

# GESCHICHTE der KREUZBANDCHIRURGIE im ALPINEN SCHISPORT

**K.P. BENEDETTO**



Abteilung für Unfallchirurgie  
und Sporttraumatologie  
Akad. Lehrkrankenhaus  
Feldkirch / Austria

The farther back you can look  
the farther forward you can see

Winston Churchill



Das NIVEAU der OPERATIVEN TECHNIK  
in der CHIRURGIE ist von  
zwei FAKTOREN abhängig

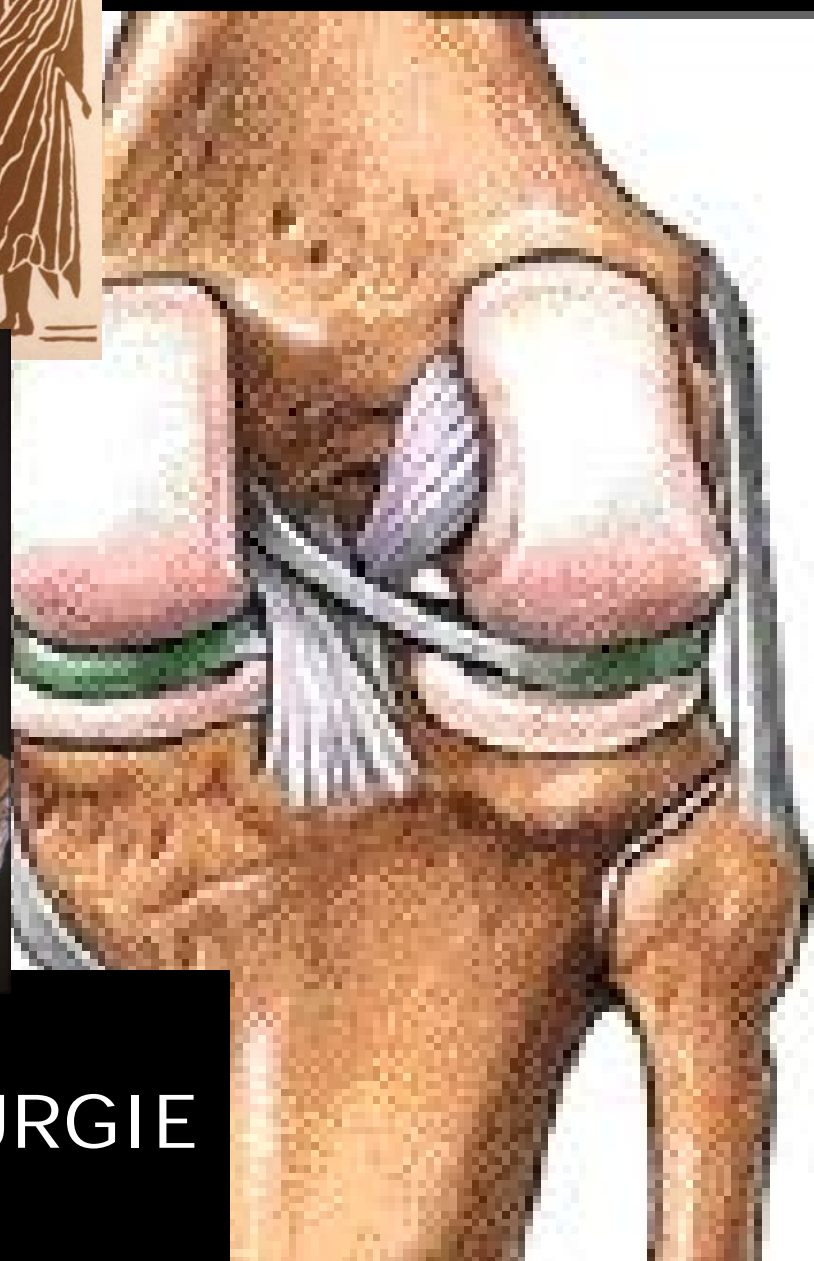
WISSEN der OBJEKTIVEN  
WISSENSCHAFTLICHEN ERKENNTNIS

STAND und dem ZUGANG des  
APPARATIVEN und INSTRUMENTELLEN  
EQUIPMENTS



WAS HAT

SICH GEÄNDERT ?



BANDCHIRURGIE



DESKRIPTIVE ANATOMIE

versus

FUNKTIONELLE ANATOMIE

1970 -- 1985

2005 -- 2015

# The crucial ligaments of the knee joint: their function, rupture and the operative treatment of the same

Hey-Groves EW

J Bone Joint Surg 1920

## The anterior cruciate ligament. A functional analysis based on postmortem studies

Furman W et al.

J Bone Joint Surg 1976

## The cruciate ligaments of the knee joint. Anatomical, functional and experimental analysis

Girgis FG et al.

Clin Orthop 1975

## Verletzung und Spannung von Kreuzbändern

Hertel P

Hefte Unfallheilkd 1980

# MENSCHIK A.

- MECHANICS of the KNEE JOINT I  
Z Orthopädie und Grenzgebiete 1974
- MECHANICS of the KNEE JOINT II - the Final  
ROTATION  
Z Orthopädie und Grenzgebiete 1975
- KINEMATICS of the KNEE JOINT and Guidelines  
for a GENERAL RECONSTRUCTION  
Hefte Unfallheilkunde 1975



# EXTRAARTICULÄRE REKONSTRUKTIONSVERFAHREN

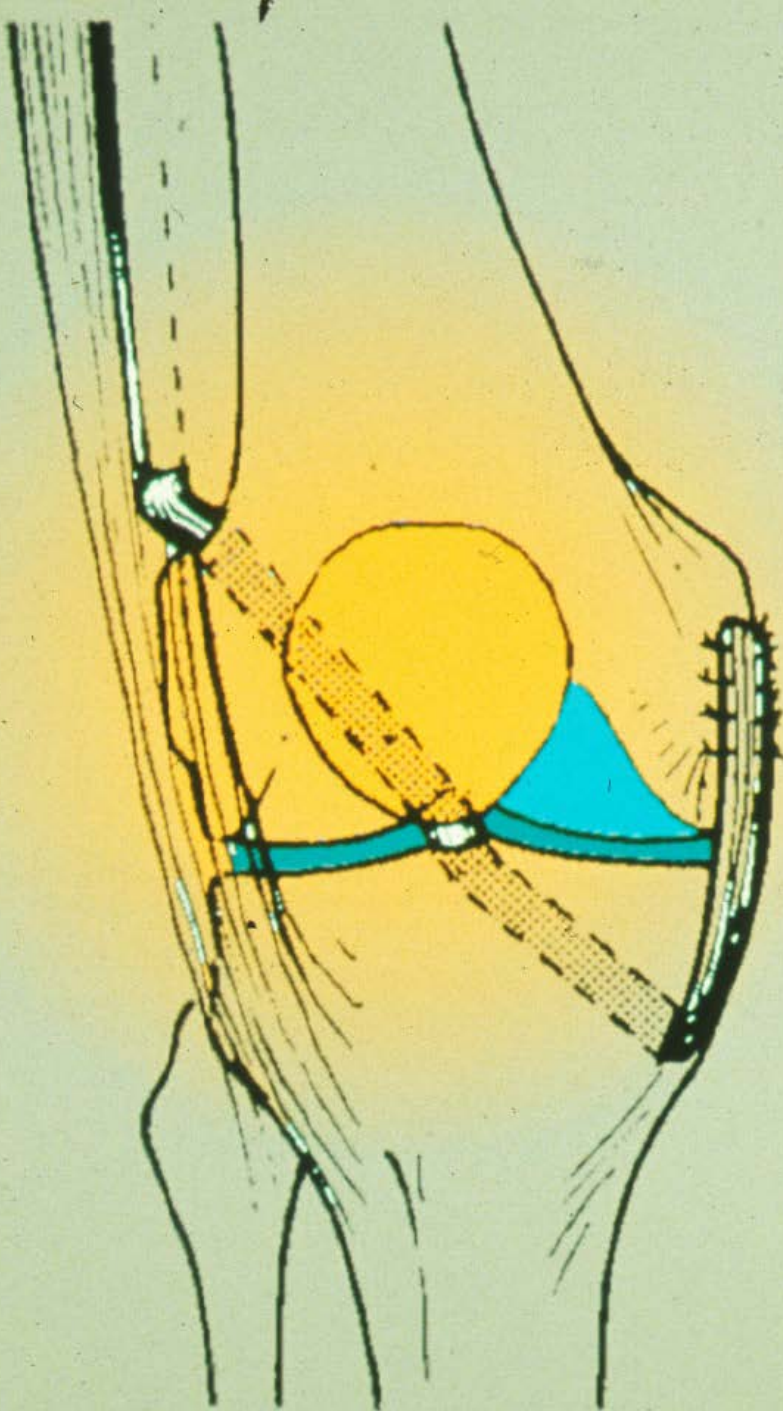
1980



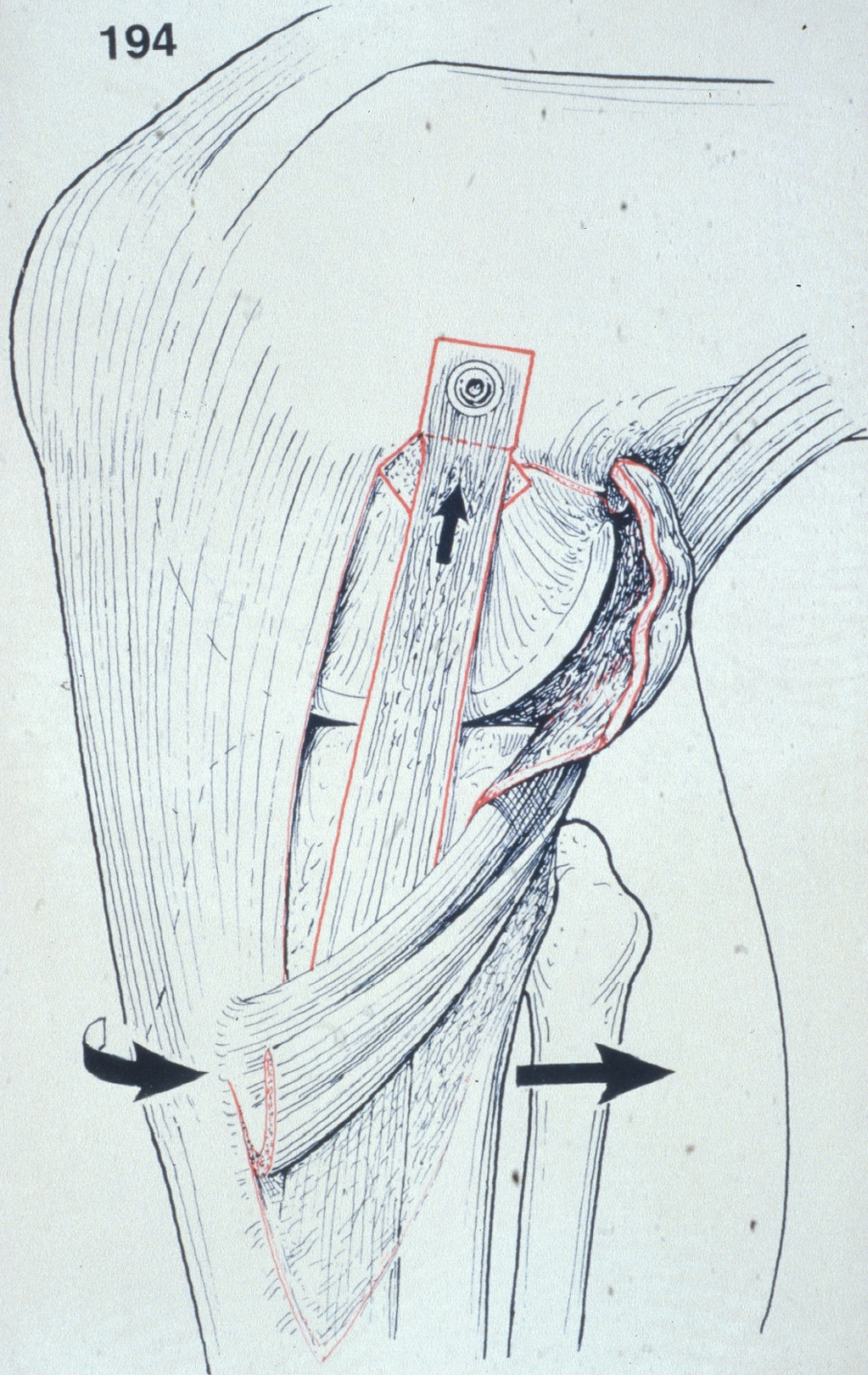
# INTRAARTICULÄRE REKONSTRUKTIONSVERFAHREN



