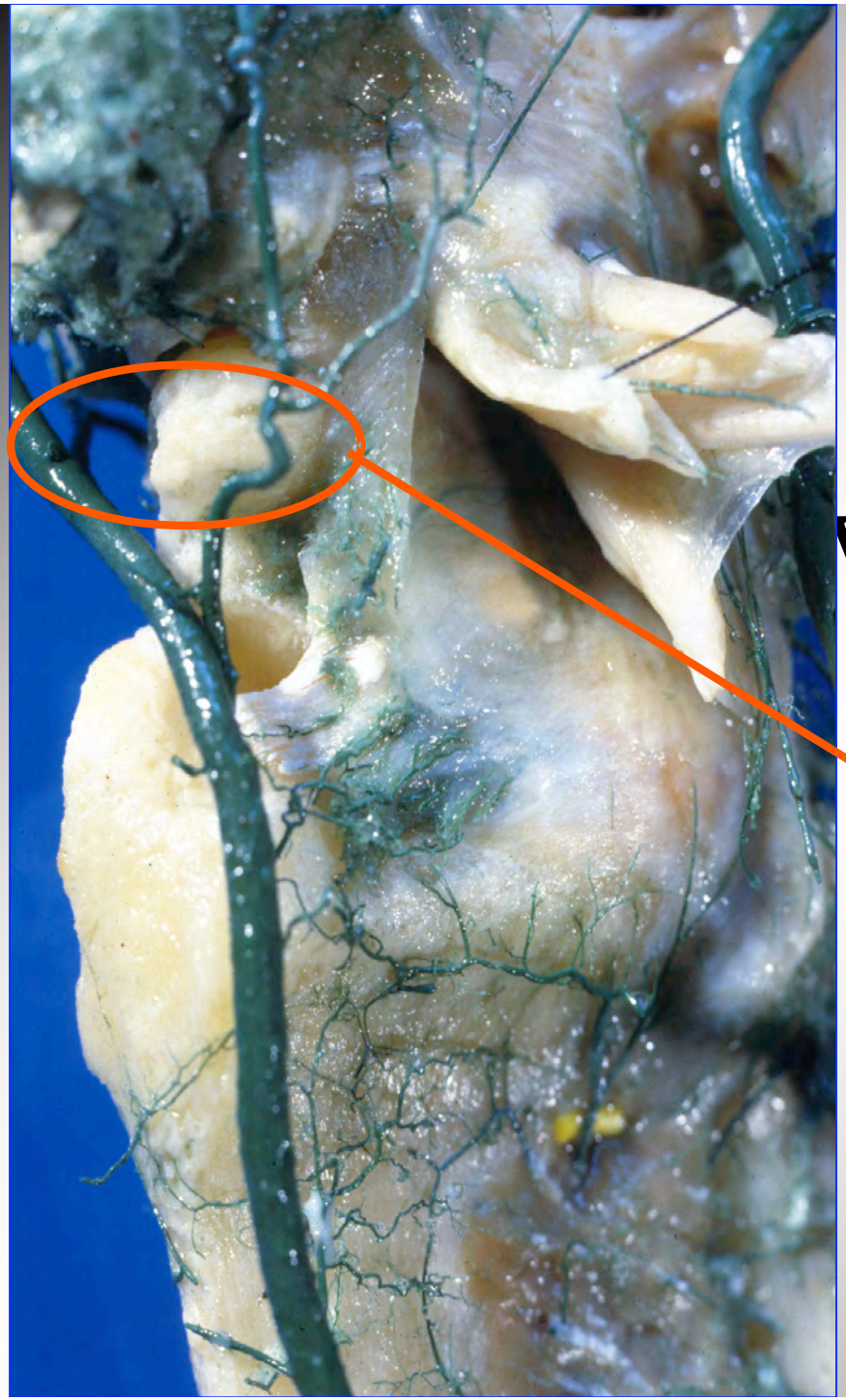

Vascularisation rétrograde
et
terminale

branche de l'artère radiale

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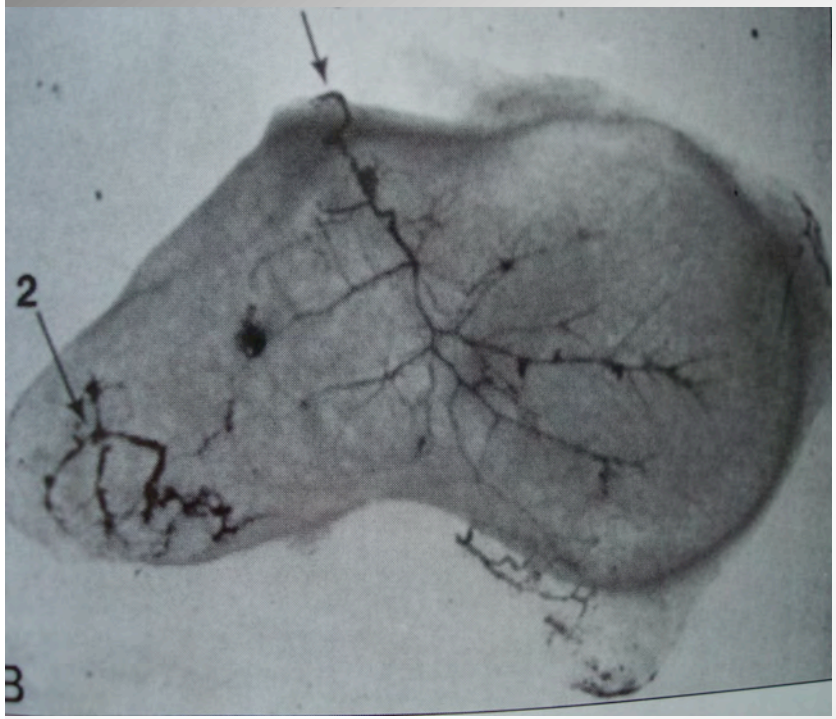
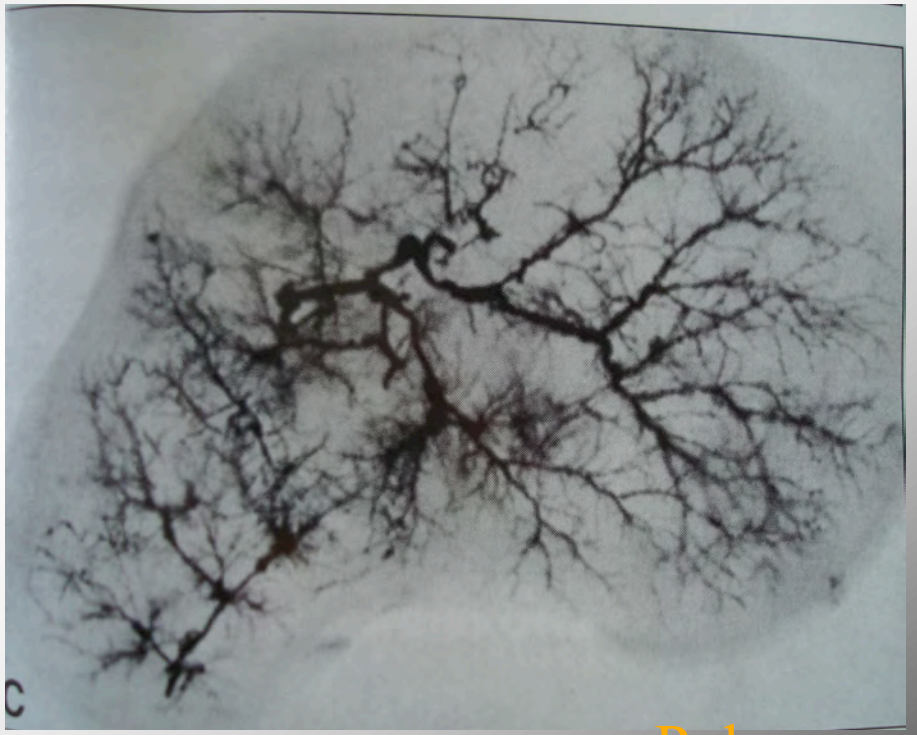
Microangiographie



Pole prox



Pole prox

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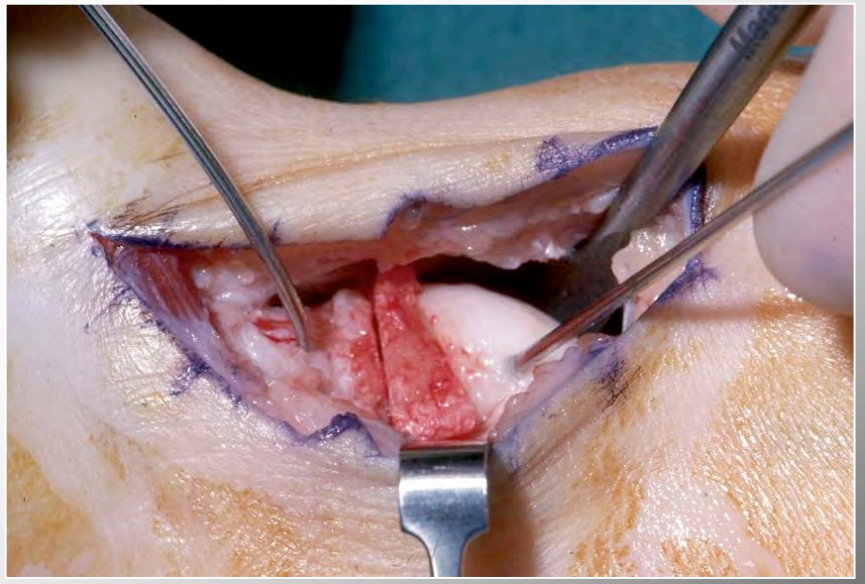
Options thérapeutiques

- Vissage percutané avec assistance arthroscopique
- Greffe osseuse
- Greffe vascularisée
- Palliatif



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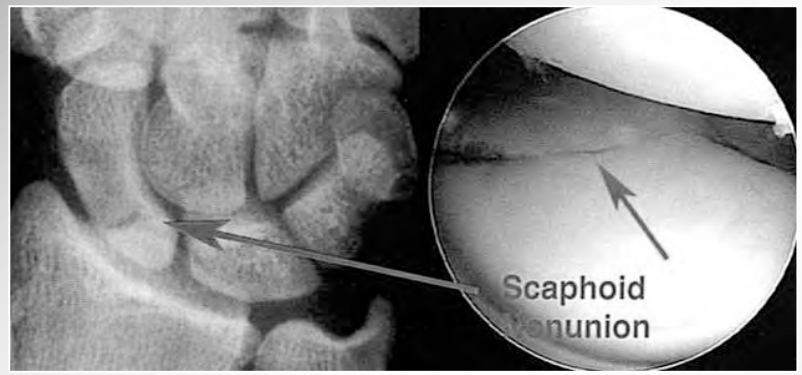
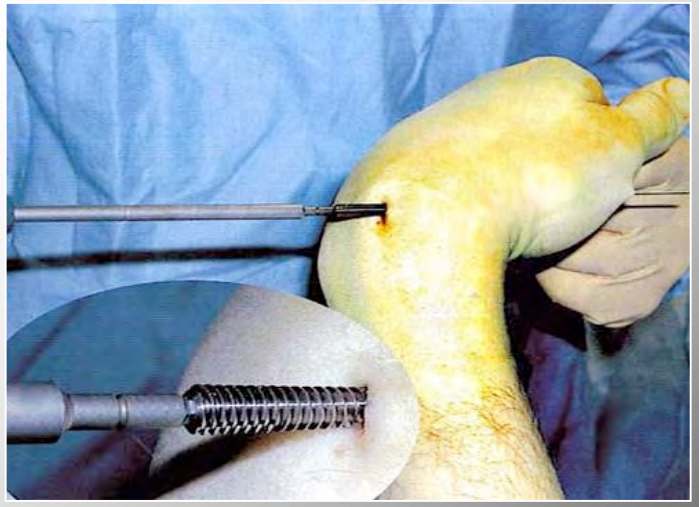
PERCUTANEOUS INTERNAL FIXATION OF SELECTED SCAPHOID NON-UNIONS WITH AN ARTHROSCOPICALLY ASSISTED DORSAL APPROACH