1980



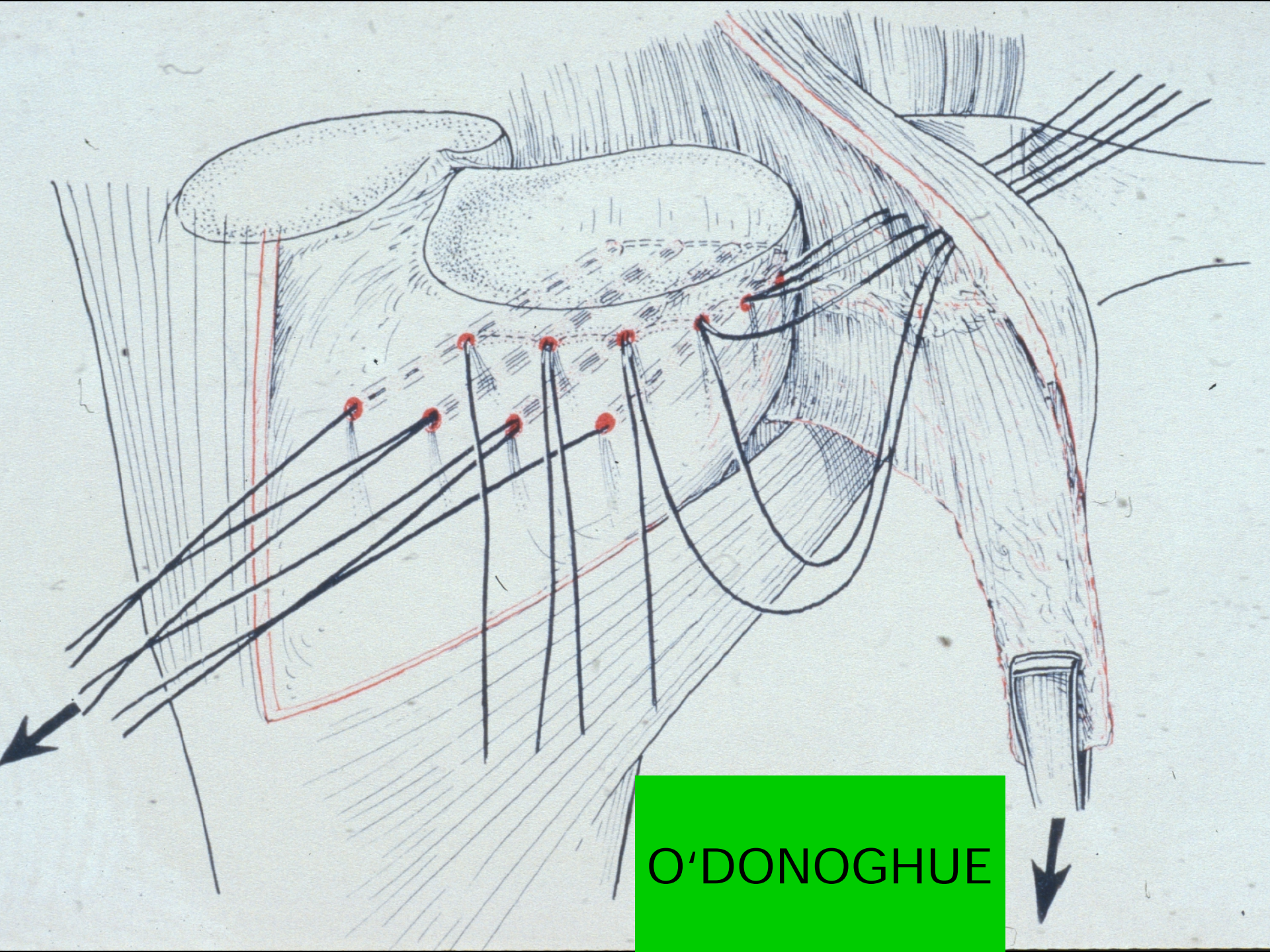
HEY -GROVES



NICHOLAS

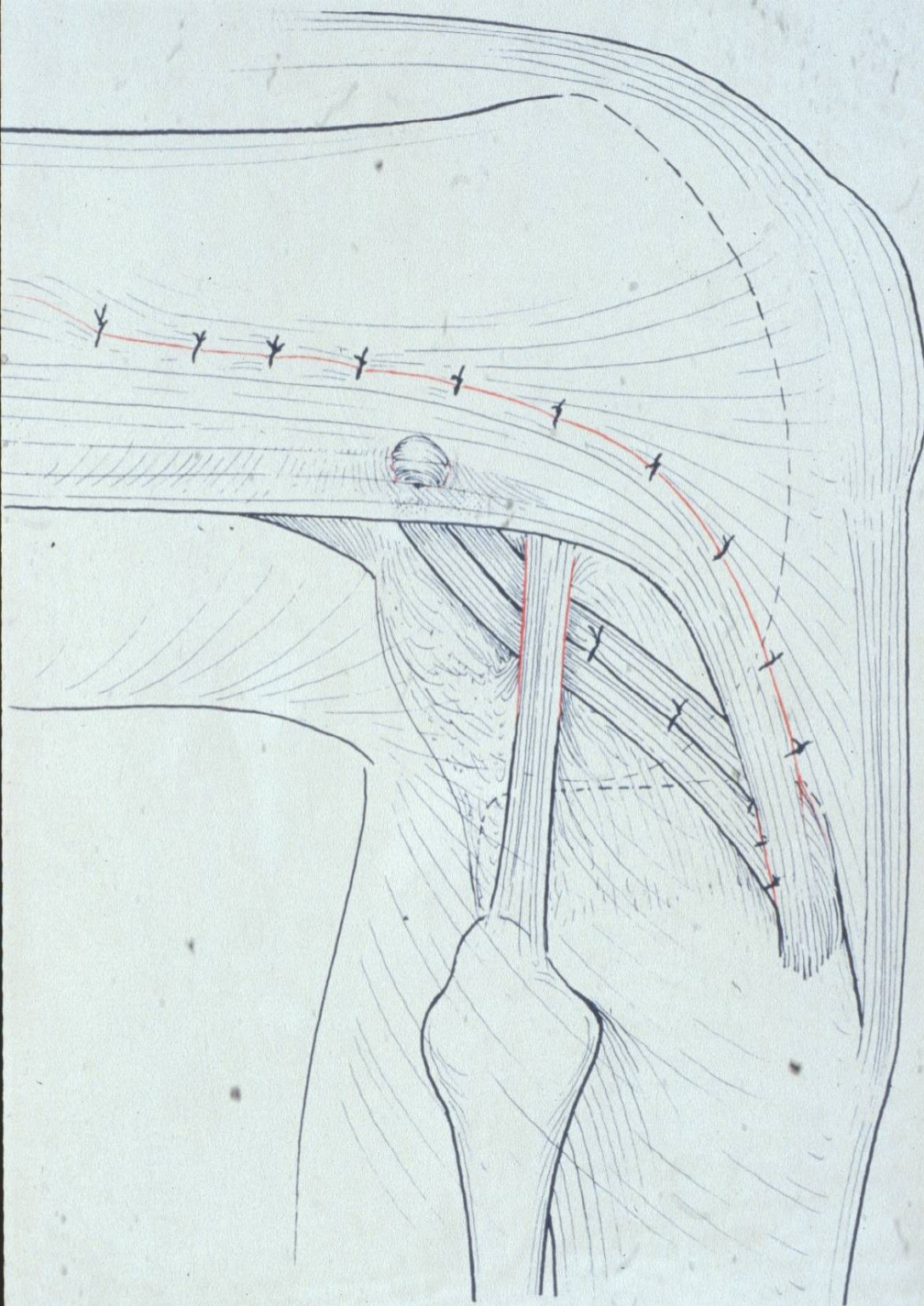
5 ONE PROCEDURE





O'DONOGHUE



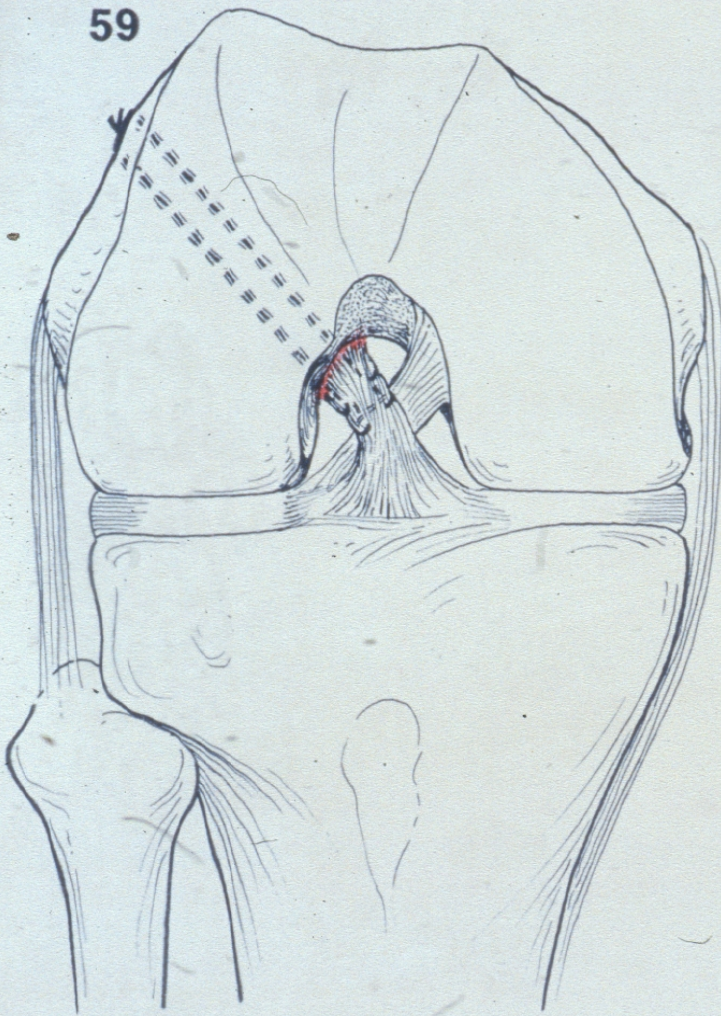


# LATERALE TENODESE

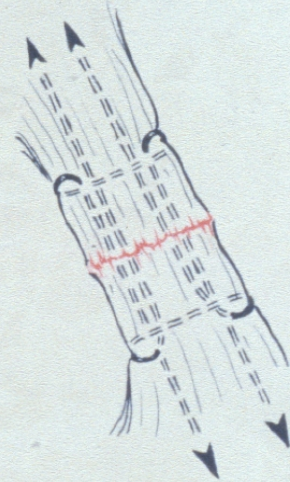
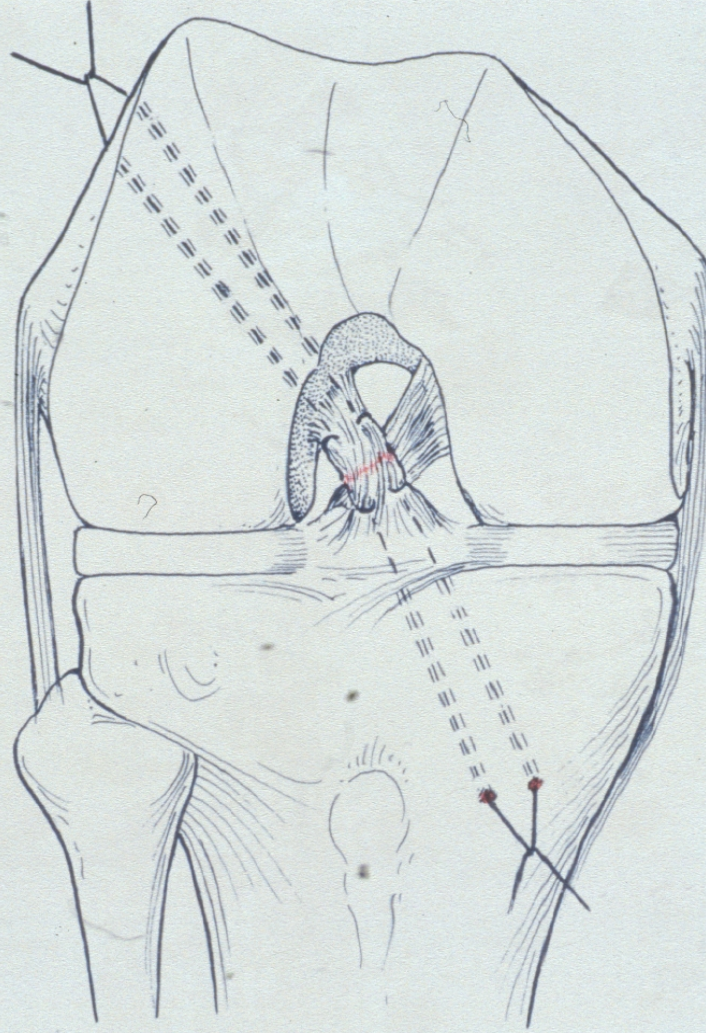
LOSEE R.  
ANDREWS-HUGHSTON  
LEMAIRE  
WIRTH