Slade JF, Geissler WB, Gutow AP, Merrell GA

JBJS 85-A Suppl 4: 20-32, 2003





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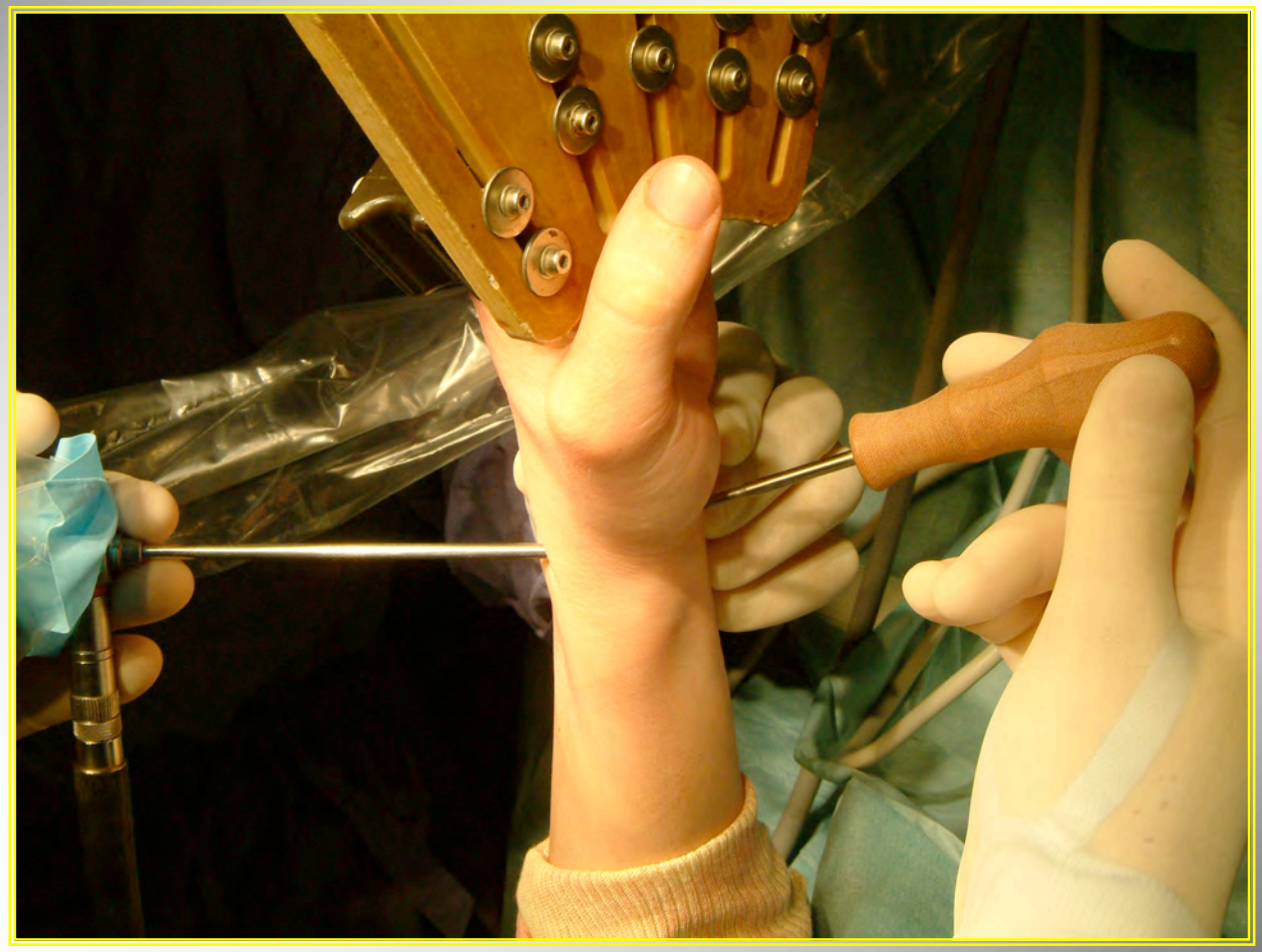
Technique antérieure



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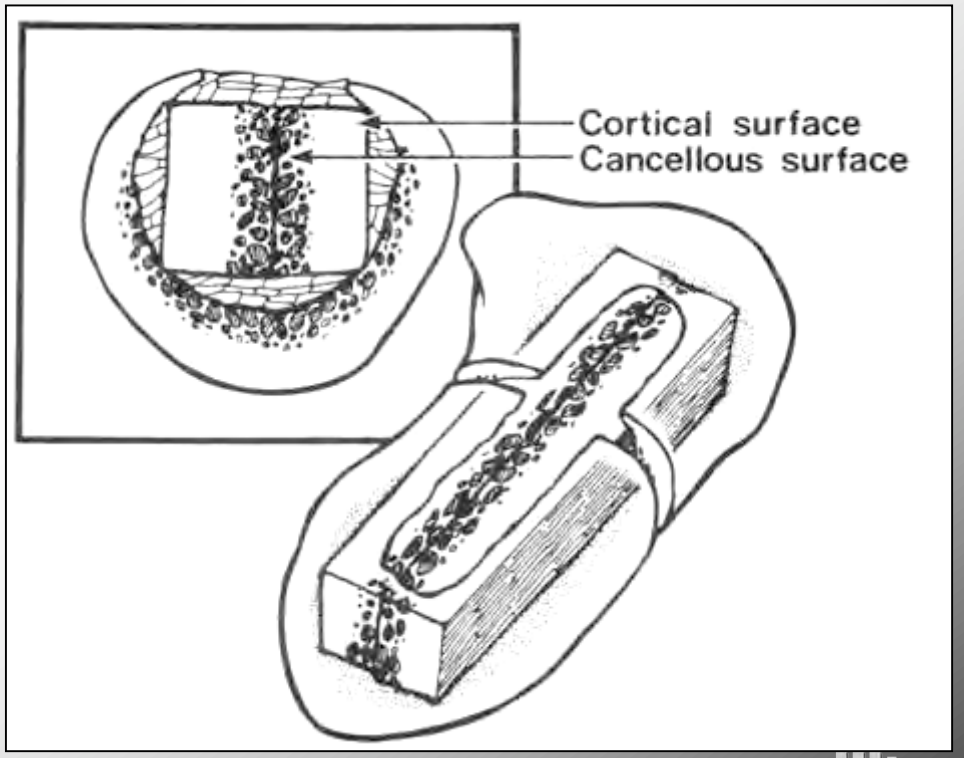
GREFFE DE MATTI-RUSSE



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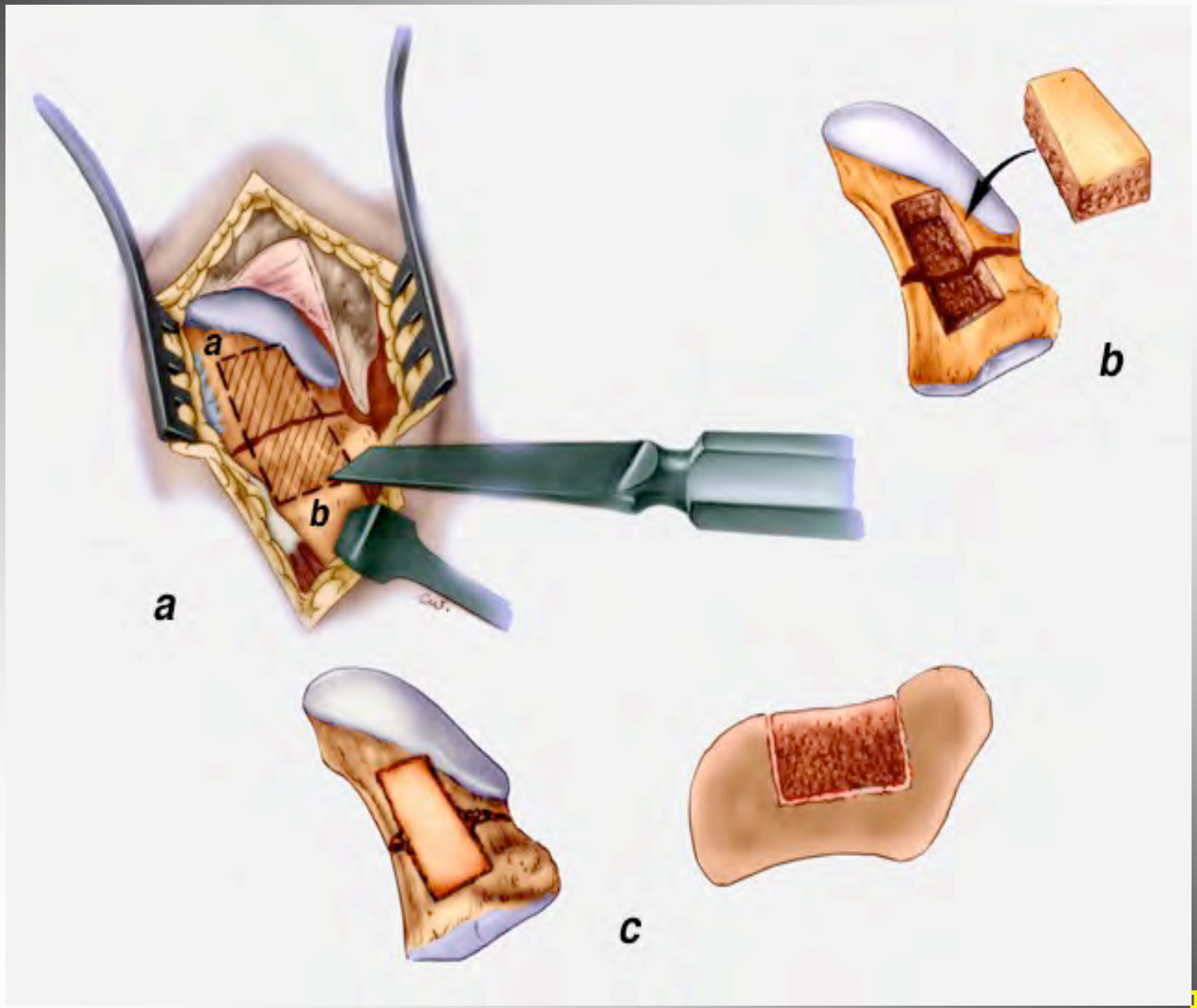

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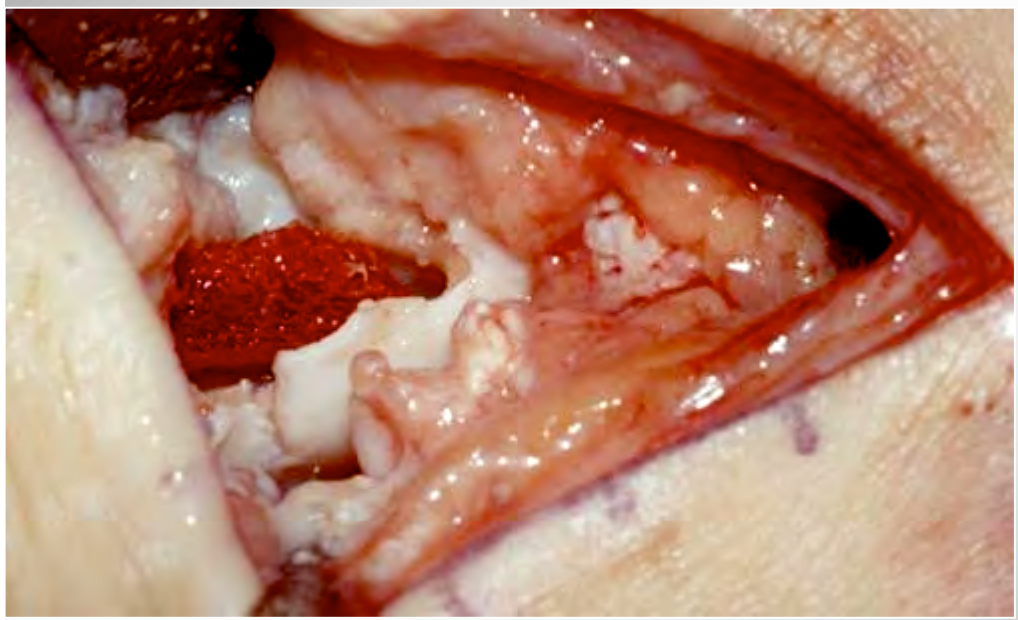
MATTI-RUSSE

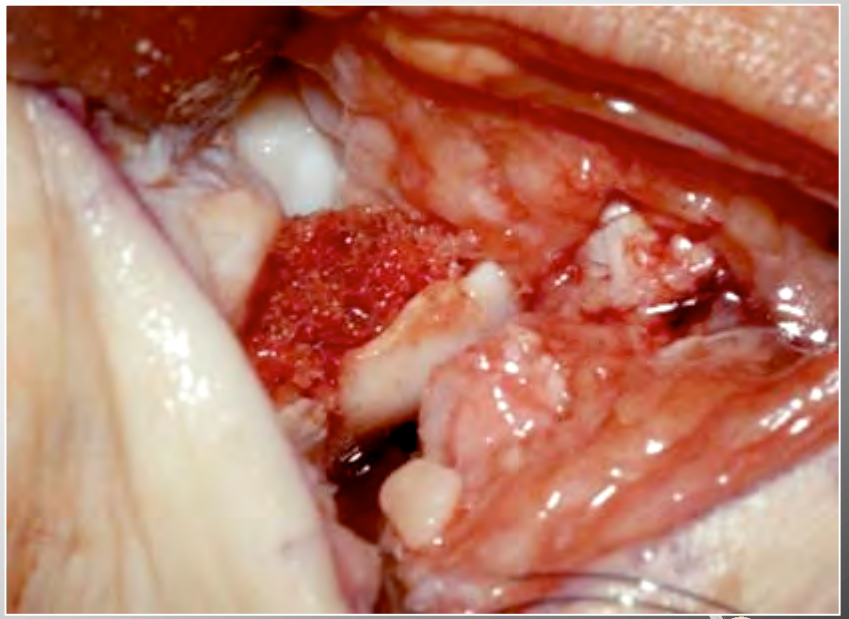
Très bonne technique si on respecte les règles