59



60

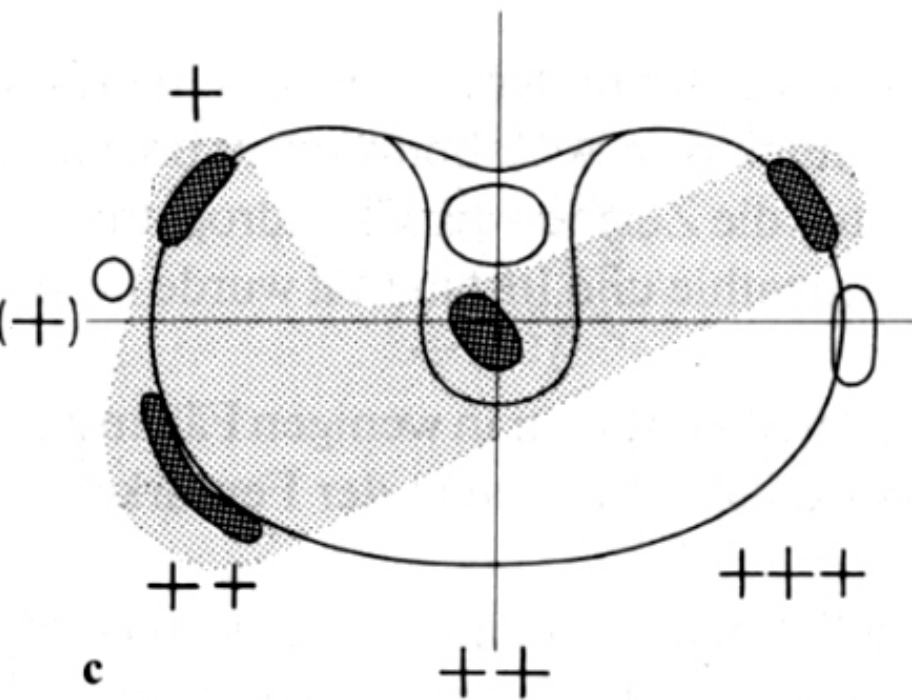


EXTRARTICULÄRE FESSELUNSPLASTIKEN →

→ INTRAARTICULÄRE „ANATOMIEGERECHTE  
REKONSTRUKTIONEN“

MÜLLER .W





Werner Müller

# Das Knie

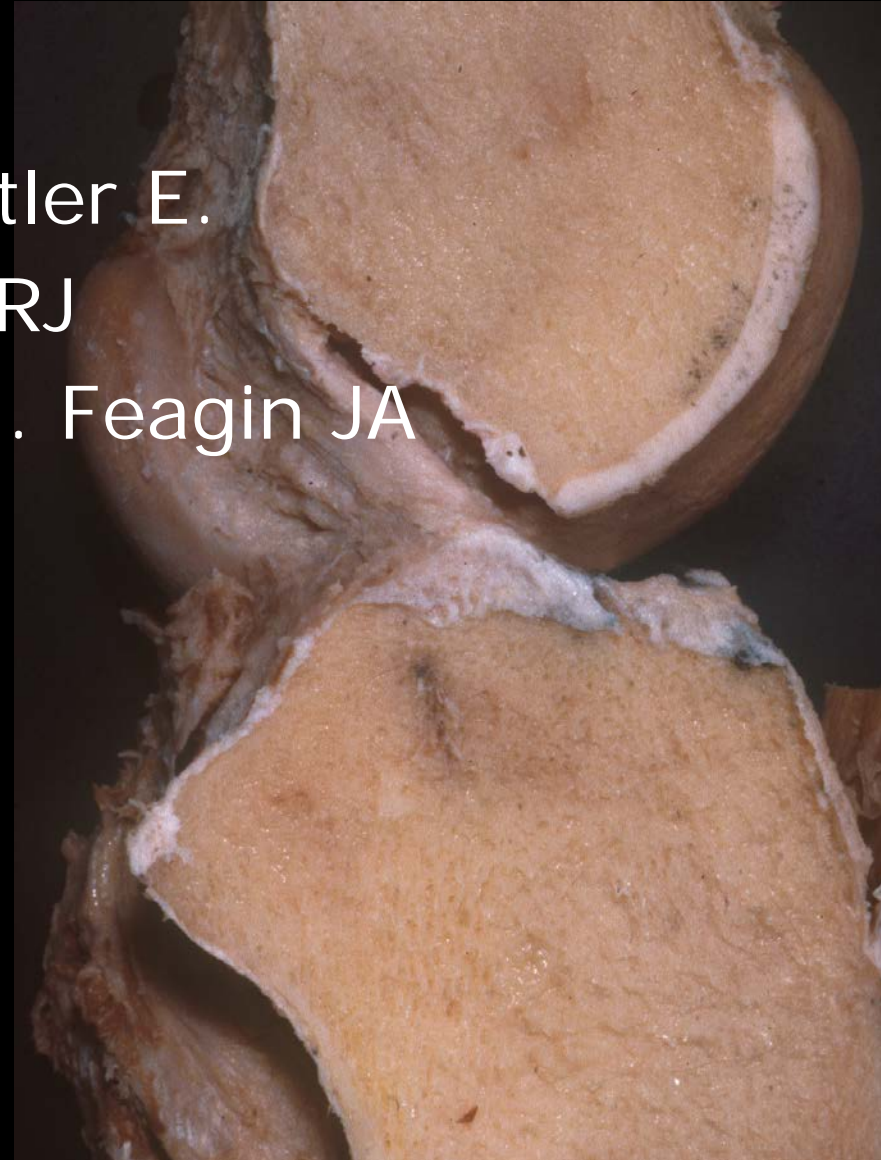
Form, Funktion und  
ligamentäre Wiederherstellungschirurgie



Springer-Verlag  
Berlin Heidelberg  
New York

# ANATOMY FUNCTION and STRENGTH of KNEE LIGAMENTS

- Noyes F. Grood E. Butler E.
- Kennedy JC Hawkins RJ
- Cabaud E. Rodkey WG. Feagin JA
- Woo SY
- Claes L.
- Amis A
- Hertel P
- Golano P
- Fu F



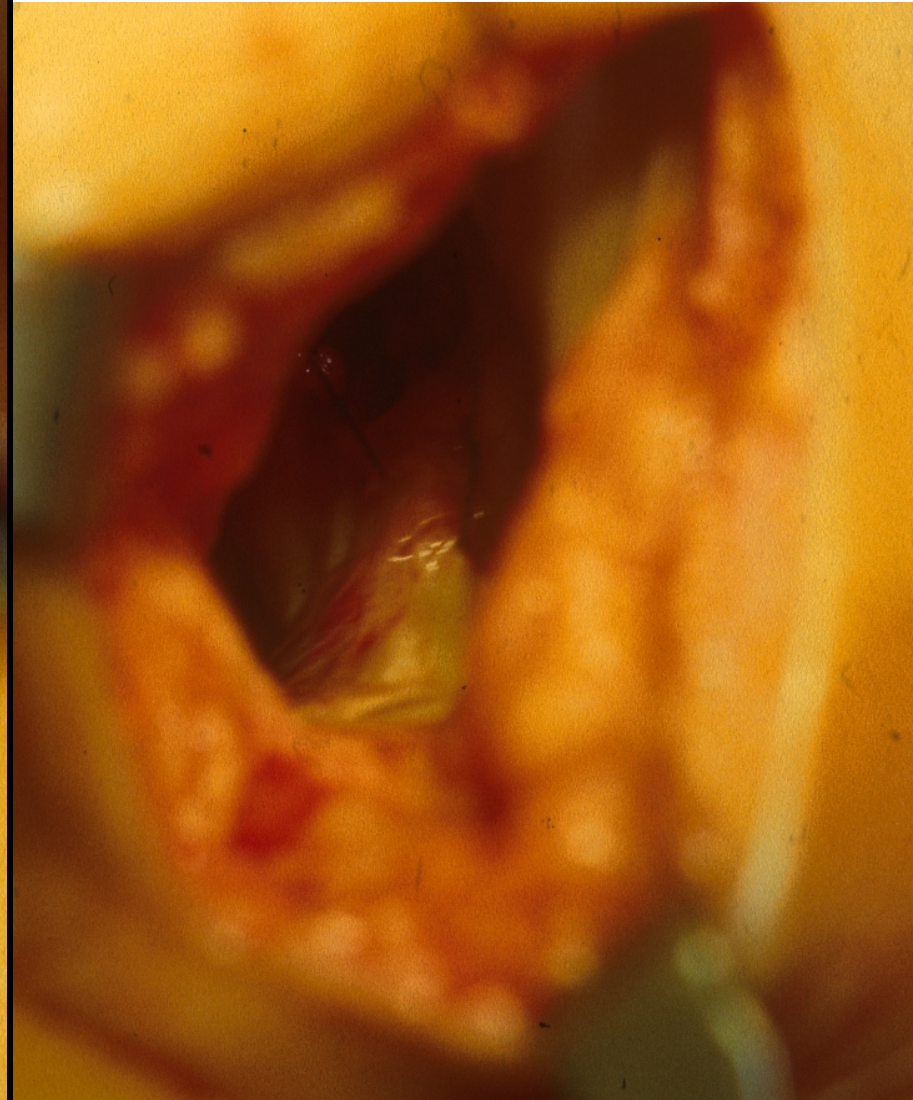
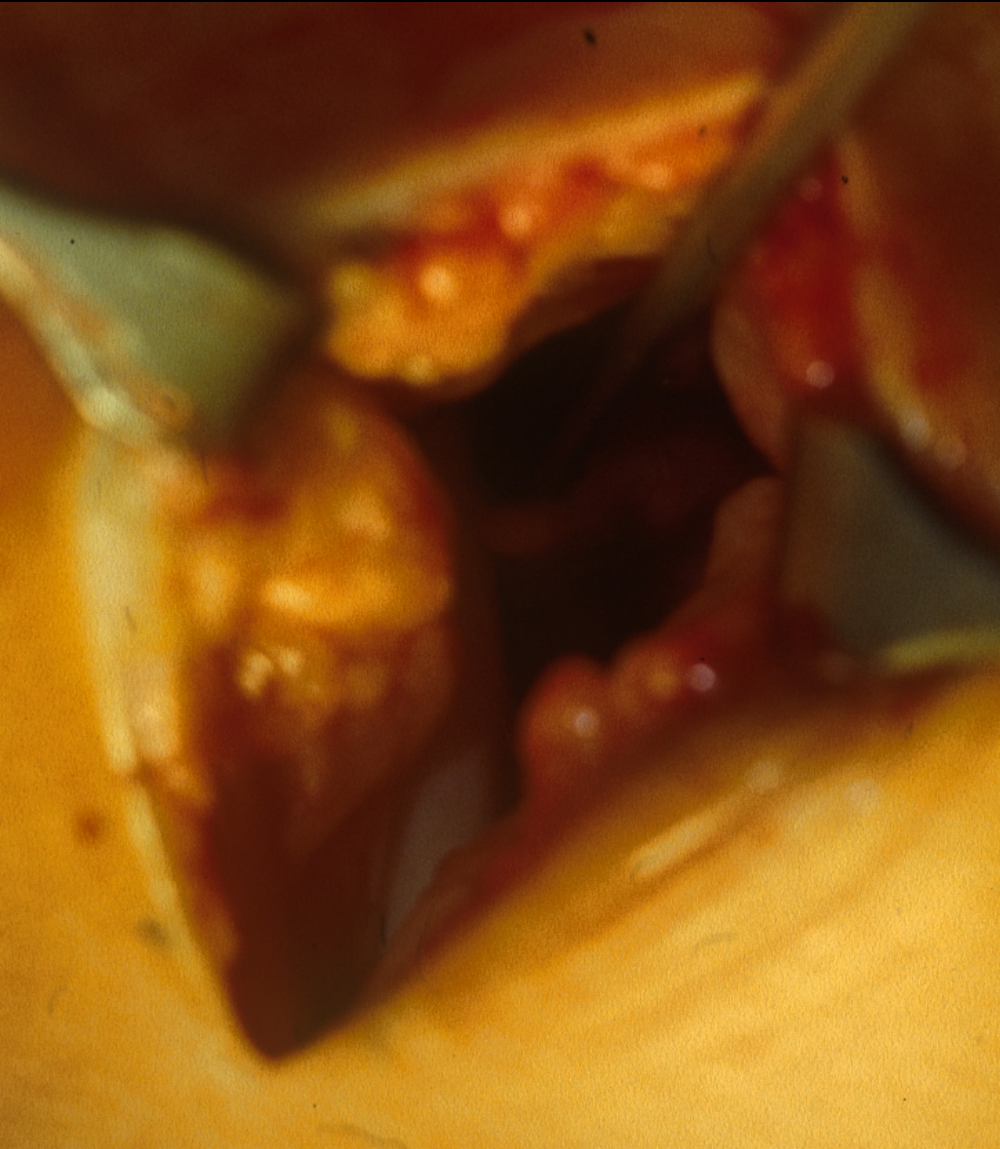


# PRIMÄRE NAHT 1970 - 1980

FEAGIN J.R.

MÜLLER W .

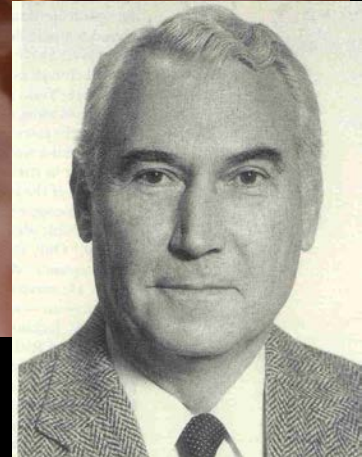
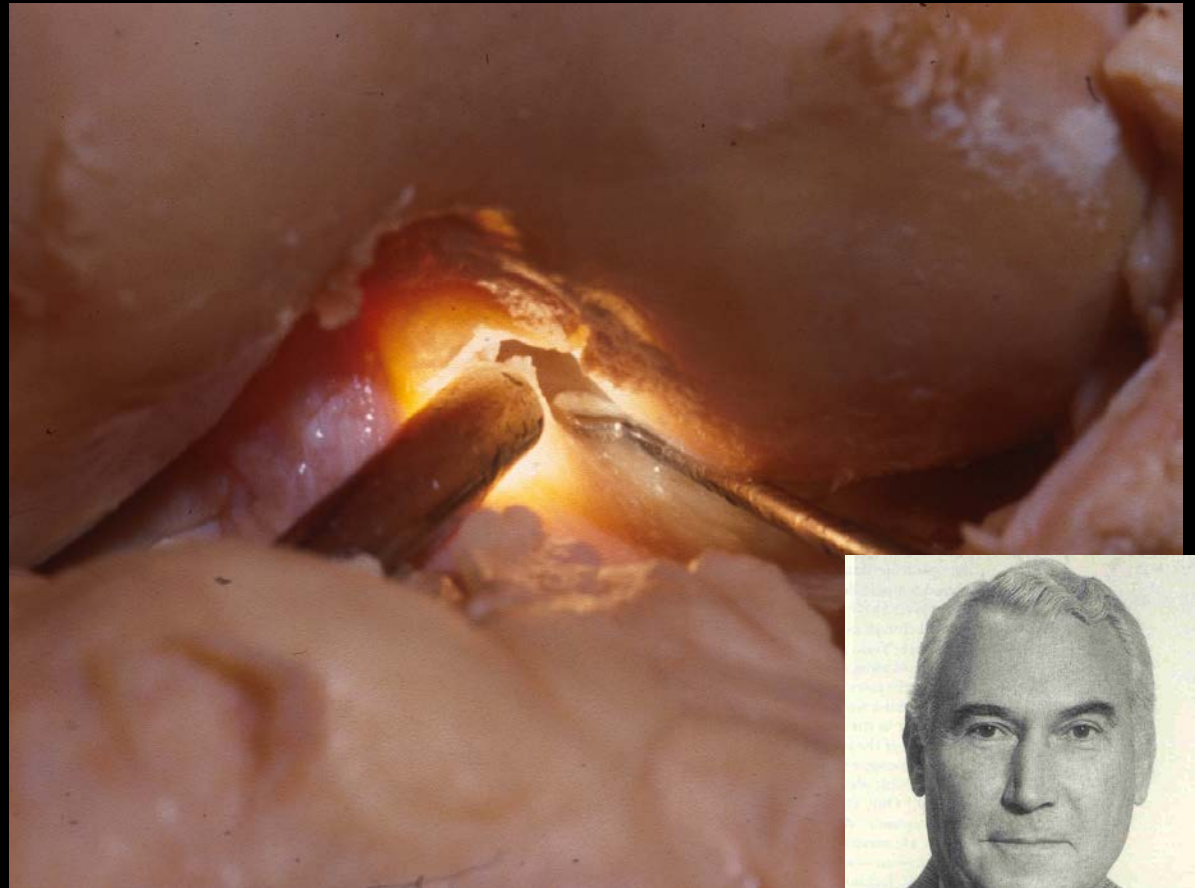
TRILLAT A. (LYONAISE KNEE  
SCHOOL )