et que le fragment proximal est bien vascularisé

***Désavantage*: <u>Platre 3-4 mois (difficile chez le sportif),</u>**

<u>Greffe iliaque avec anesthésie générale</u>





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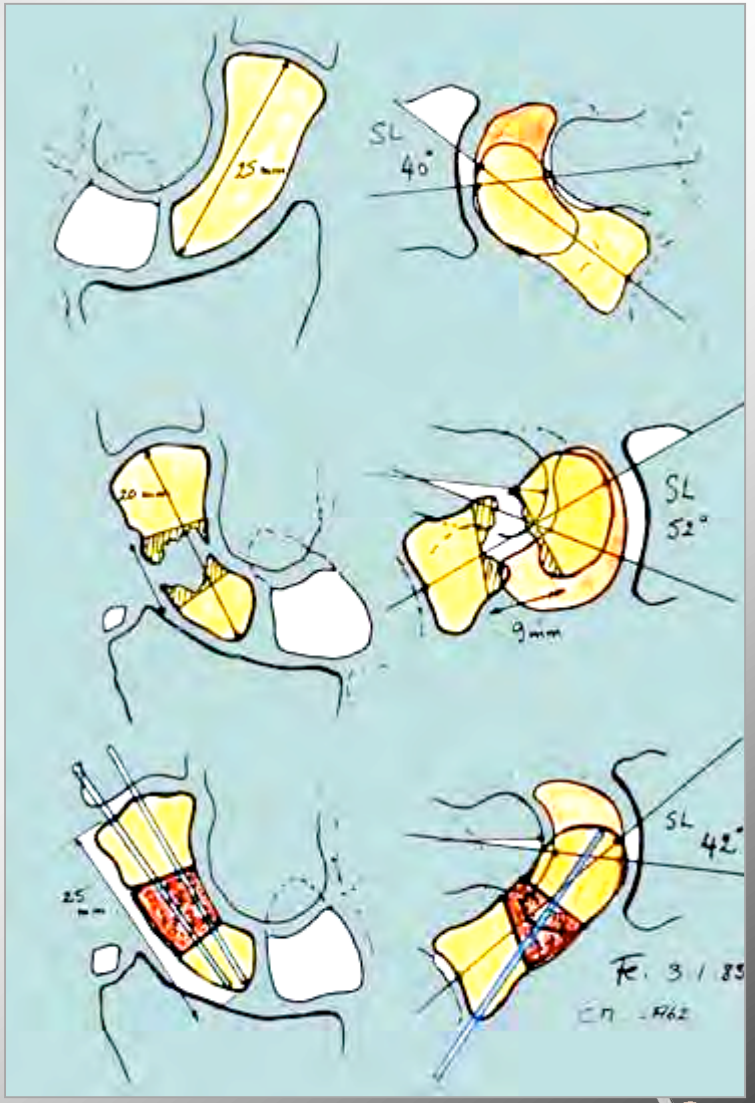
A TECHNIQUE FOR ANTERIOR WEDGE-SHAPED GRAFTS FOR SCAPHOID NONUNIONS WITH CARPAL INSTABILITY

DIEGO L. FERNANDEZ, M.D.,
Aarau, Switzerland

From the Traumatology Section, Department of Surgery, Kantonsspital, Aarau, Switzerland.

Reprinted from
THE JOURNAL OF HAND SURGERY,
St. Louis

Vol. 9A, No. 5, pp. 733-737, September, 1984



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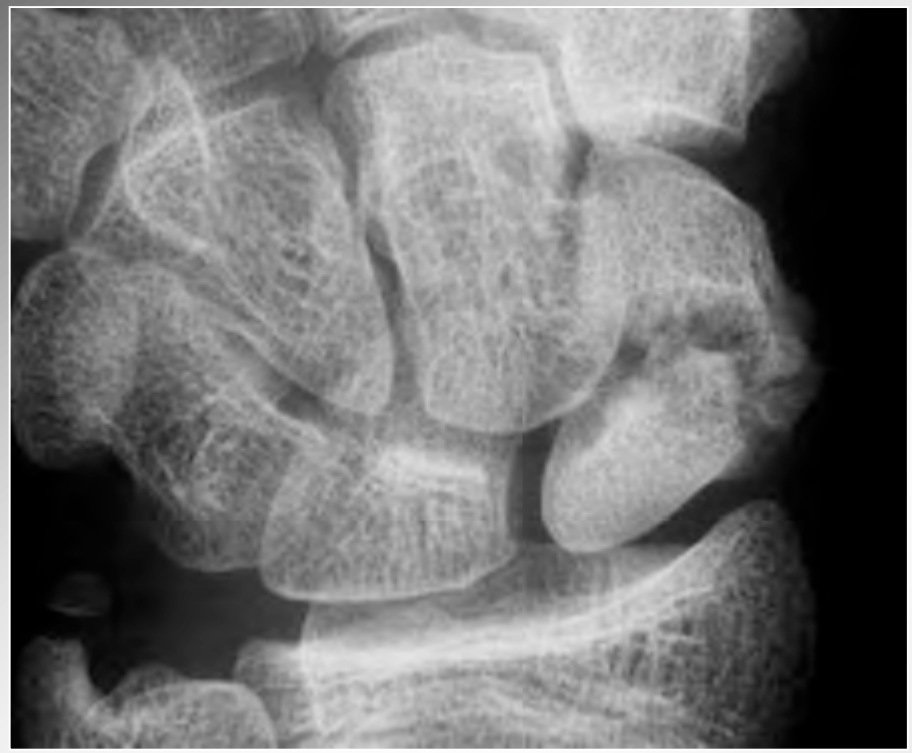

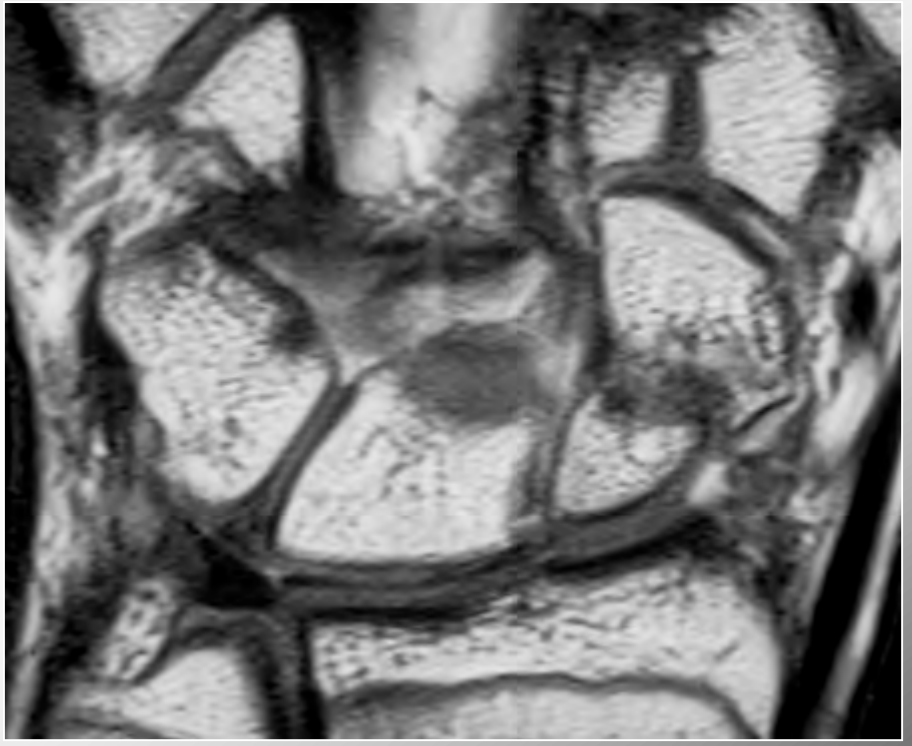

Fragment proximal bien vascularisé

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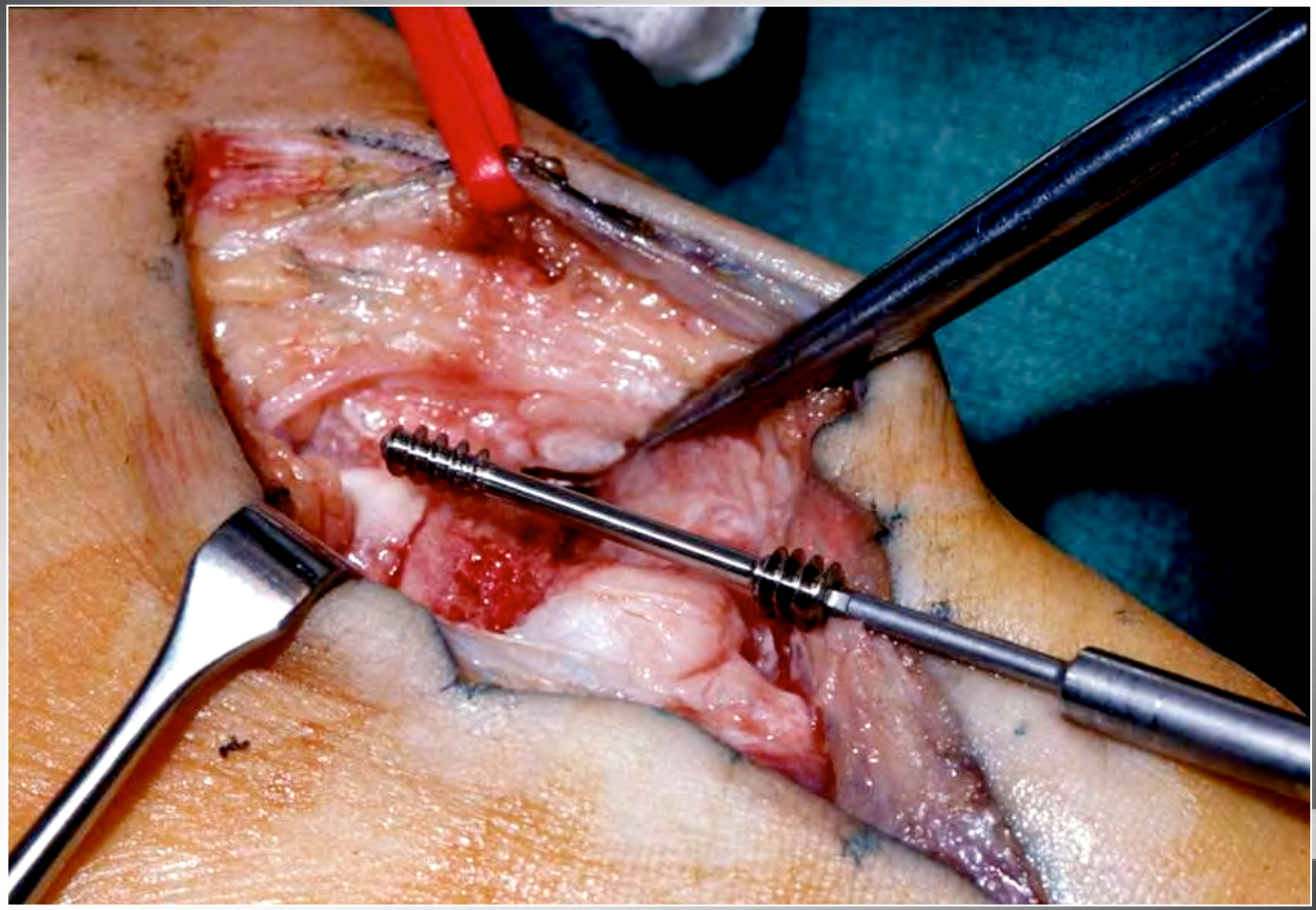

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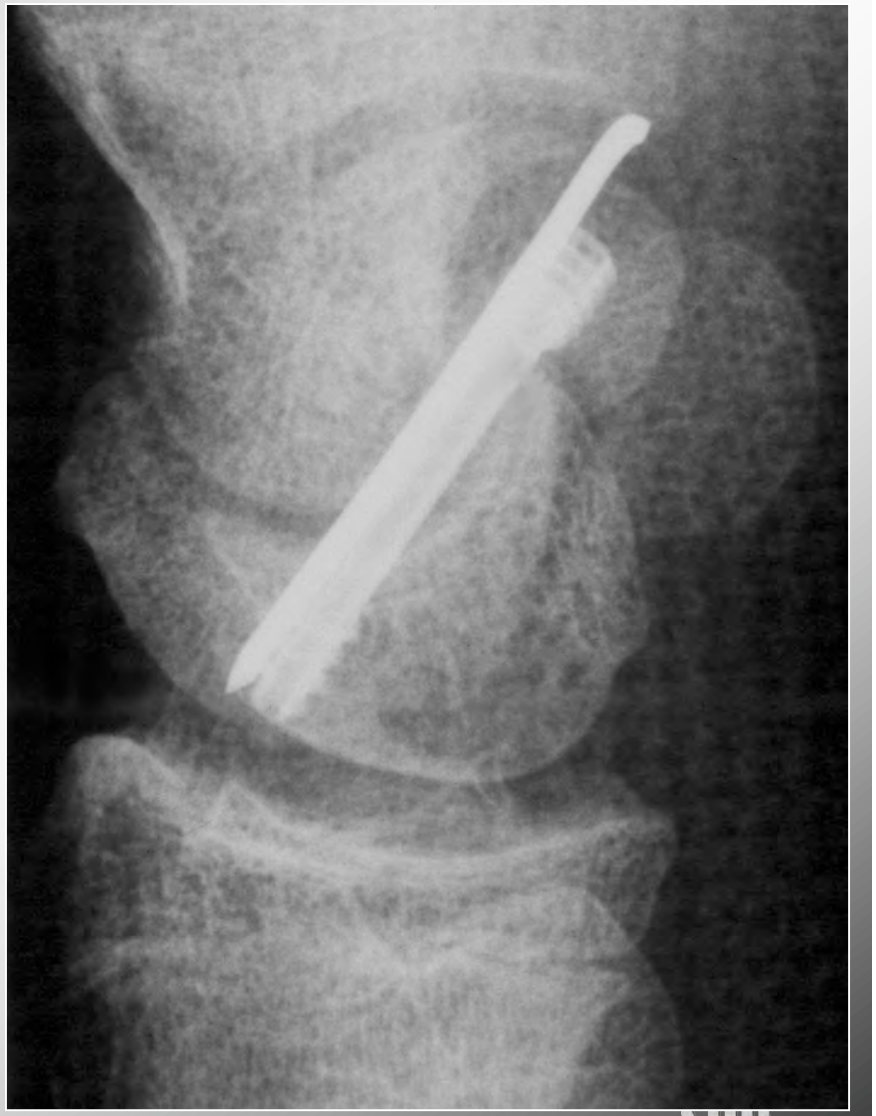

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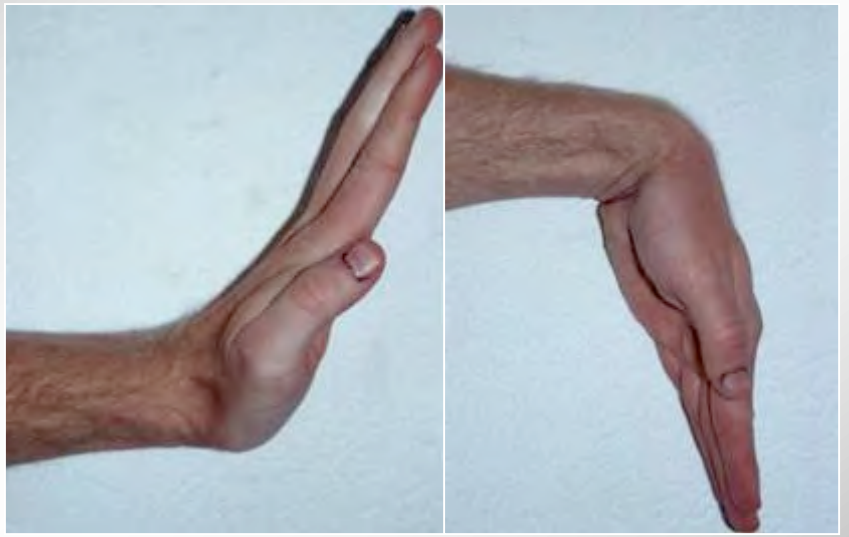
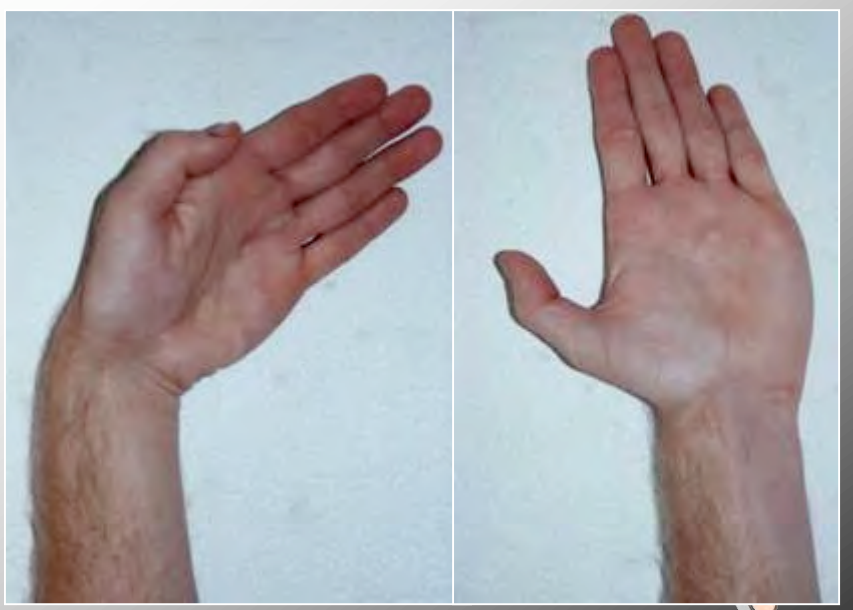
1,5 ans





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Greffe osseuse vascularisée

Radius dorsal
1er métacarpien
2ème métacarpien
Radius palmaire
Ulna…

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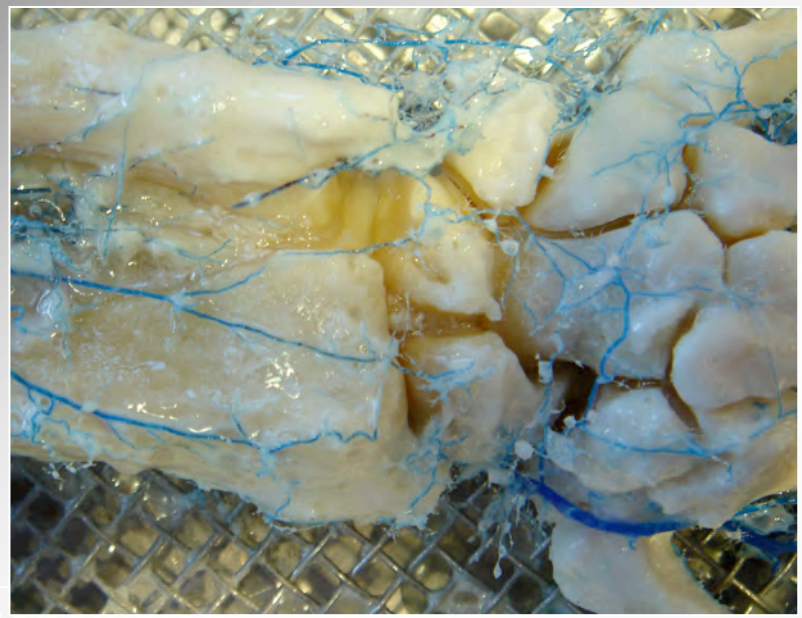
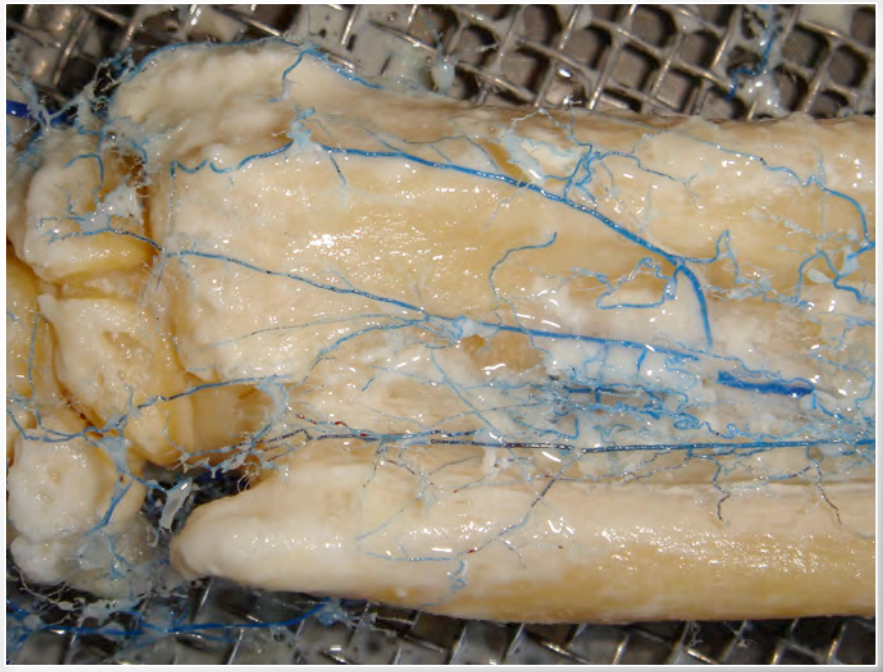
HISTORY, ANATOMY

DORSAL
SHEETZ, BISHOP, BERGER (MAYO CLINIC)
1995-2002





Conclusion

T. Balaguer, M. Verga, E. Lebreton

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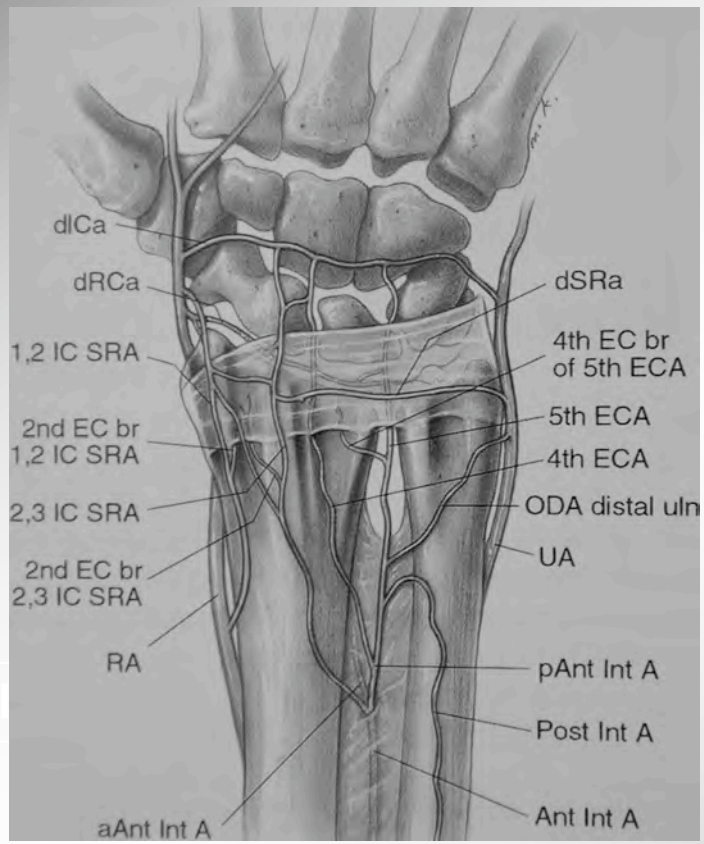
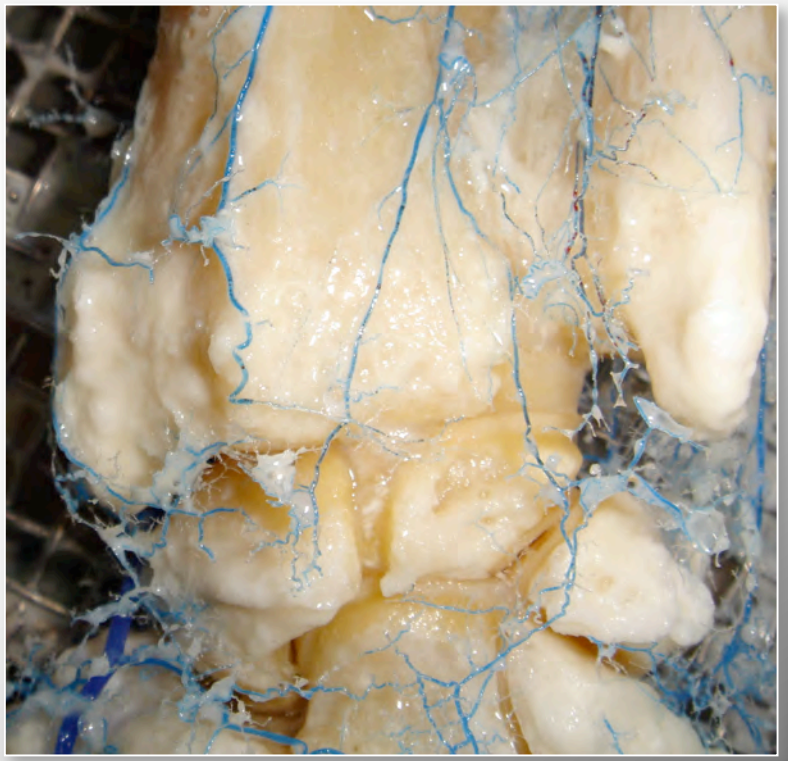
HISTORY, ANATOMY