# ENTWICKLUNG der ARTHROSKOPIE



- EUGEN BIRCHER
- WATANABE
- MCGINTY
- JACKSON R
- ERIKKSON E
- WRUHS O
- HENCHE H – R
- GLINZ W
- KIESER Ch

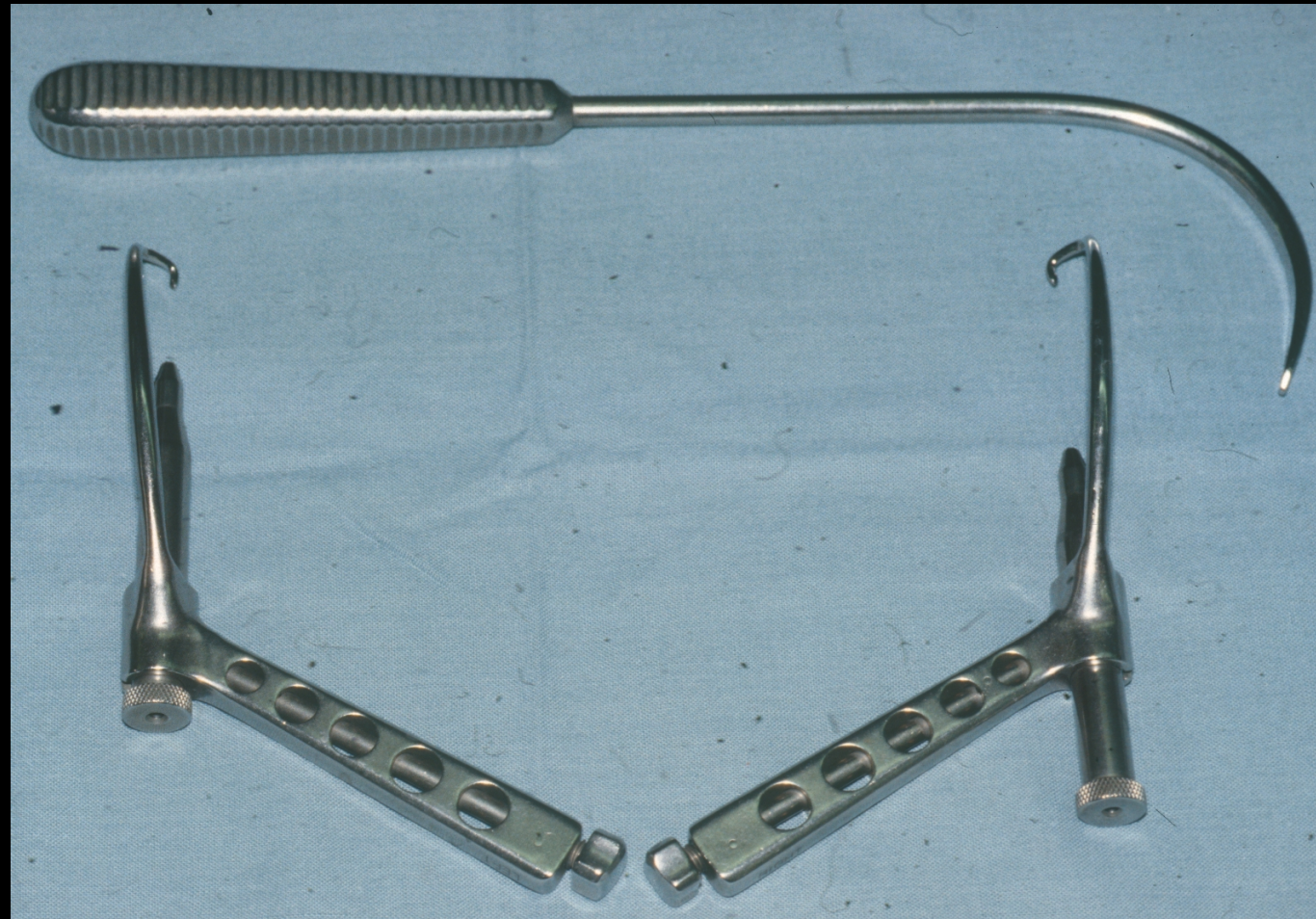




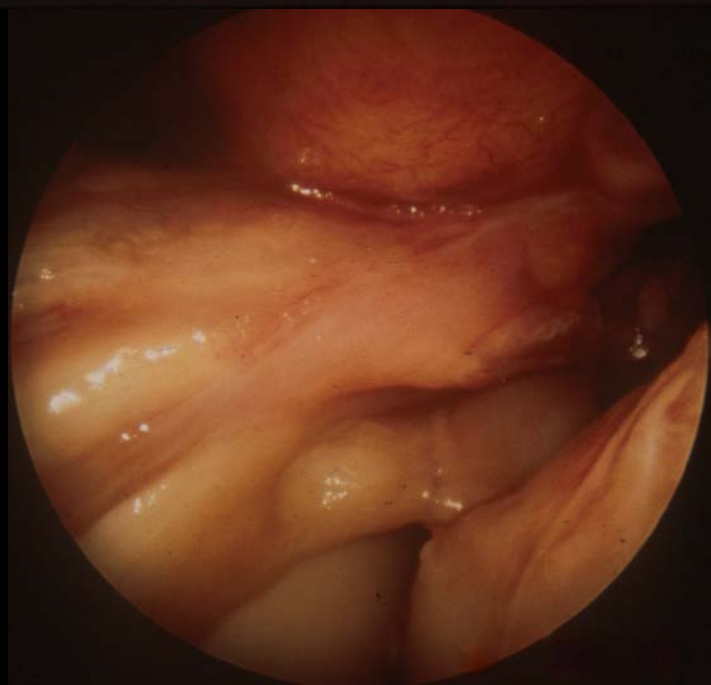
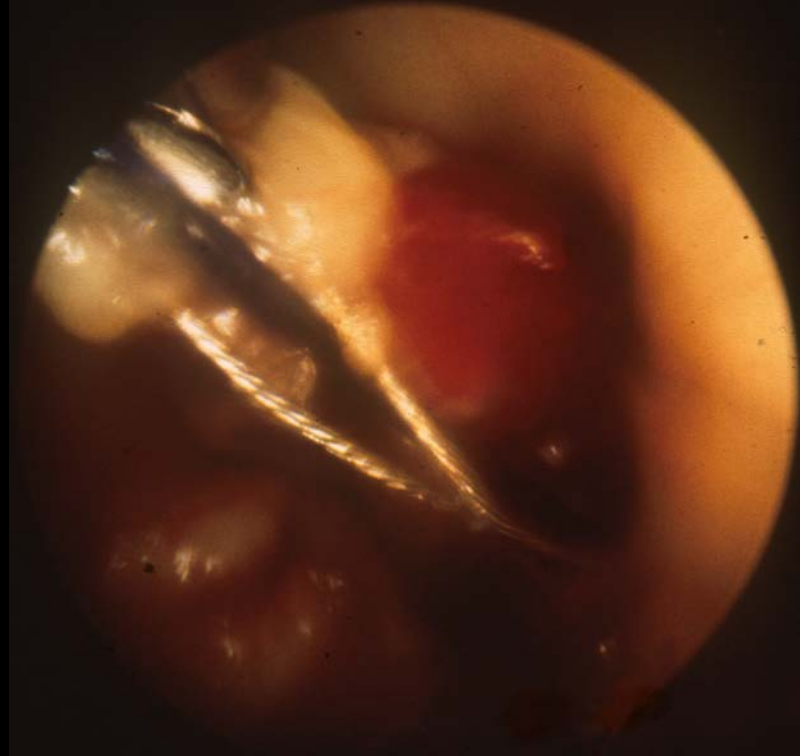
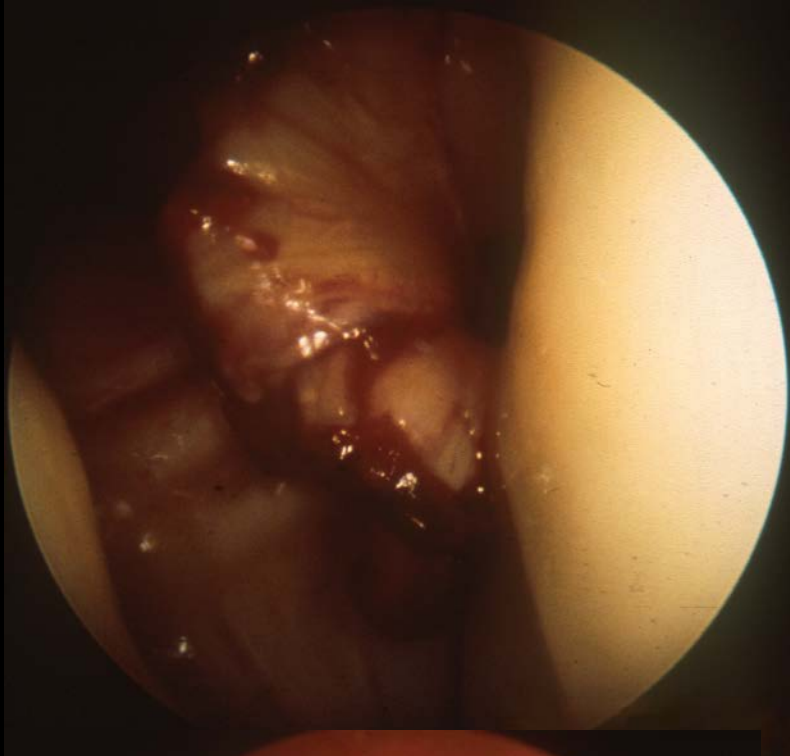
# ARTHROSKOPIE ohne KAMERA



DIE ENTWICKLUNG der  
ARTHROSKOPISCHEN INSTRUMENTE führte zu  
einer  
REVOLUTION in der  
KREUZBANDCHIRURGIE



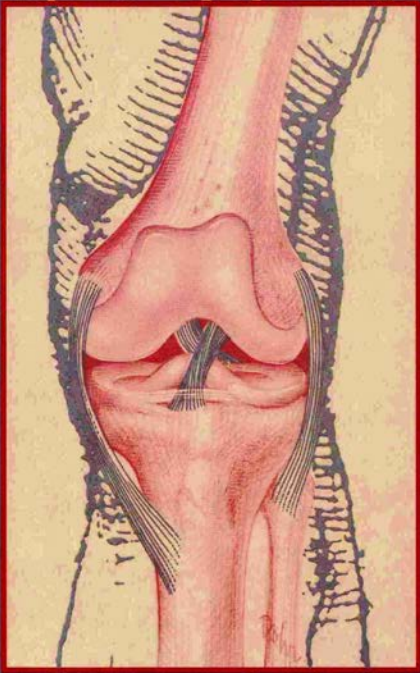




J. R. Andrews  
S. P. Arnoczky  
I. Arvidsson  
C. W. Bolton  
T. D. Cooke  
R. R. Cunningham  
D. M. Daniel  
K. E. DeHaven  
J. C. DeLee  
S. F. Dye  
E. Eriksson  
J. G. Garrick  
E. S. Grood  
H. W. Hamilton  
C. E. Henning  
P. A. Indelicato  
R. W. Jackson  
R. J. Johnson  
K. G. Jones  
K. L. Lambert  
R. L. Larson  
I. M. Levy  
R. E. Losce  
W. Müller  
F. R. Noyes  
B. C. Ogilvie  
L. E. Paulos  
D. W. Polly, Jr.  
W. G. Rodkey  
T. D. Rosenberg  
F. H. Sim  
G. A. Snook  
W. D. Stanish  
J. R. Steadman  
R. A. Teitge  
R. F. Warren  
A. B. Weiss

# THE CRUCIAL LIGAMENTS

Edited by John A. Feagin, Jr.



## Isolated tear of the anterior cruciate ligament: 5-year follow-up study

Feagin JA et al.