DORSAL
SHEETZ, BISHOP, BERGER (MAYO CLINIC)
1995-2002





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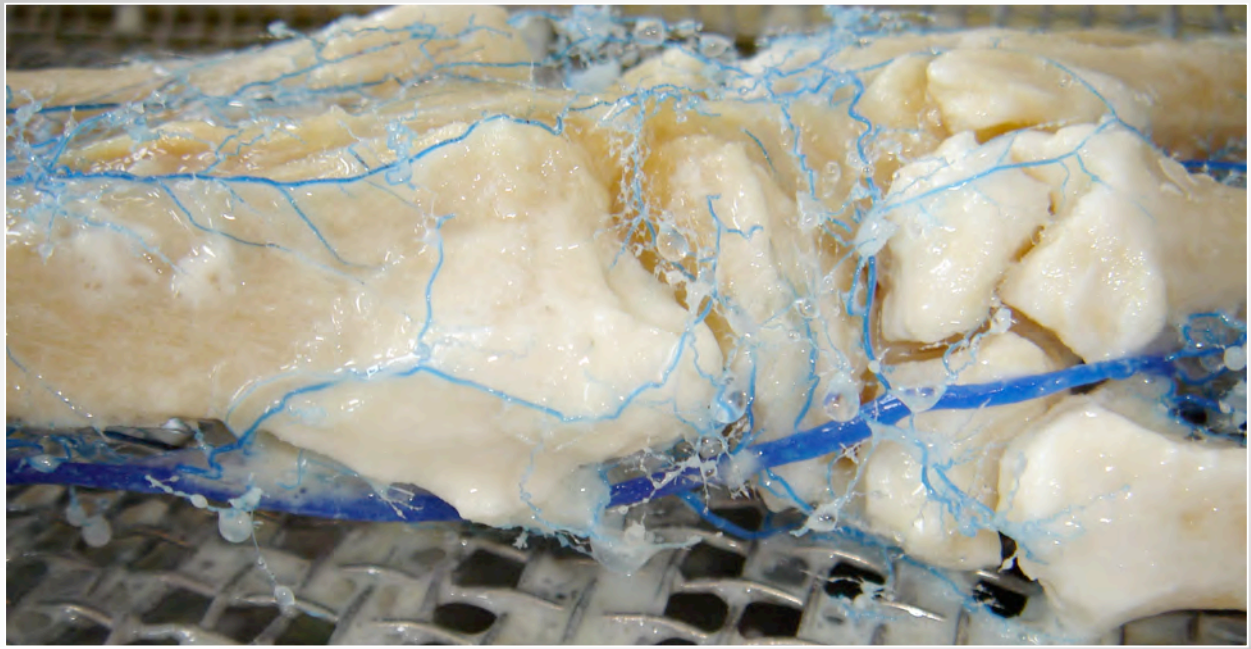
HISTORY, ANATOMY

LATERAL
ZAIDEMBERG
1991



Conclusion

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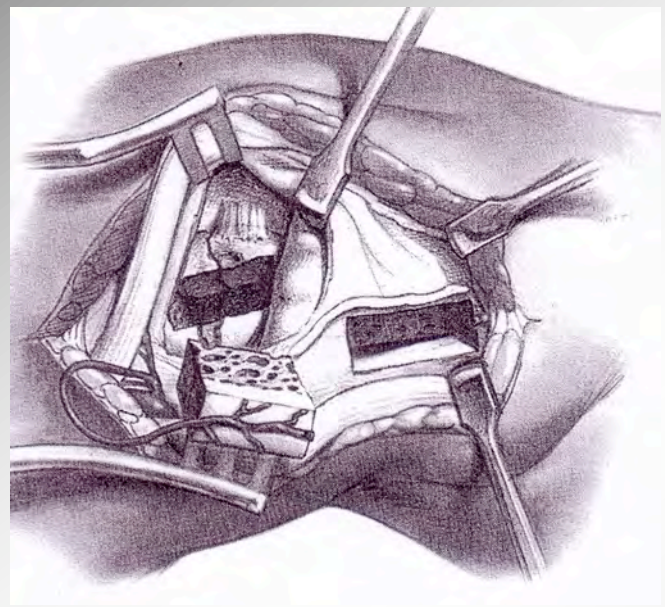
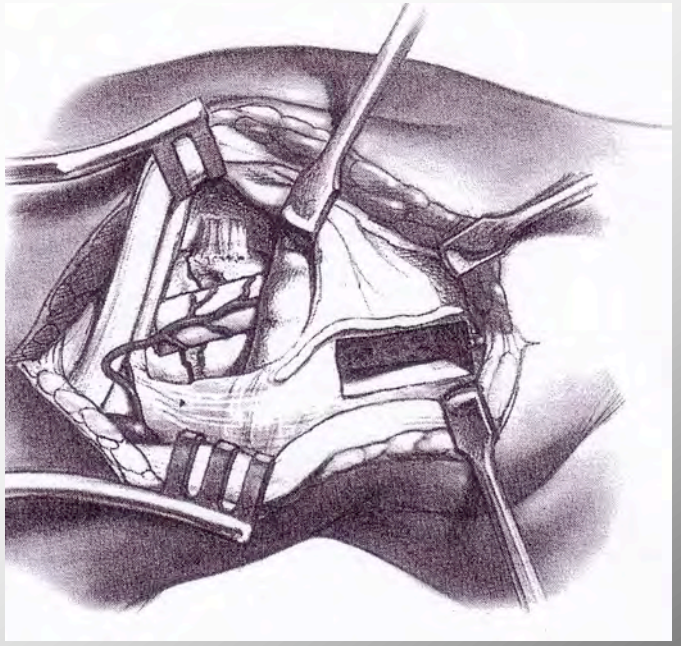
HISTORY, ANATOMY

LATERAL
ZAIDEMBERG
1991





Conclusion

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HISTORY, ANATOMY

VOLAR CARPAL ARTERY

Robert Judet (1964-65)
Mencke (1970)
Braun (1987) Kulhman (1987)
Kawai (1988)

Anatomical background :
Haerle, Mathoulin (1995)

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HISTORY, ANATOMY

VOLAR

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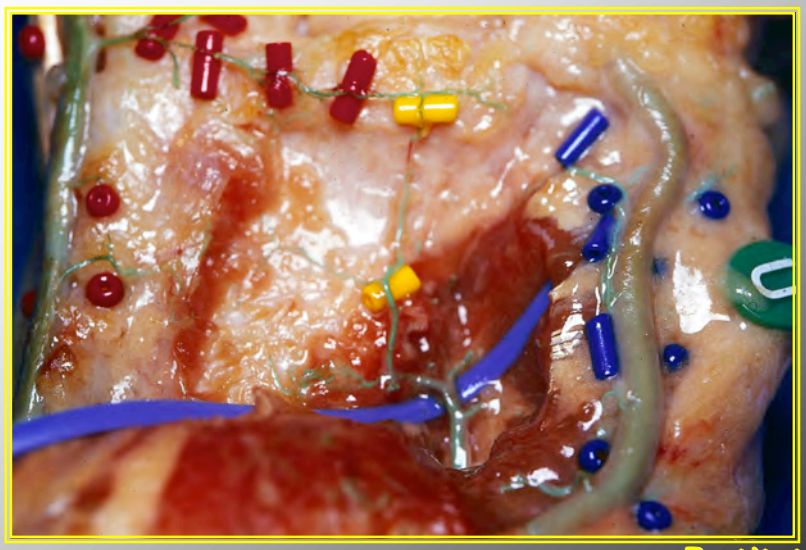
HISTORY, ANATOMY

Volar carpal artery arises from the radial artery and runs along the volar aspect of the radius

It branches on the palmar side of DRUJ forming anastomoses with a branch of interosseus artery and a branch of ulnar artery



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HISTORY, ANATOMY

Radial branch of the volar carpal artery was always predominent

Many small branches vascularize the medial part of the distal radius epiphysis

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VOLAR CARPAL ARTERY

TECHNIQUE: VASCULARIZED BONE GRAFTS FROM THE VOLAR DISTAL RADIUS TO TREAT SCAPHOID NONUNION

BY CHRISTOPHE L. MATHOULIN, MD, AND MAX HAERLE, MD

The use of vascularized bone grafts to treat scaphoid nonunion has been proposed by various investigators. We examined the blood supply to the palmar surface of the distal radius in 40 fresh cadavers that were injected with a colored latex solution and determined that the radial portion of the palmar carpal arterial arch can serve as a pedicle for vascularized grafts. Scaphoid nonunions with a humpback deformity can be corrected by harvesting a wedge of vascularized bone from the palmar cortex of the distal radius, providing easier access to the scaphoid deformity compared with the use of dorsal distal radius vascularized grafts. We also review our series of 72 patients treated by this technique.

Nonvascularized autogenous bone grafts combined with internal fixation have become the preferred treatment for scaphoid nonunions for many surgeons. In 1965 Judet and Roy-Camille[1] suggested using a bone graft harvested from the palmar aspect of the radius with a vascular supply from fibers of the pronator quadratus muscle. Braun[2] and Kawai and Yamamoto[3] reported excellent results in treating scaphoid nonunions by using this source of vascularized bone. Other vascularized grafts from the radial and dorsal aspects of the wrist and hand have been described, with similarly encouraging results.[4-11] In this review, we describe the technical aspects of the vascular supply to the palmar aspect of the radius based on cadaver dissections and report on our experience using a vascularized palmar graft in a series of patients with scaphoid nonunions.

From Institut de la Main, Paris, France.
Address reprint requests to Christophe L. Mathoulin, MD, Institut de la Main, 6 Square Jouvenet, 75016, Paris, France. E-mail: mathoulin@wanadoo.fr

1531-0914/04/0401-0004$30.00/0
doi:10.1016/j.jassh.2003.12.004

ANATOMIC BASIS FOR VOLAR VASCULARIZED BONE GRAFTS

Inspired by the work of Kuhlman et al,[12] we describe a vascularized graft harvested from the anterior aspect of the radius based on the volar carpal artery.[13] This pedicle is long enough to reach the

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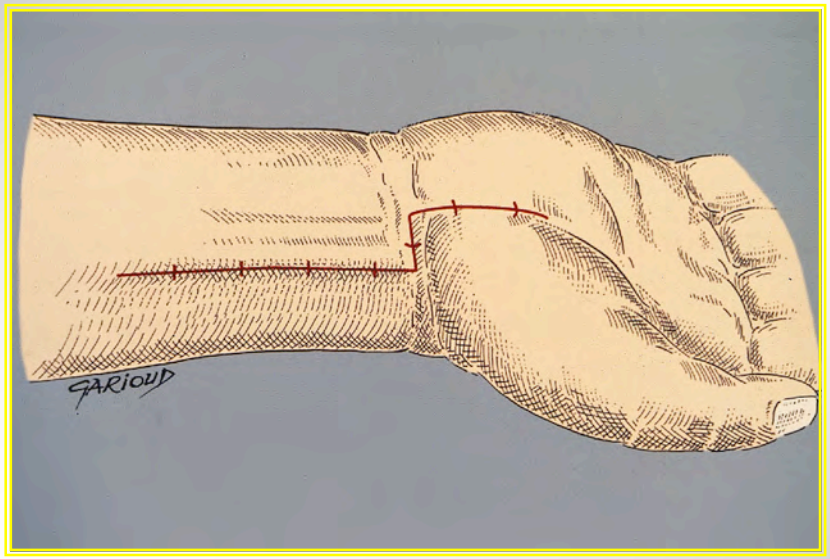
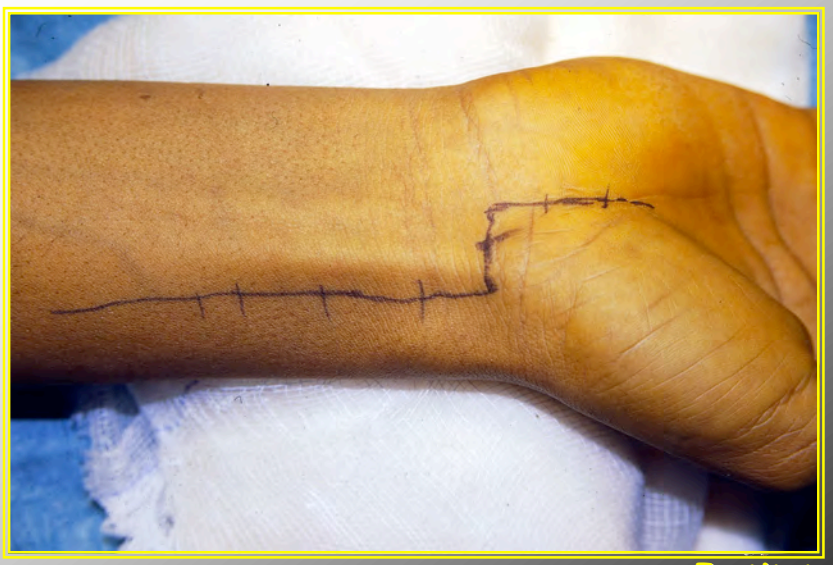
Technique

- Local-regional anaesthesia
- Tourniquet
- Outpatient surgery
- Palmar approach





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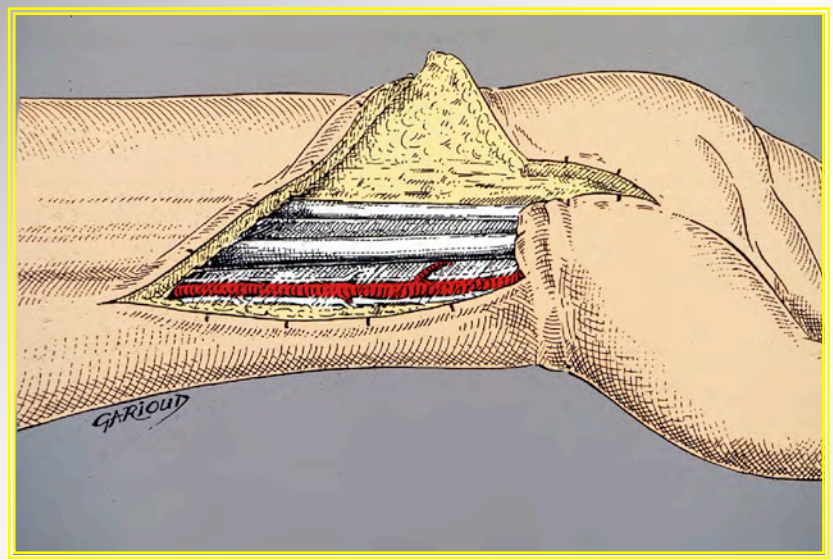
Technique

- First spotting of F.C.R. and radial artery



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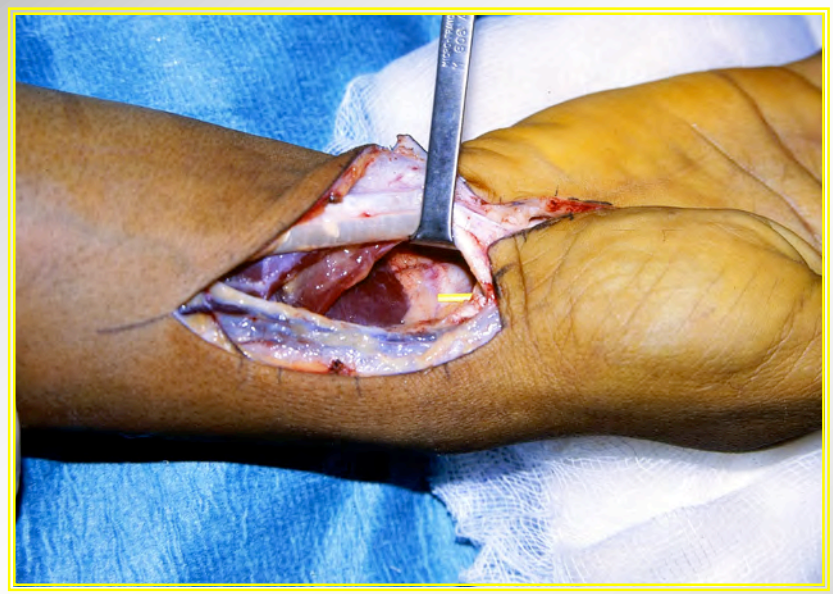
Technique

- Flexing the wrist to release tension of FCR and FPL
- Palmar carpal artery in front of and along the edge of Pronator Quadratus
- Dissection of superficial aponeurosis of PQ until periosteum



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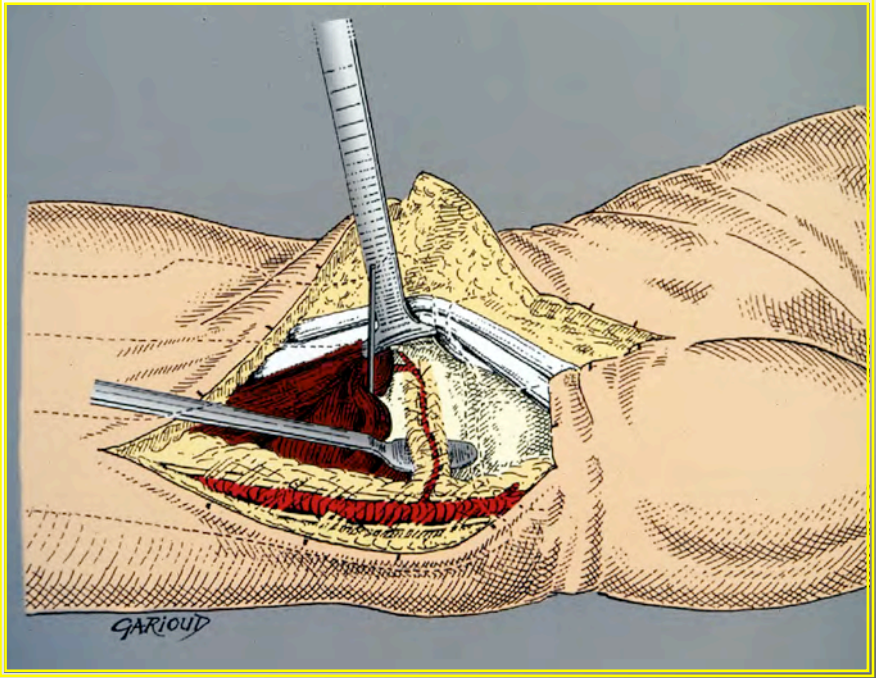
Technique

- Temporary proximal retraction of PQ
- Lateral half of pedicle subperiosteally dissected



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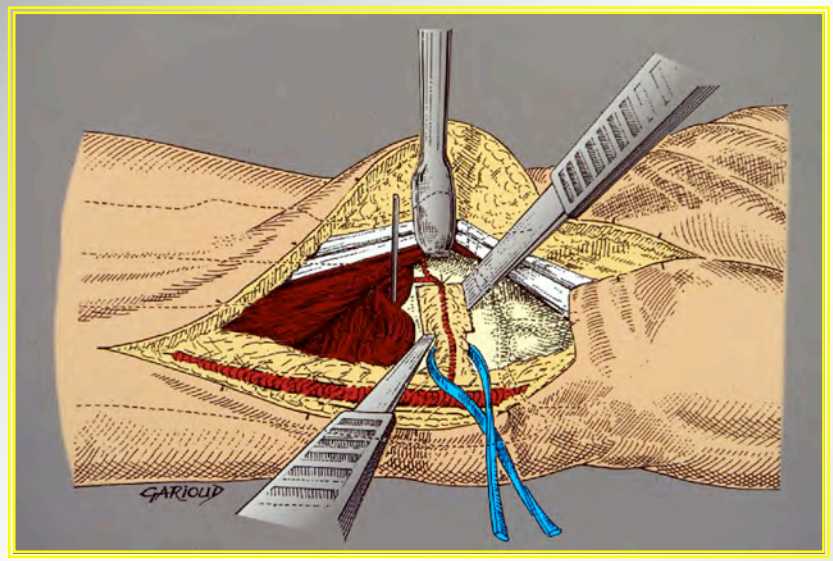
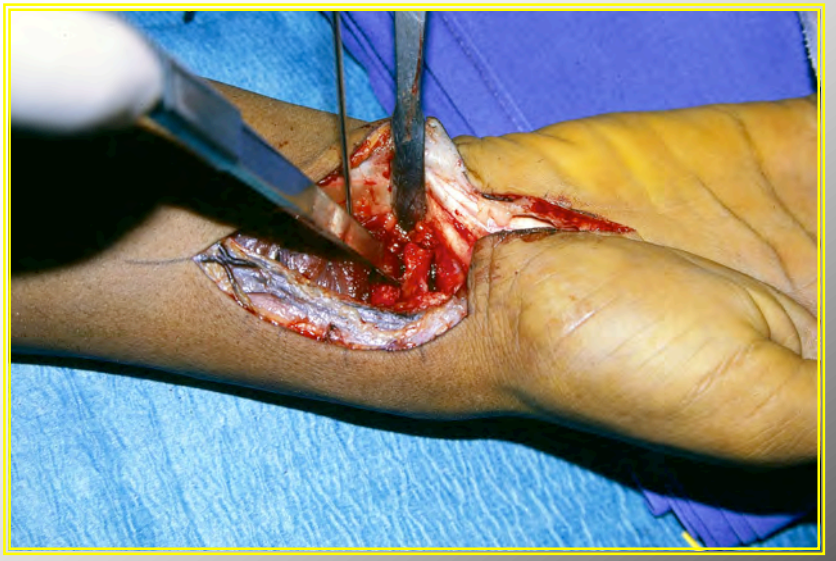
Technique

- Harvesting of graft with a chisel
- Medial half of pedicle attached to the graft was not detached





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Technique

- Harvesting of graft with a chisel
- Medial half of pedicle attached to the graft was not detached

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Technique

- Graft and pedicle were dissected back to the radial artery
- Then the tourniquet is released

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Technique

- Graft and pedicle were dissected back to the radial artery
- Then the tourniquet is released

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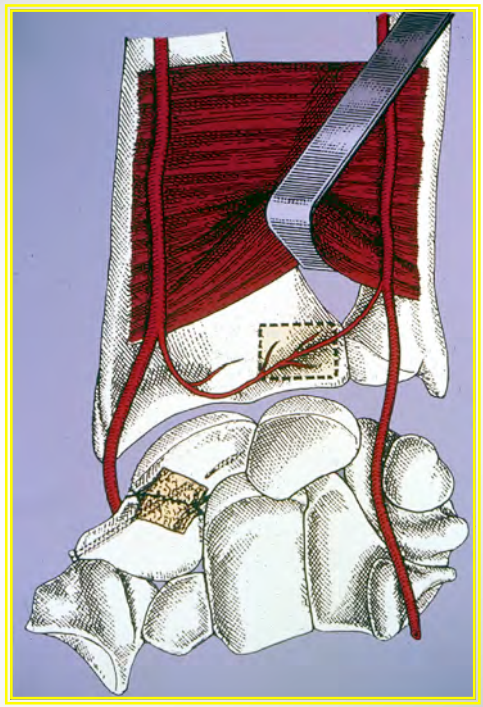
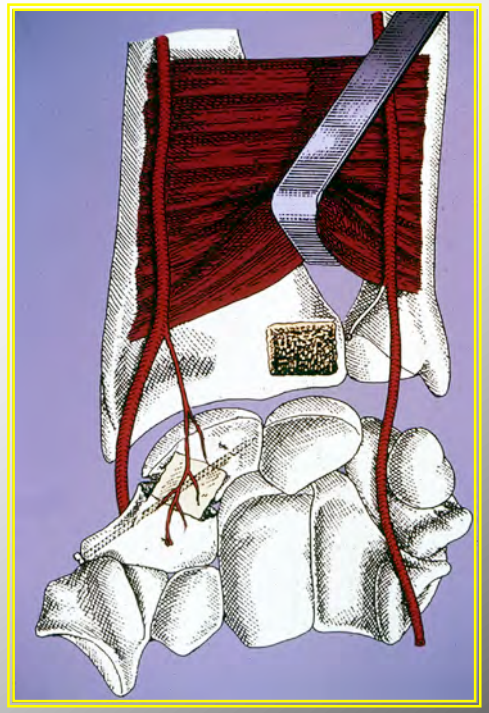
Technique

- Opening fracture site
- Freshening the bone ends
- Scaphoid osteosynthesis with screw





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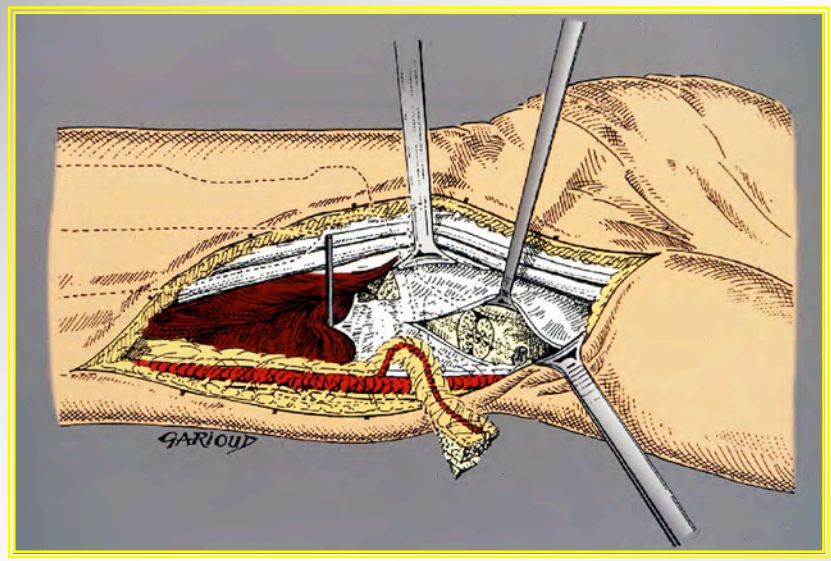
Technique

- Opening fracture site
- Freshening the bone ends
- Scaphoid osteosynthesis with screw



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Technique

- Opening fracture site
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Technique

- Opening fracture site
- Freshening the bone ends
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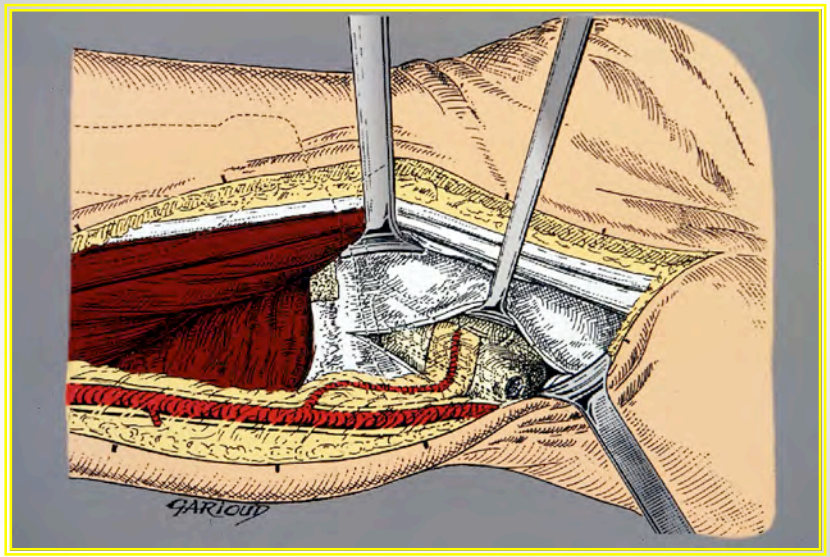
Technique

- Graft placed at the anterior site of bone loss
- Scaphoid osteosynthesis with screw
- Graft fixed by 10 mm K-wire parallel to screw