Am J Sports Med 1976

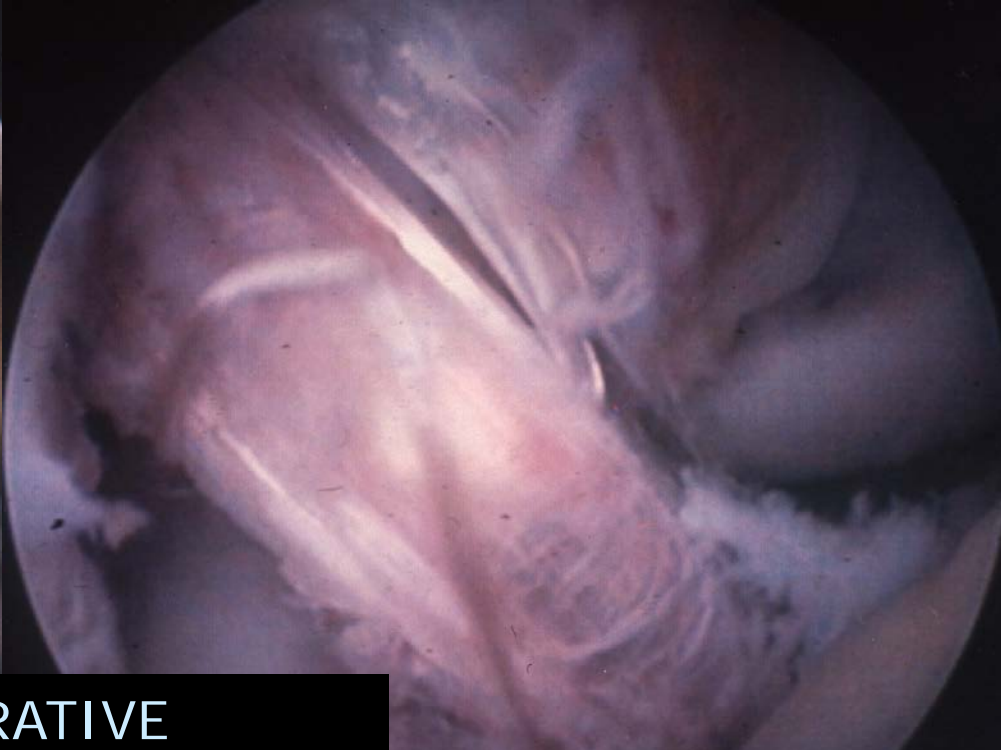
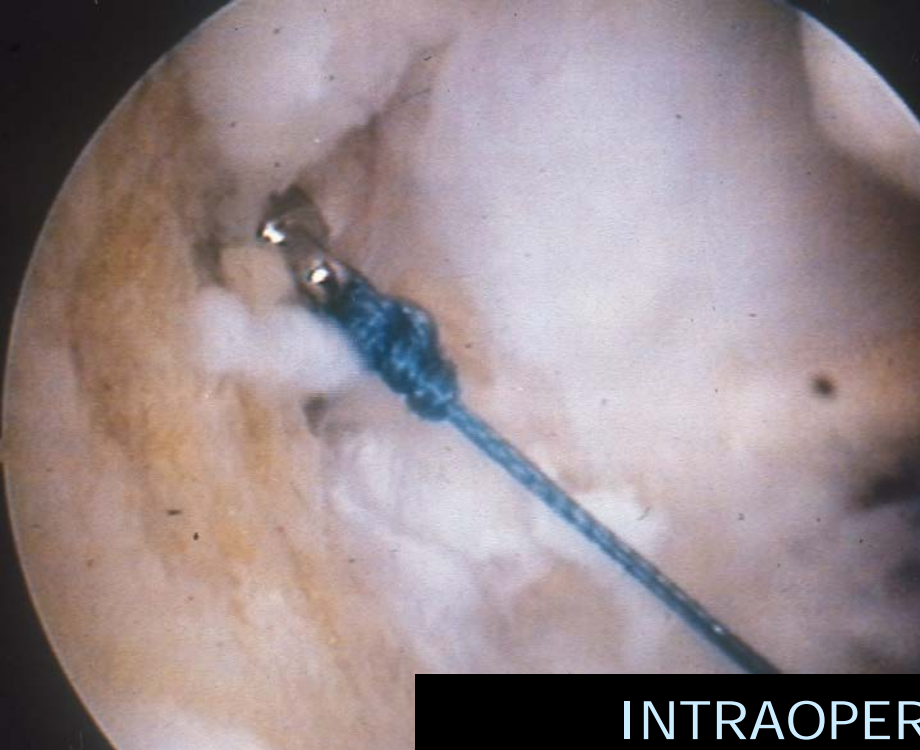


DIE PRIMÄRE NAHT FÜHRTE zu GUTEN  
FRÜHERGEBNISSEN  
ABER ZU  
SCHLECHTEN LANGZEITERBNISSSEN

5 YEAR RESULTS FOLLOWING ACL RECONSTRUCTION  
Feagin J.R. Am J sports Med



ACL REPLACEMENT BY USING  
GRAFTS or  
AUGMENTATION of ACL

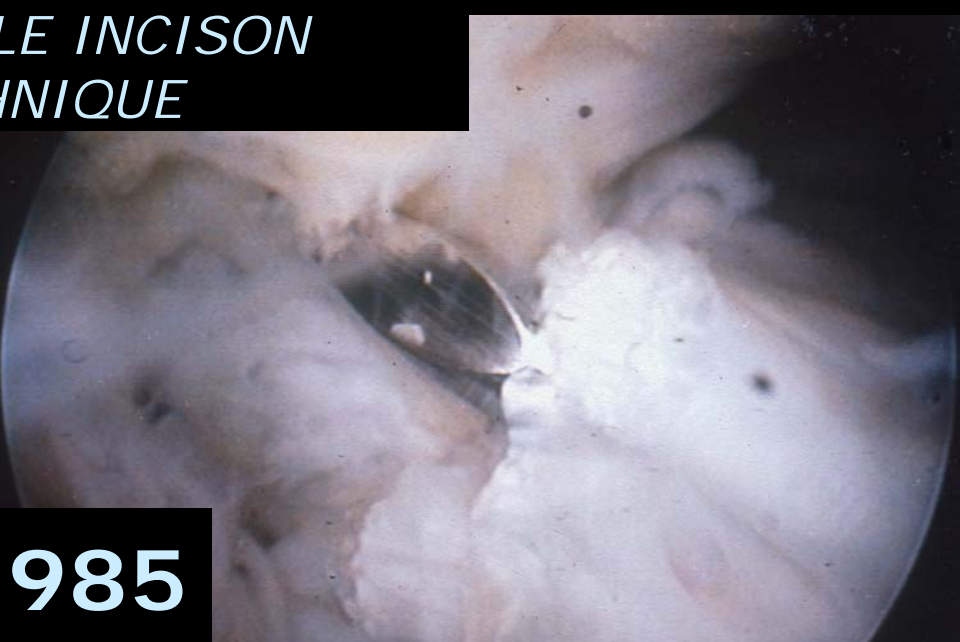


INTRAOPERATIVE  
ISOMETRIEMESSUNG

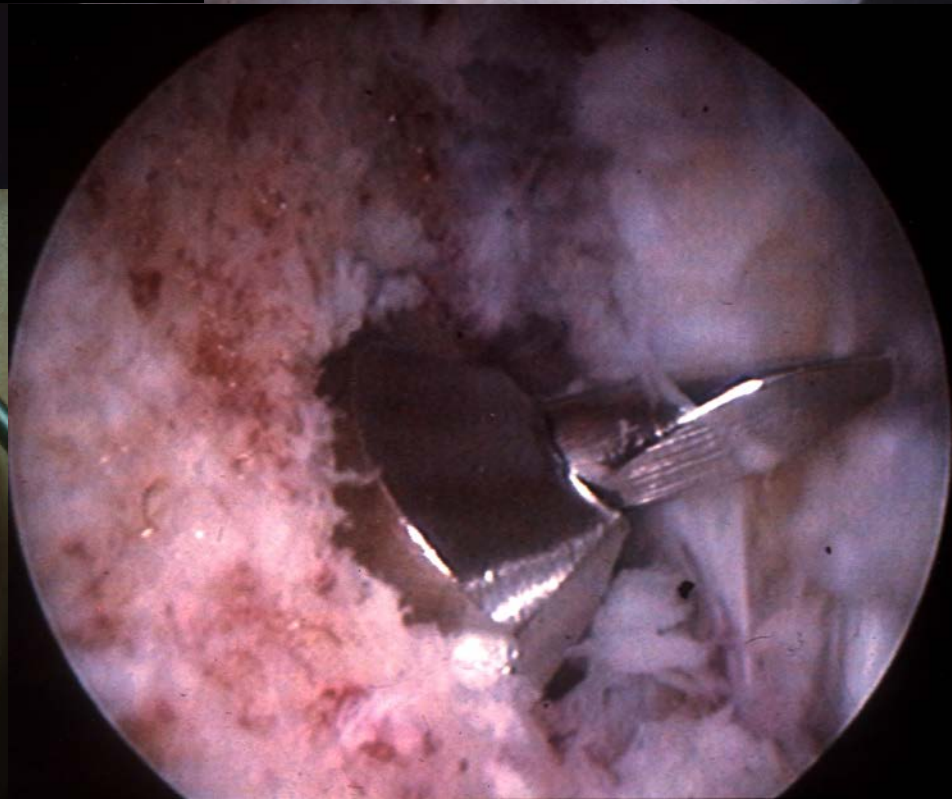
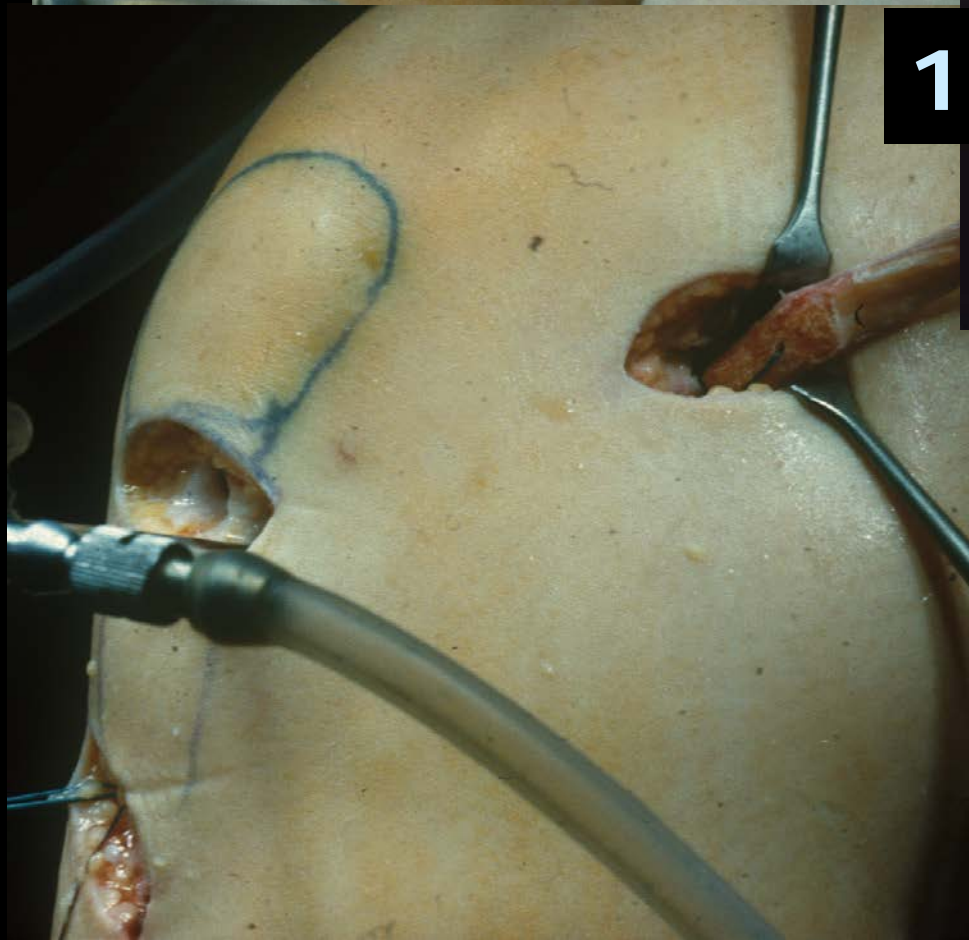