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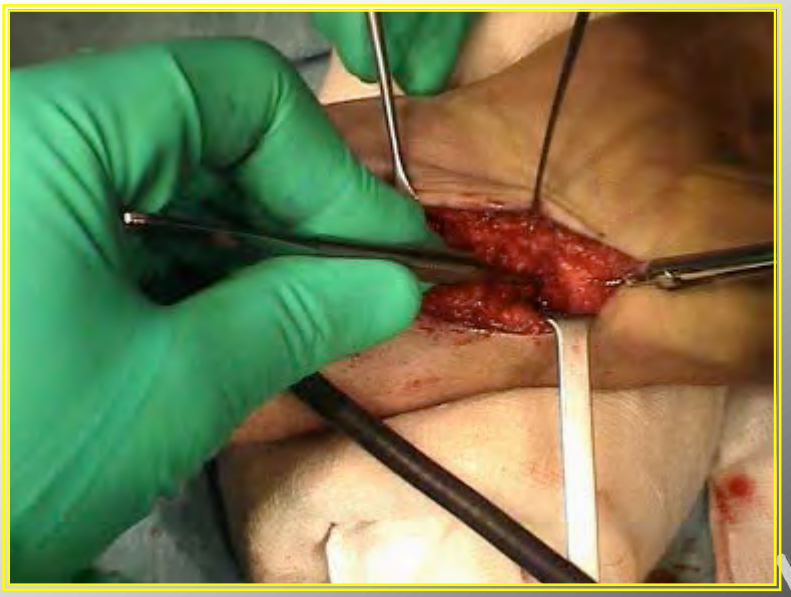

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Technique

- Graft placed at the anterior site of bone loss
- Scaphoid osteosynthesis with screw
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Technique

- Pin removal at 3 weeks
- Below elbow plaster cast until union

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Material
94 patients

20 females – 74 males

- 38 left – 56 right : 57 dominant wrists
- 45 manual workers – 49 sedentary occupation

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Material
94 patients

- Mean age at surgery : 31,4 y.o. (18-63)
- Mean delay before surgery : 23 months
- Mean follow-up : 42 months (10-117)

8 years of follow-up

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Material
94 patients

- 81 waist fractures
- 13 proximal third fractures

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Material

Previous surgery: 31 patients

- 18 patients had an iliac bone grafting procedure
- 2 patients had two previous grafting procedures
- 16 patients had an osteosynthesis

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Alnot's Staging

1 :	linear pseudarthrosis	
2A :	slight bone resorption	42
2B :	palmar flexion, DISI	47
3A :	+ radio-scaphoid arthritis	5
3B :	+ radio-carpal arthritis	

		87

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Clinical case

Stage IIB

Adaptative DISI

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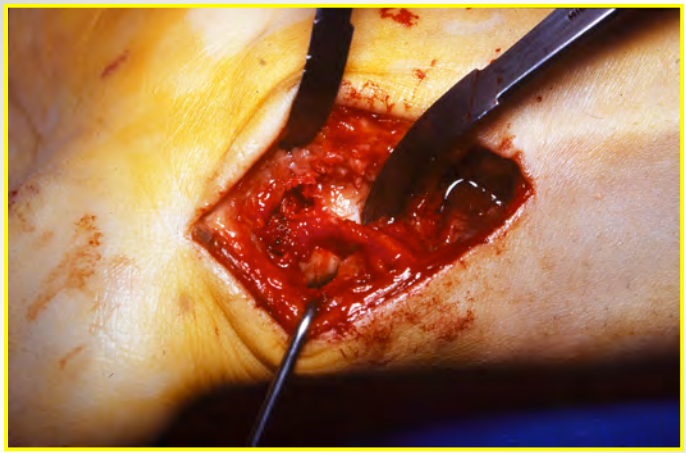
Clinical case



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Clinical case

D + 21

D + 45

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Clinical case

D + 6 months

No DISI

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Results union

- **Time to union : 8.3 weeks (6-24 w) [without one case (24w) : 6.5 w]**

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Results

Range of motion

- Increase in mean flexion : 45° ➡ 58°
- Increase in mean extension : 54° ➡ 67°

Grip strength

- 52% ➡ 90% of controlateral wrist

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Complications

- **Südeck's dystrophy : 3**
- **Stiffness : 3**
- **Nonunion : 6**

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Complications

D+1

D+90

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Results

Mayo wrist score

Excellent	54
Good	27
Fair	9
Poor	4

	94

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Clinical case

Stage IIB

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Clinical case

Adaptative DISI

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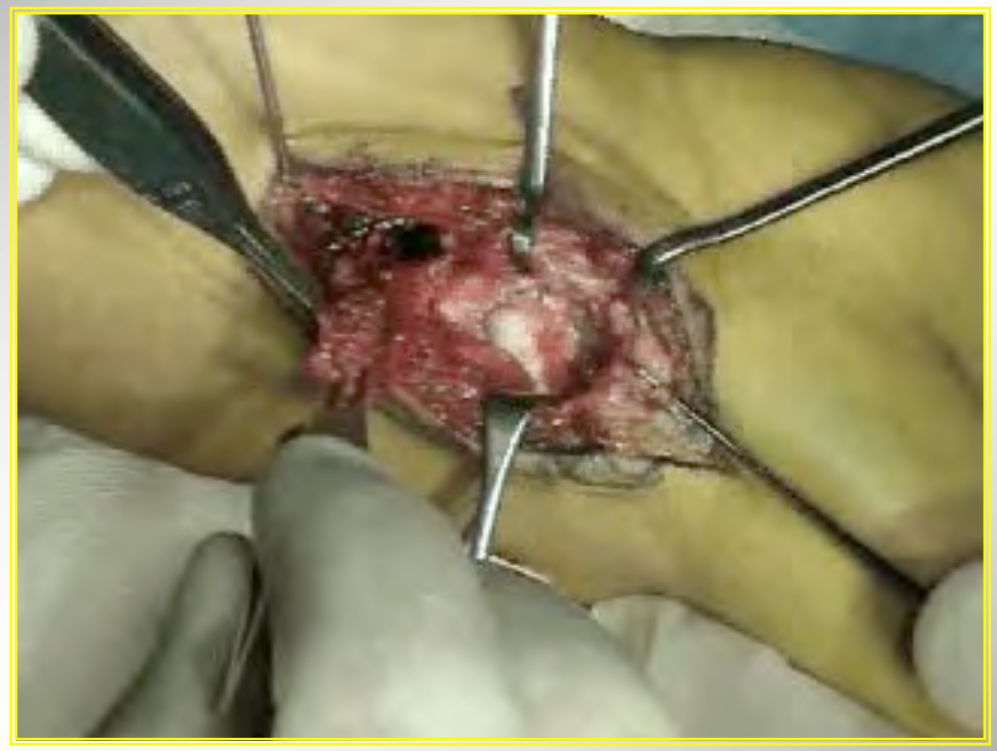
Clinical case



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Clinical case

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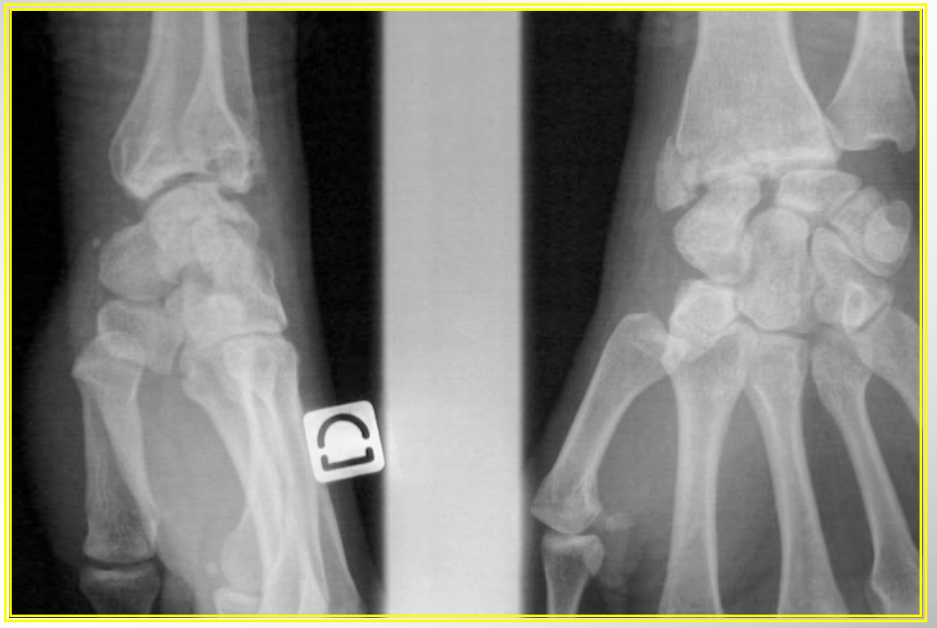
Clinical case



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Subjective results

- Satisfied without reservations : 64 patients
- Satisfied with some reservations : 27 patients
- Not satisfied : 3 patients

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Statistical analysis

Outcome was significantly related to

- **Age (better outcome in younger patients)**
- **Alnot's stage**
- **Occupation (better outcome in sedentary patients)**
- **Delay surgery (better outcome if small delay)**

Outcome was not related to :

- **Pseudarthrosis location**
- **Previous surgery**

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Clinical case

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Clinical case

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Clinical case

Conclusion 1

93 % union in 7 weeks

97 % satisfied patients

89 % excellent or good results

Vascularized bone graft give good union in short delay, even in failure of previous surgery

Palmar approach is enough simple to be recommanded as primary treatment of scaphoid nonunion

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IInd Metacarpal

- Brunelli 1988
- Mathoulin, Brunelli, Saffar 1992

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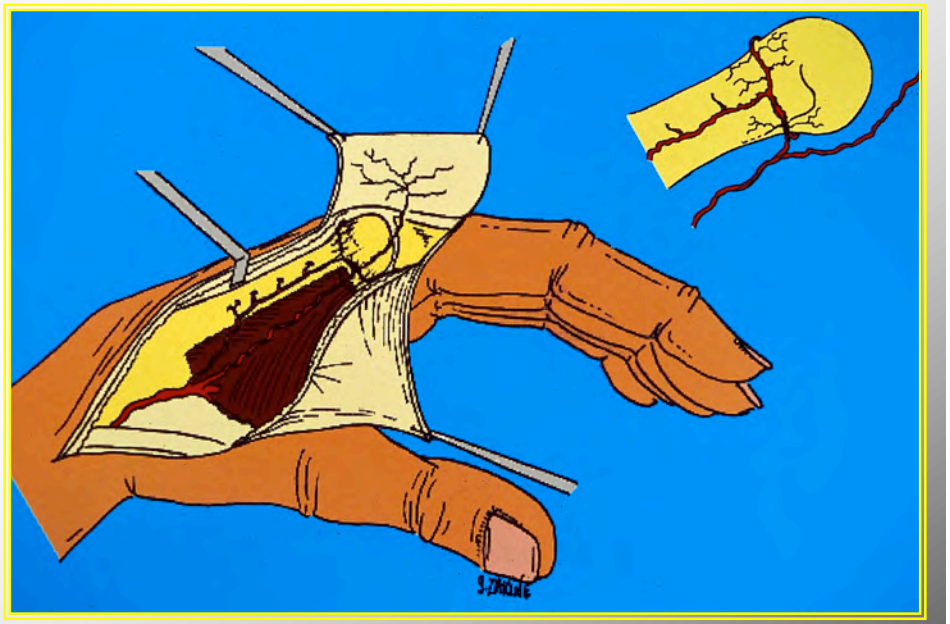
Technique

- 2 approaches dorsal and palmar
- Scaphoid reconstruction (palmar)
- Bone graft harvesting (dorsal)
- Graft is filled in scaphoid bone loss



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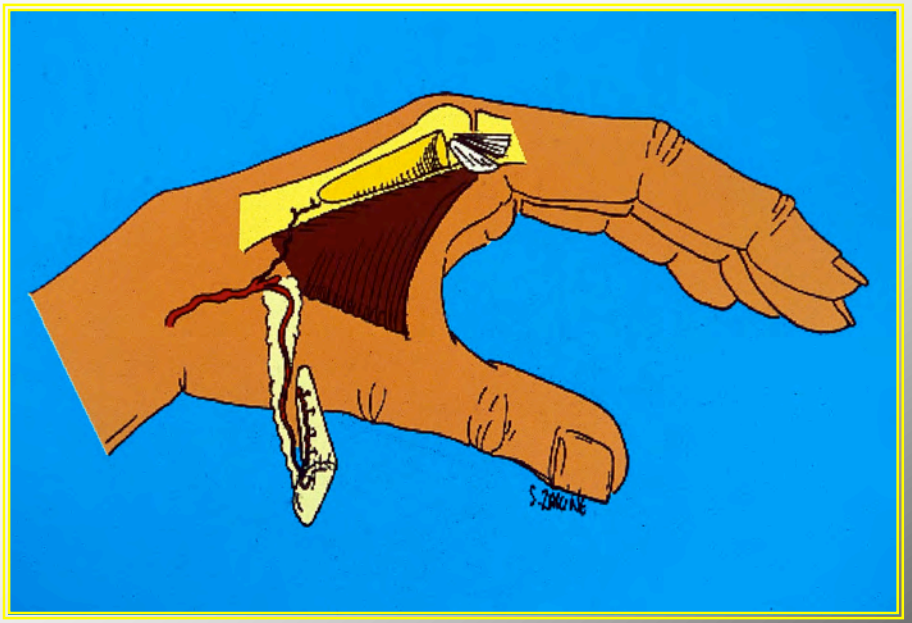