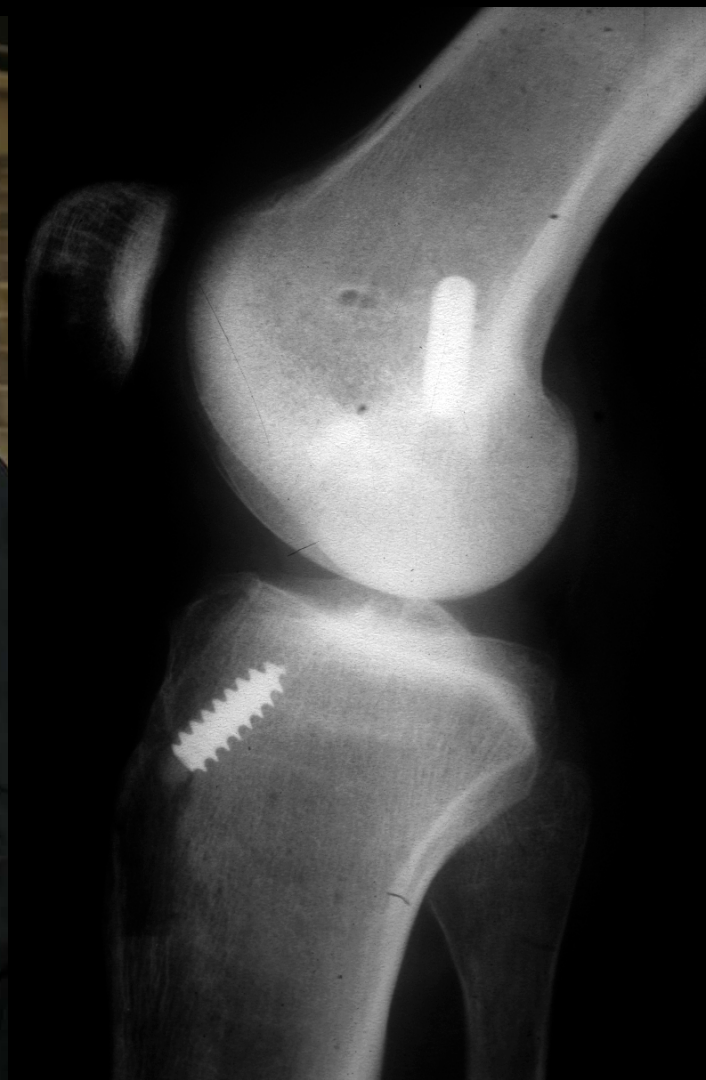
*AS DOUBLE INCISION  
TECHNIQUE*



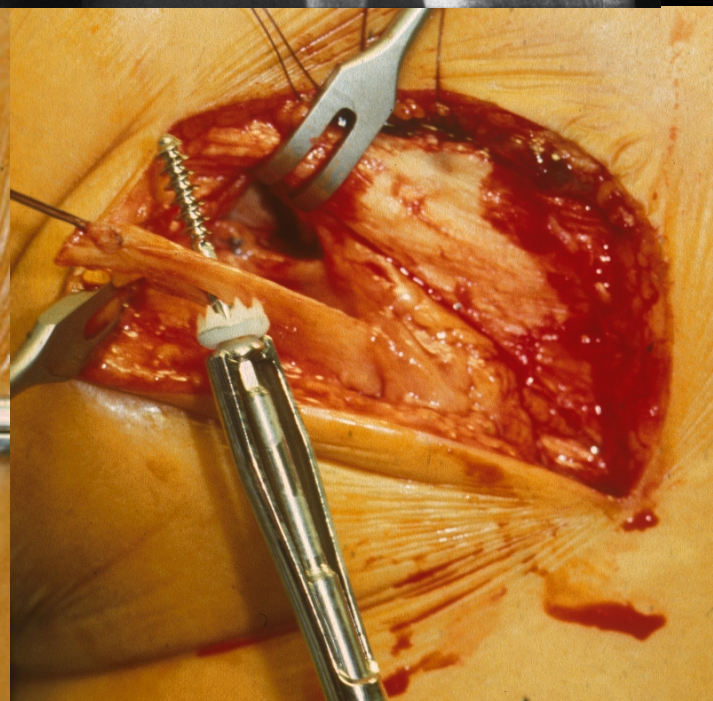
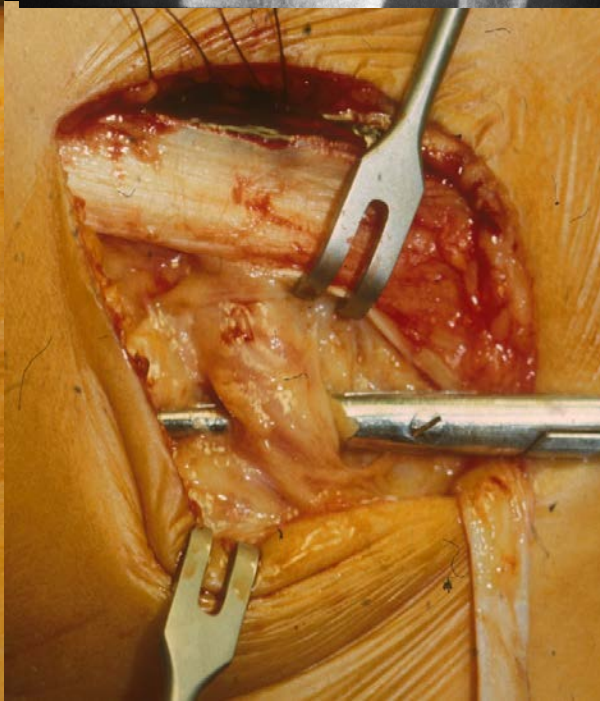
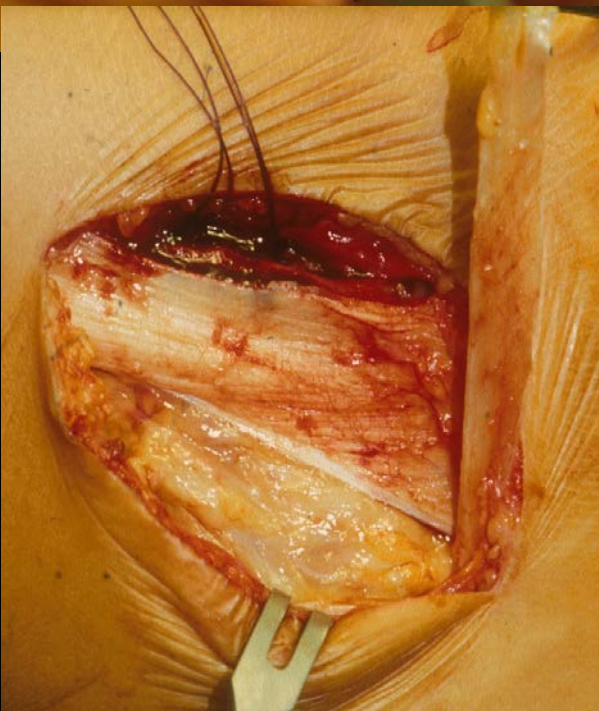
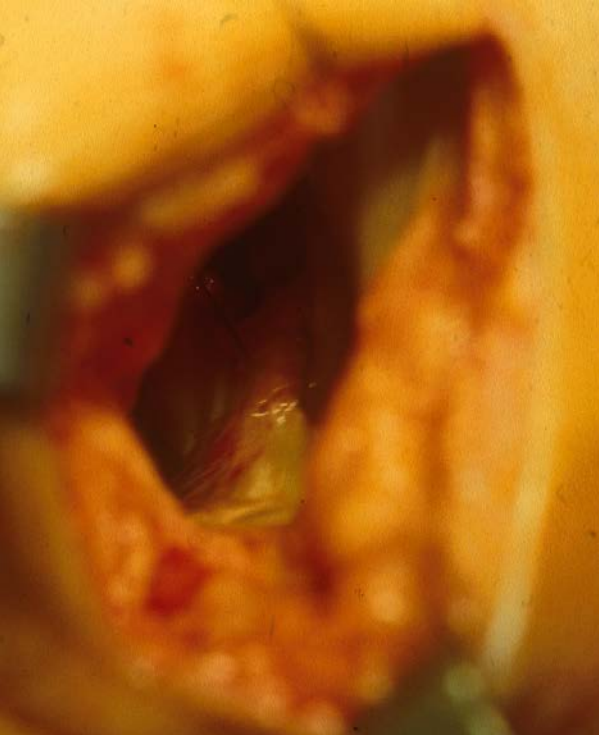
**1985**