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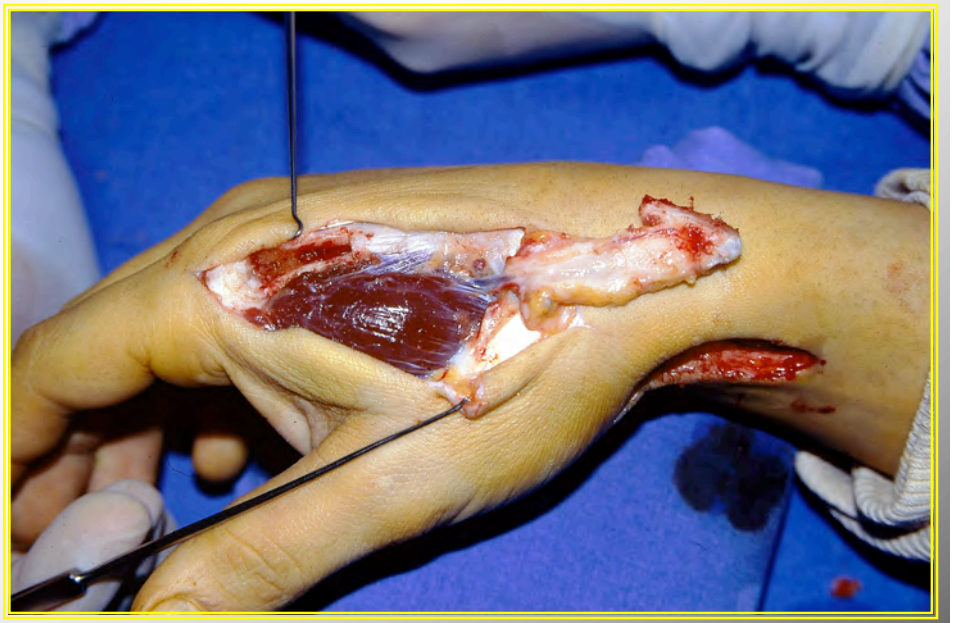

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Technique

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Material

- 17 patients (1988-1999)
- 10 males 7 females
- Mean age : 34 y.o. (26 - 44)

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Material

- Always waist fractures
- Number of previous surgery : 2 (range 1 to 6)

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Union

- Union obtained in 16 cases (1 failure)
- Average delay of union : 3 months (range 2 to 6 months)

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Results : pain

Average follow-up : 7.6 y (range 2 to 13 y)

- **No pain : 10**
- **Climatic : 6**
- **Permanent tolérable : 1**
- **Incapacitating : 0**

FLEXION-EXTENSION

- **> 120° : 12**
- **60° to 120° : 5**
- **< 60° : 0**

PRONO-SUPINATION

- **> 120° : 15**
- **60° to 120° : 2**
- **< 60° : 0**

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Complications

- No problem with IInd métacarpal
- Radio-scaphoid arthritis : 2 cases
- Lesion of radial nerve : 2 cases
- Secondary fracture : 1 case

Clinical case

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Clinical case

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Clinical case

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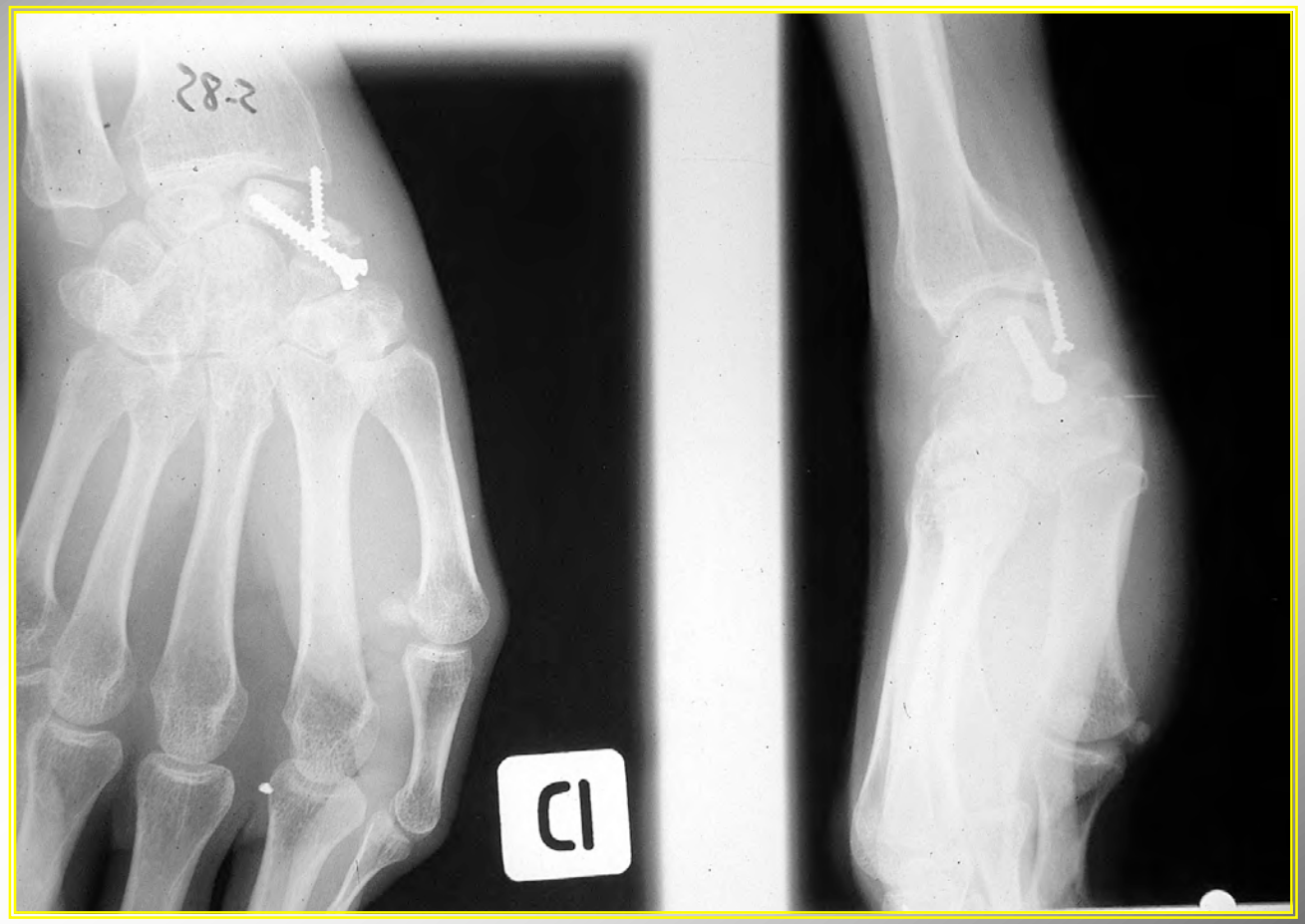
Clinical case



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Clinical case

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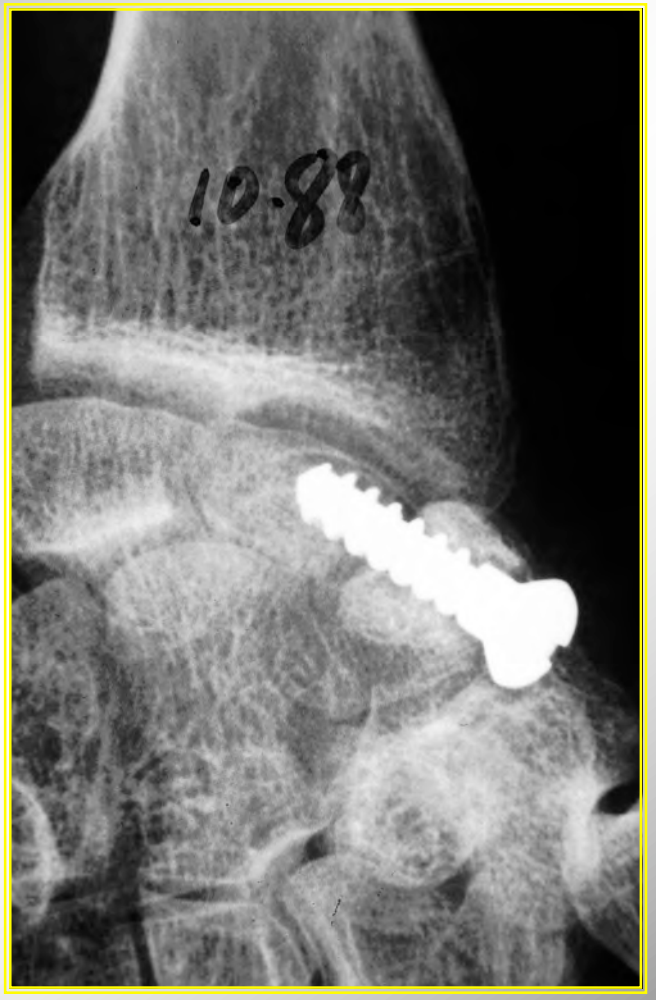

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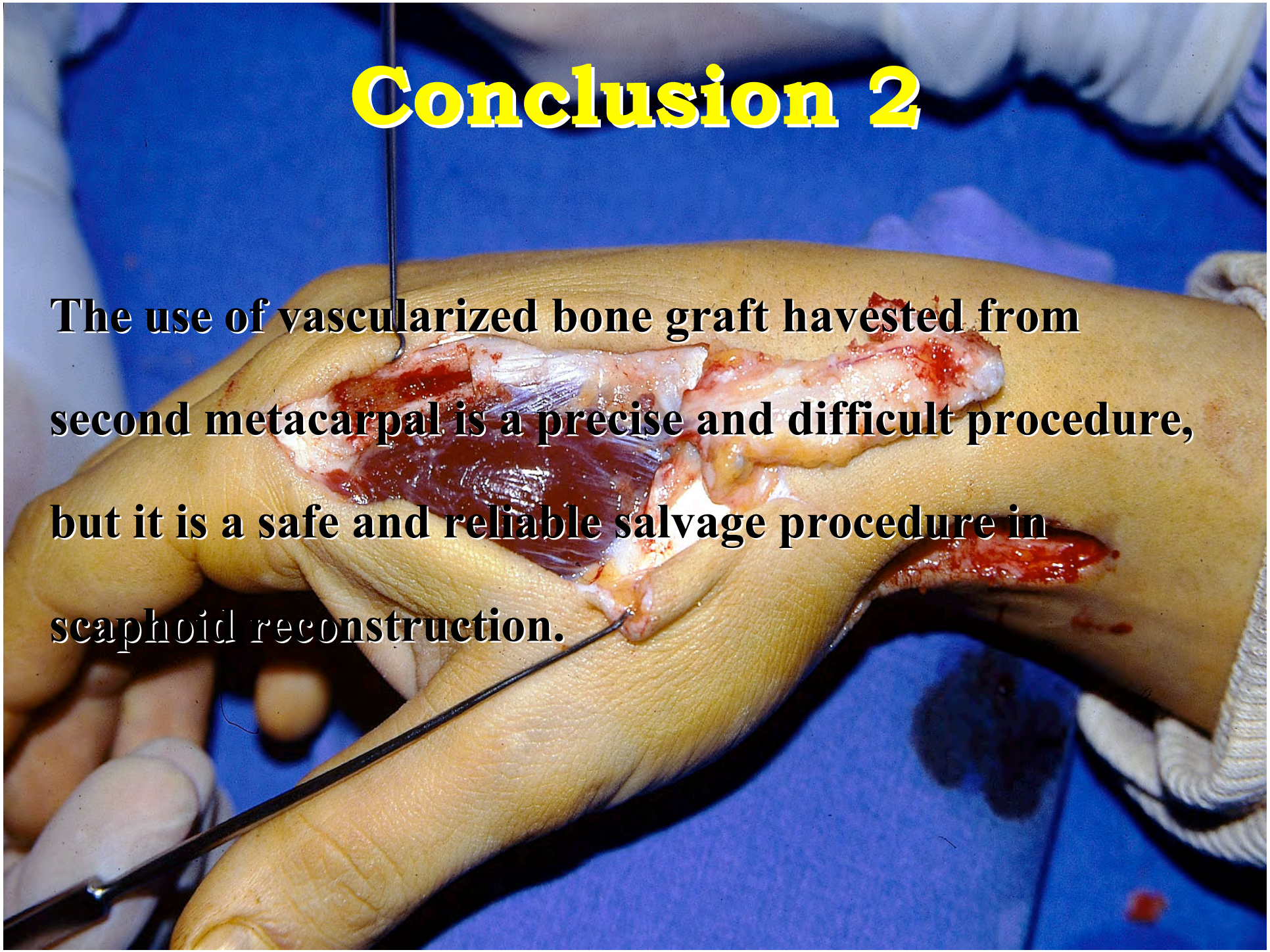

Conclusion 2

The use of vascularized bone graft havested from second metacarpal is a precise and difficult procedure, but it is a safe and reliable salvage procedure in scaphoid reconstruction.

Conclusion

STAGE 1 Alnot, D1 Herbert: Percutaneous fixation

STAGE 2A Al., D2 Herb. : Matti-Russe grafting…

STAGE 2BAl., D3 Herb. : Anterior wedge grafting

STAGE D4 Herbert : Vascularized bone graft

MAIS !!!!!

STAGE 1, D1 : Vissage percutané sous arthroscopie

Tous les autres : Greffe vascularisée antérieure

LE PLUS TOT POSSIBLE

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