K.LAMBERT  
H. KUROSAKA  
INTERFERENZSCHRAUBE







# Rekonstruktion des vorderen Kreuzbandes – Methodenvergleich

Herausgegeben von  
Johannes Poigenfürst  
Hartmut Pelinka

## **15 Der Einfluß der lateralen Tenodese auf die intraartikuläre Kreuzbandrekonstruktion im Langzeitergebnis**

*K. P. Benedetto, Ch. Hoser, Ch. Fink, W. Glötzer*





# HALL of FAME (HUGHSTONECLINIC)



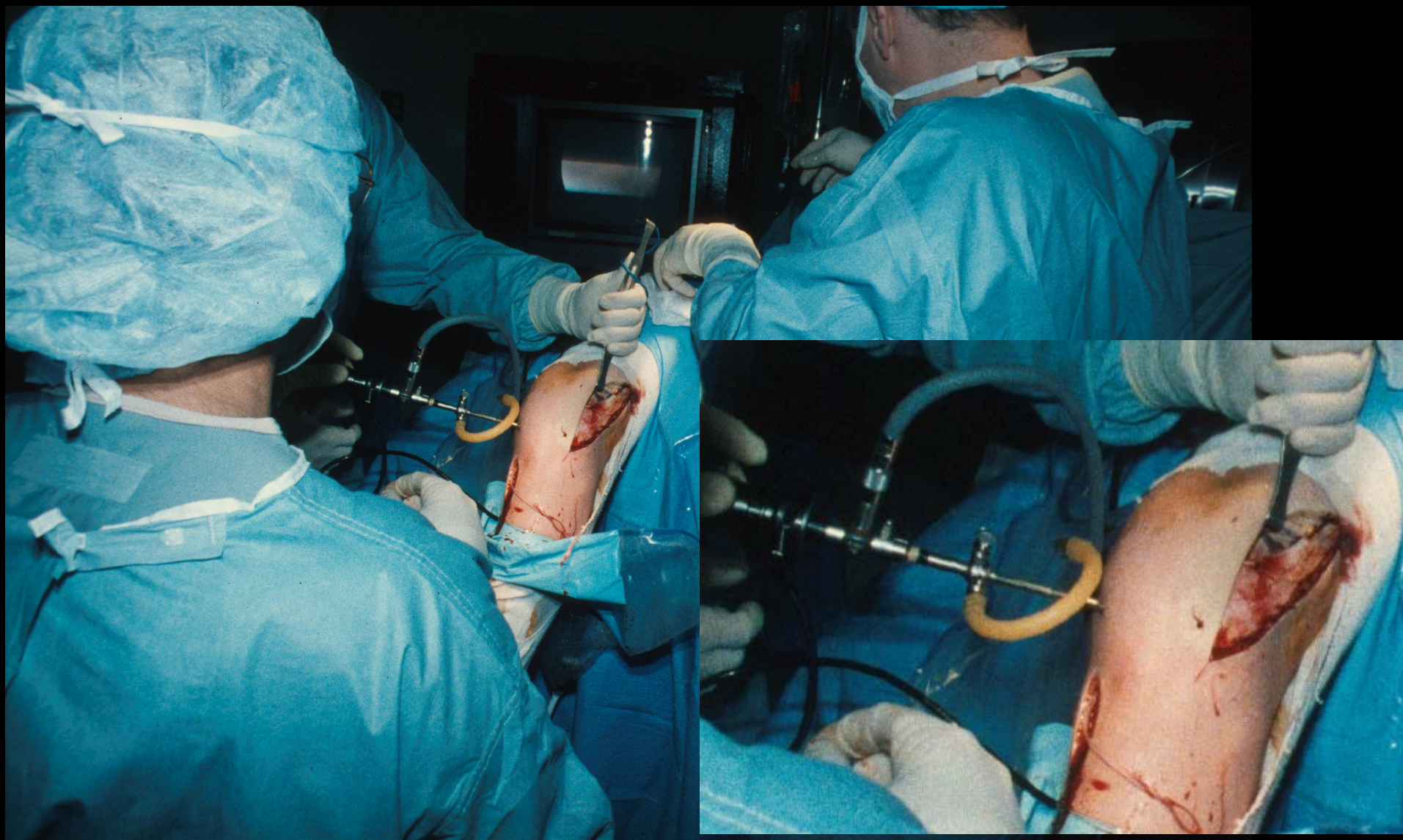
**JACK C. HUGHSTON**

NO KNEE is so BAD that it can` t made WORSE  
by SURGERY



# HUGHSTON CLINIC 1987

## OPERATIVE TREATMENT of COMBINED KNEE INSTABILITY



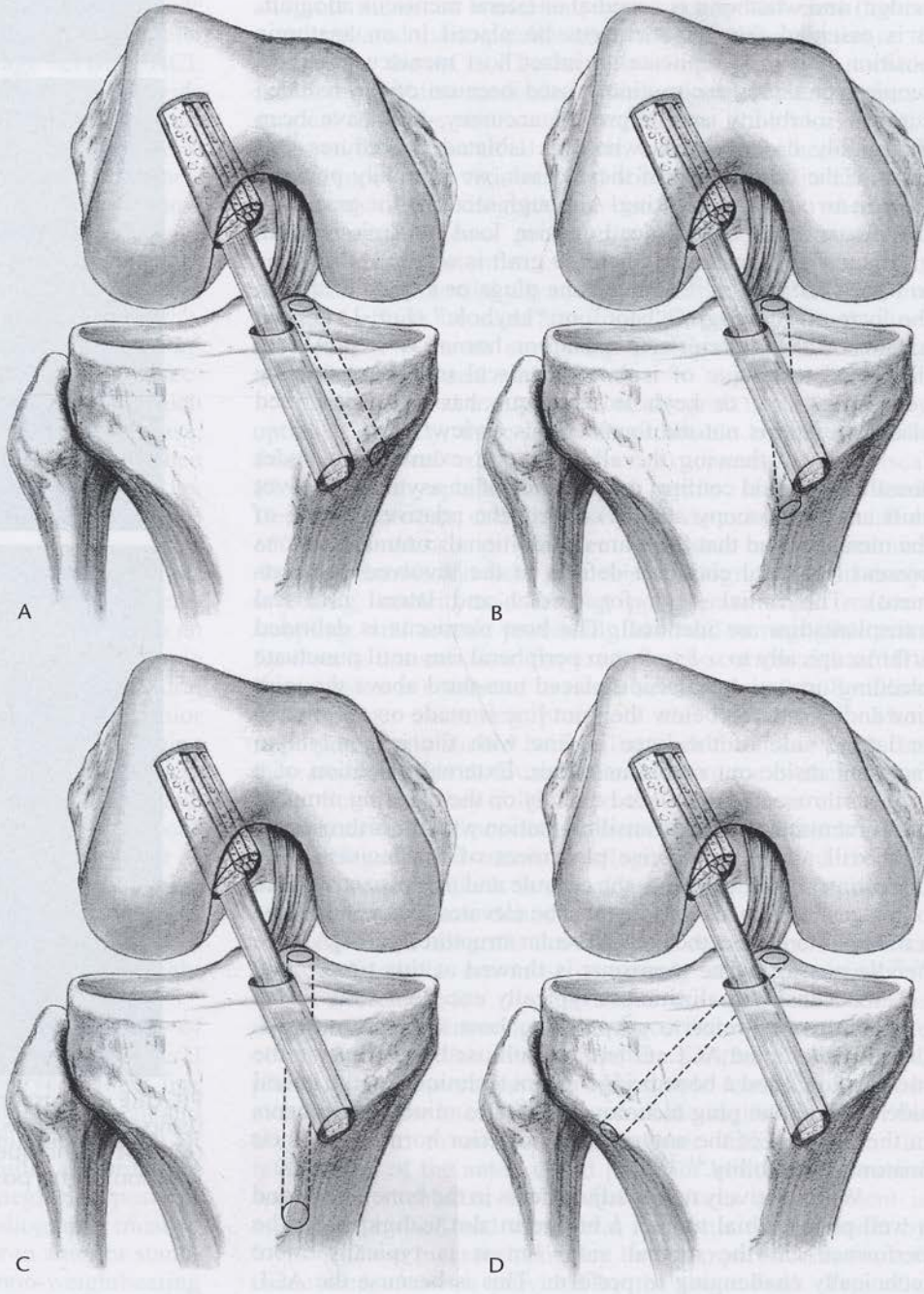


**LIG.PATELLAE**

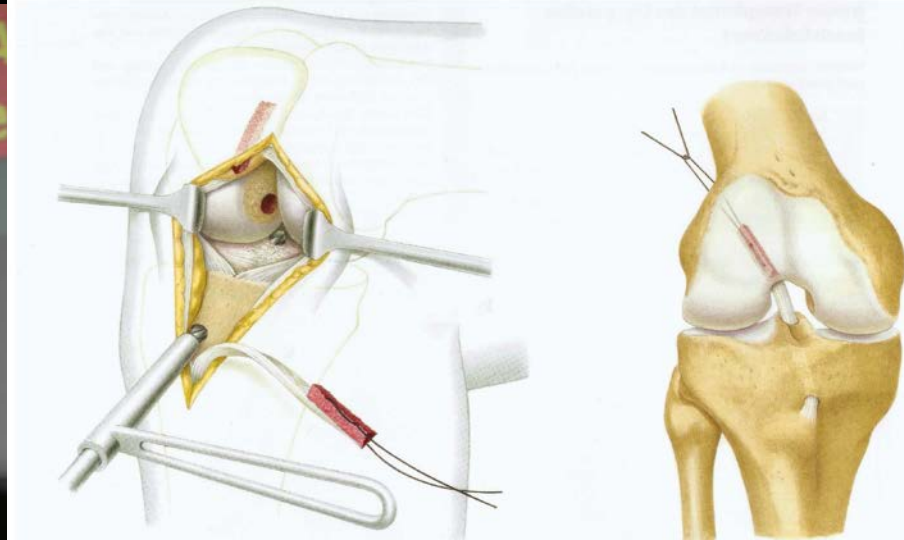
**BRÜCKNER**

**JONES**

**ERIKKSON**







# Reconstruction of the anterior cruciate ligament

Eriksson E

Orthop Clin North Am 1976

# VASCULARISATION und REVASCULARISATION des TRANSPLANTATES

Mikro- vasculature of the cruciate ligaments and its  
response to injury. An experimental study in dogs

Arnoczky SP et al.

J Bone Joint Surg 1979

Anterior cruciate ligament replacement using patellar  
tendon. An evaluation of graft revascularization in the  
dog

Arnoczky SP et al.

J Bone Joint Surg 1982

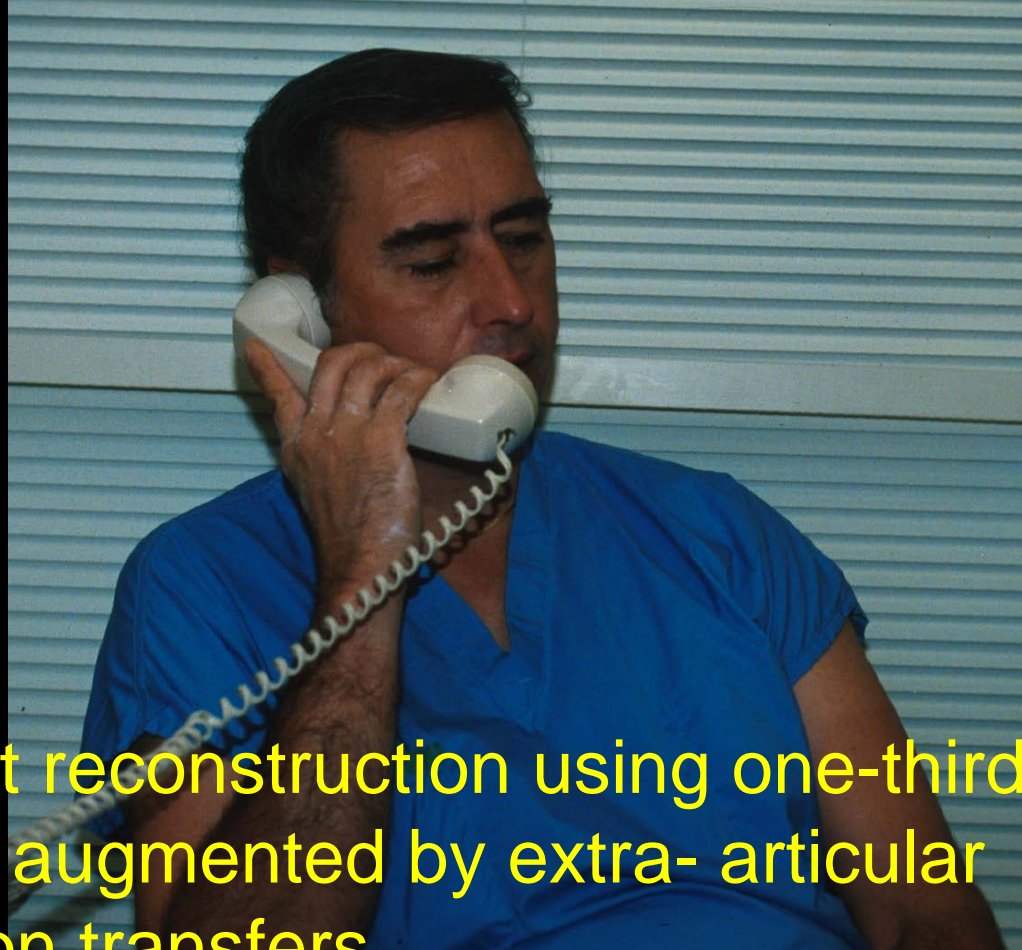
Pediculated patellar tendon grafts for reconstruction of  
the anterior cruciate ligament - experimental analysis of  
vitality and operative technique

Drobny TK et al.

Berlin 1984



CLANCY W.G



Anterior cruciate ligament reconstruction using one-third  
of the patellar ligament, augmented by extra- articular  
tendon transfers

Clancy WG Jr et al.

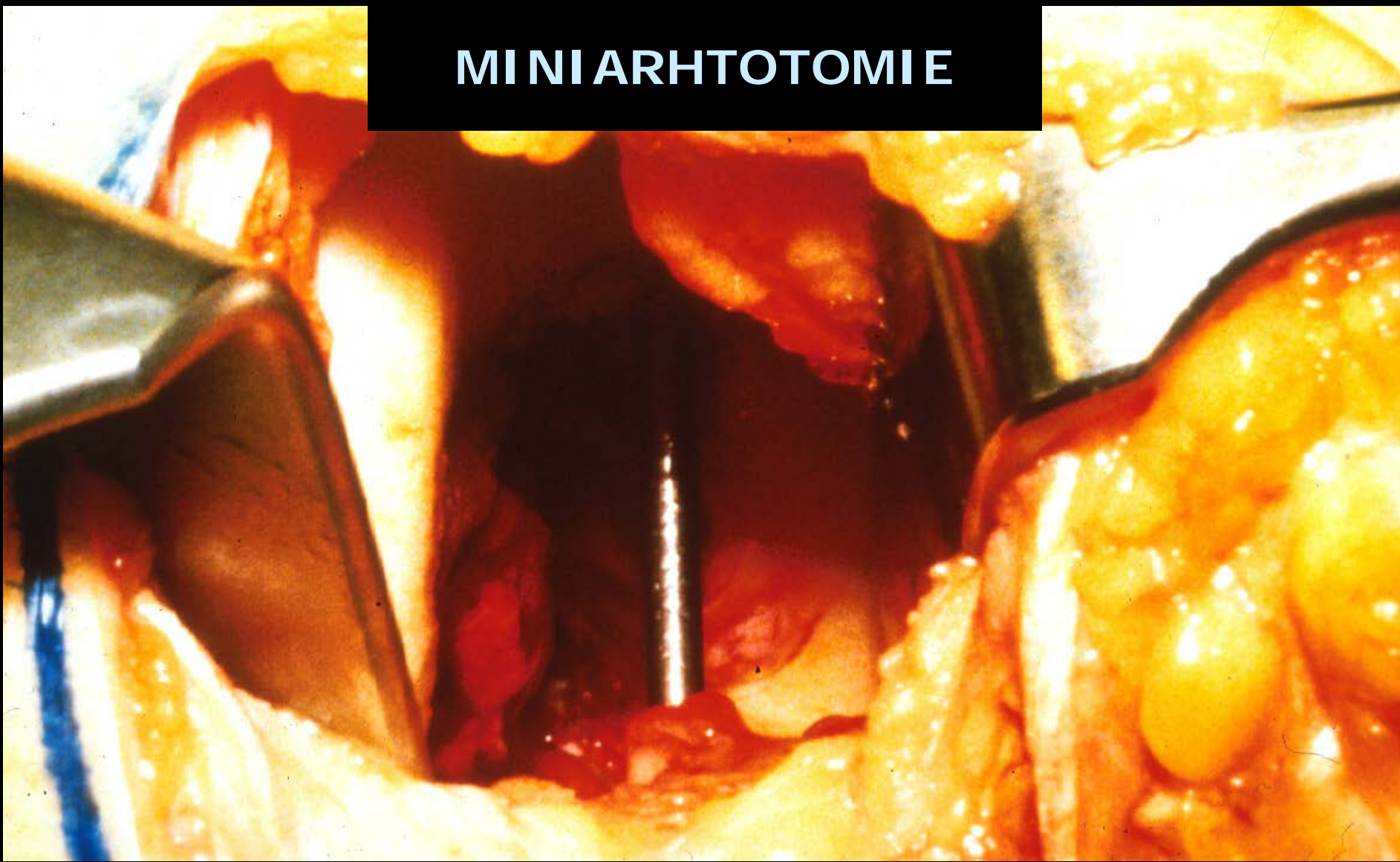
J Bone Joint Surg 1982

Anterior cruciate ligament reconstruction using one-third  
of the patellar ligament, augmented by extra- articular  
tendon transfers

Clancy WG Jr et al.

J Bone Joint Surg 1982

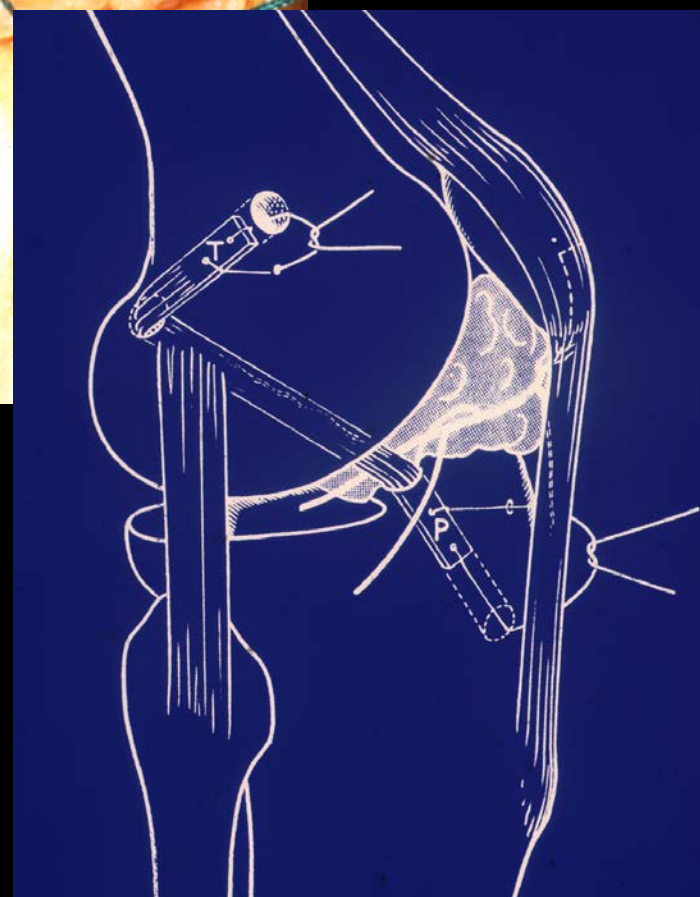
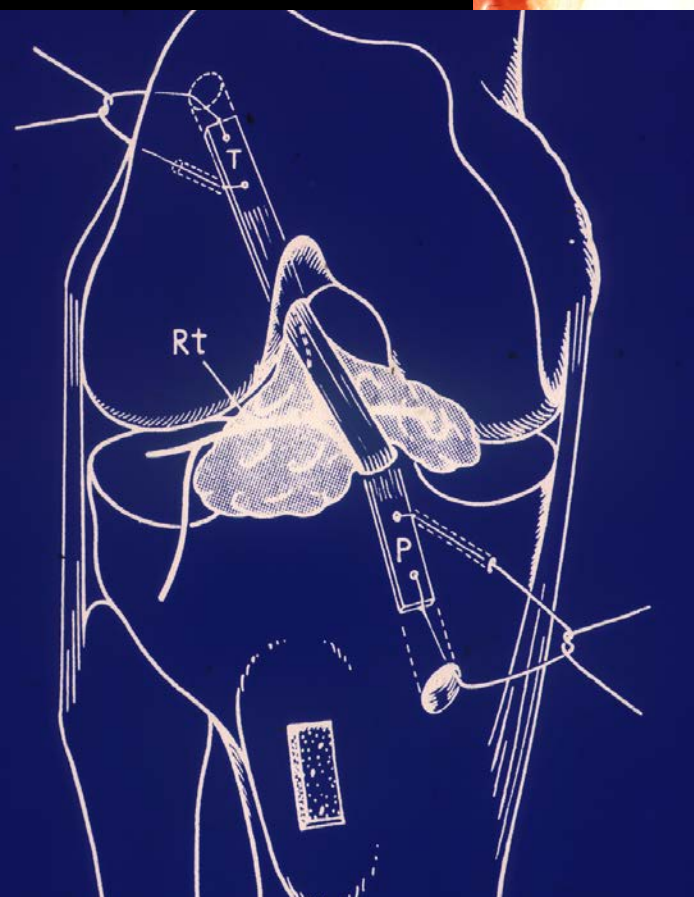
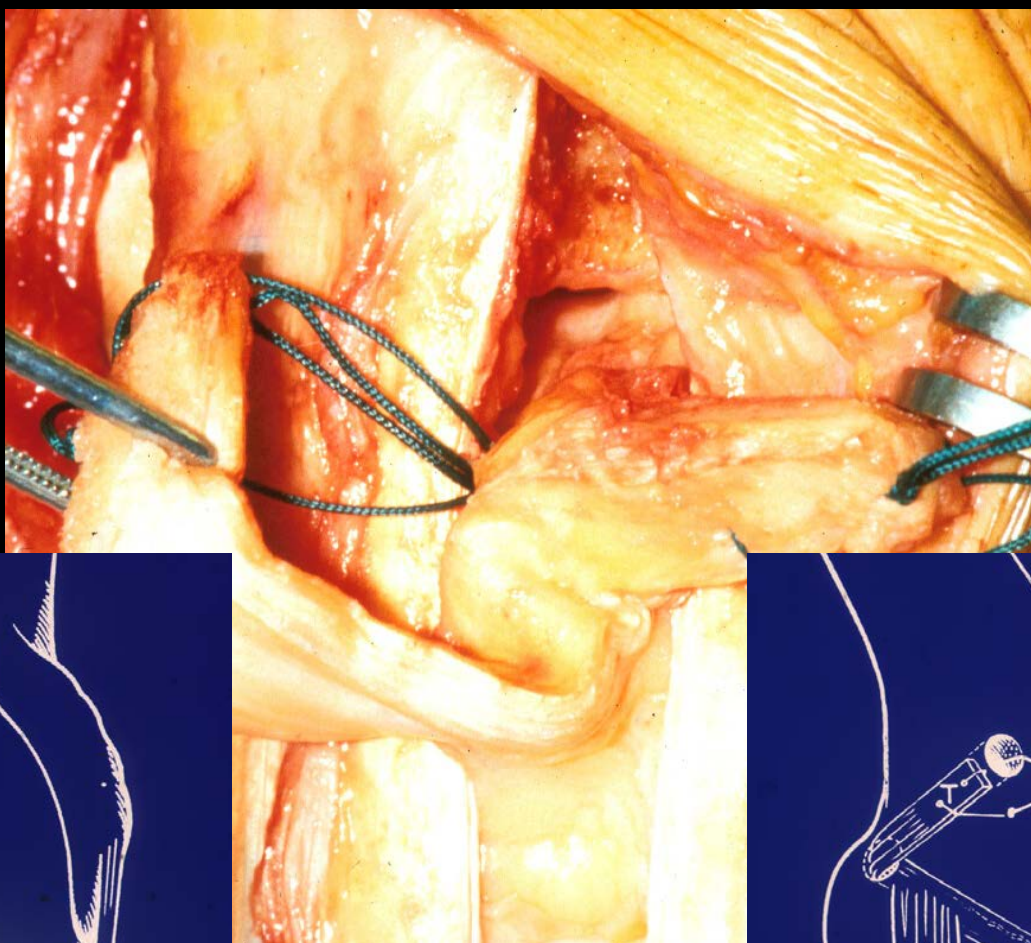
# MINI ARHTOTOMIE



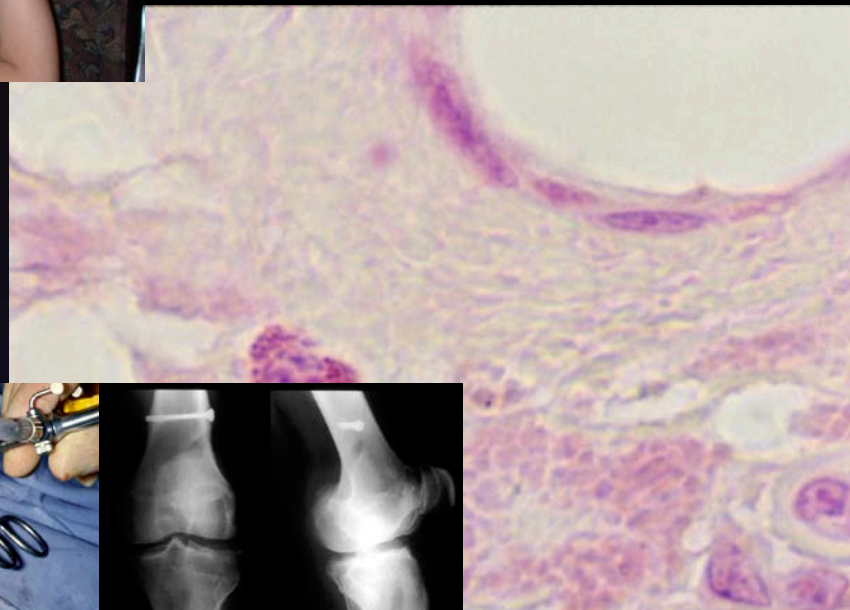
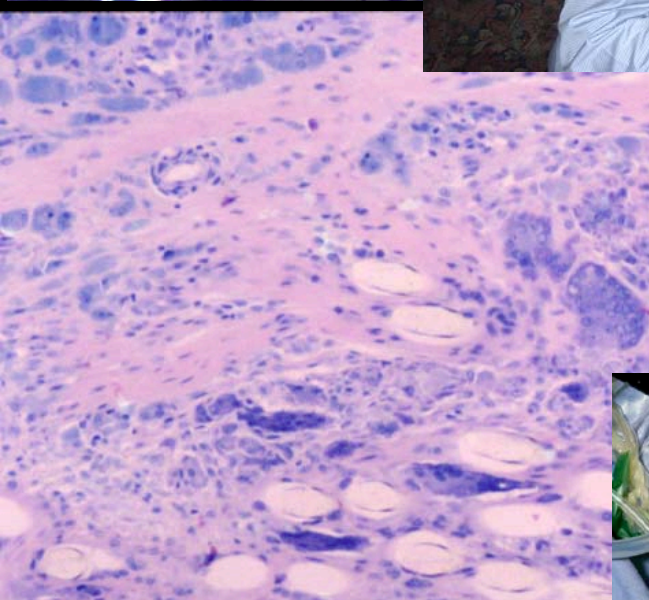
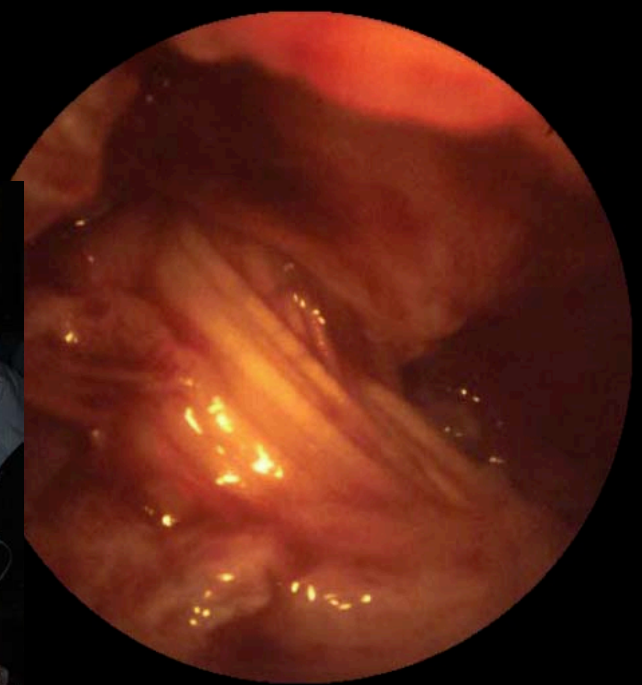
## VASCULARISIERTES LIG.PATELLA

CLANCY W.R.      BENEDETTO K.P.      DROBNY JACOB RP









WEAR PARTICLES

FU F.

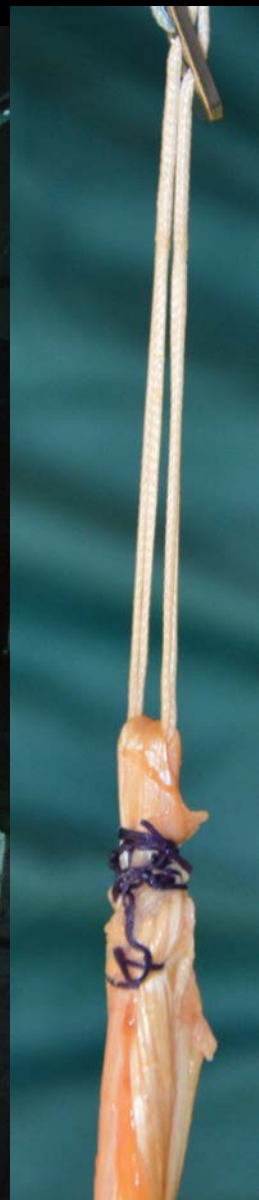


# GORE TEX 28a FOLLOW -UP



ROSENBERG T

PAULOS L





# BIOMECHANIK



## REISSFESTIGKEIT

LIG. PATELLAE KNOCHEN-LIG.-KNOCHEN

2376-3200 N

GROOD E 1984

SEMITENDINOSUS + GRACILIS

800-4000 N

NOYES F 1984, HAMNER D 1999

QUADRICEPSSEHNE

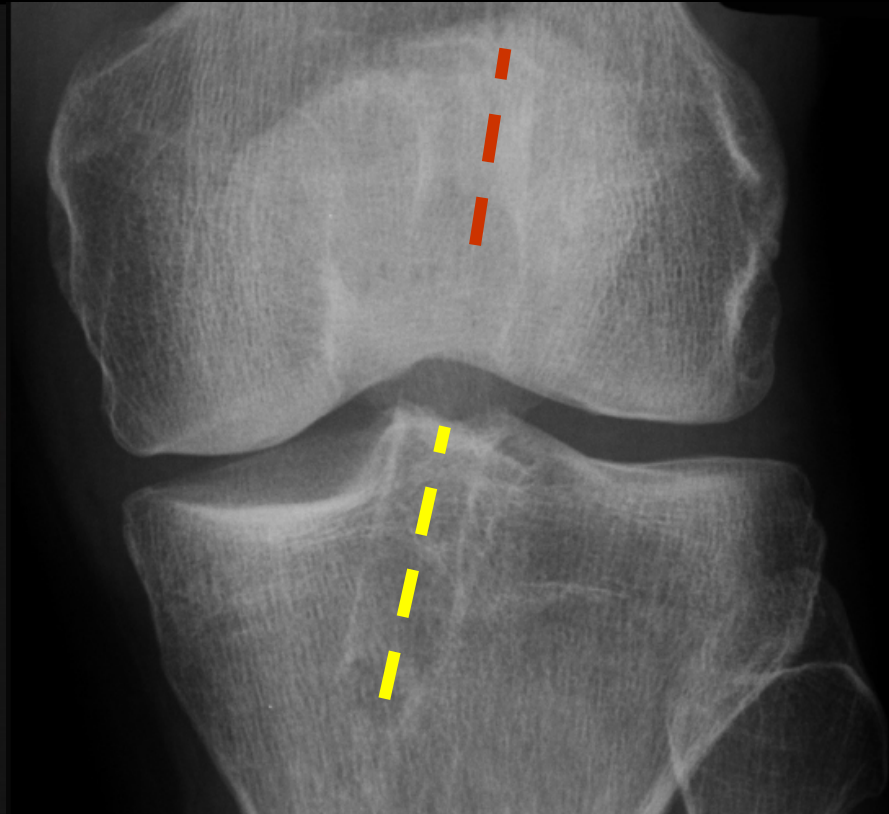
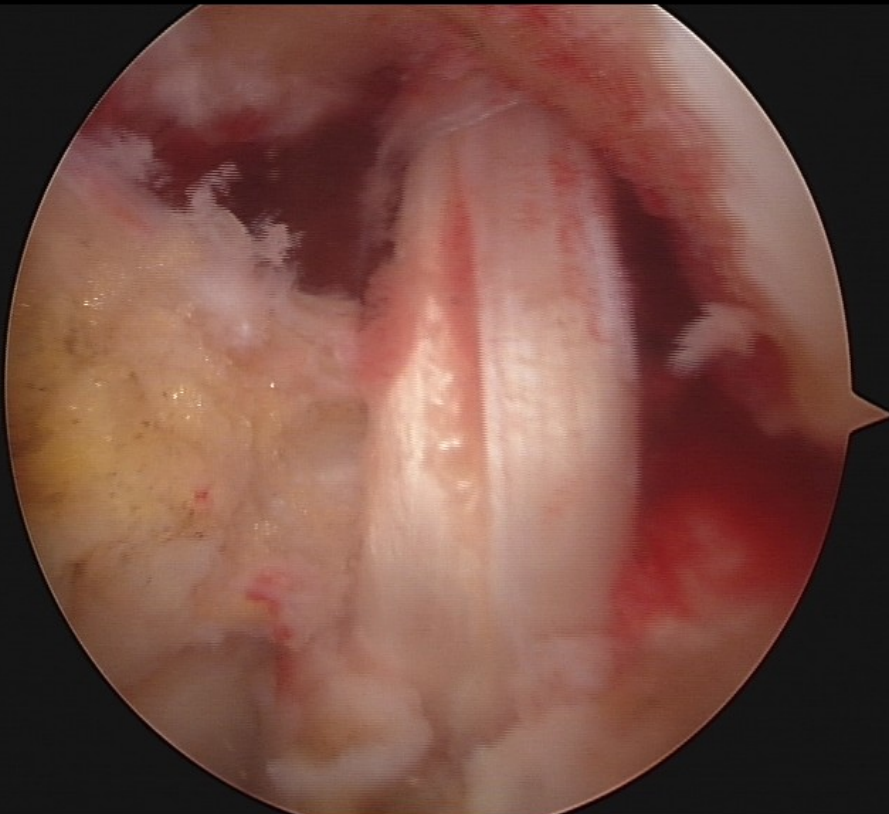
2353 N



STÄUBLI HU 1994

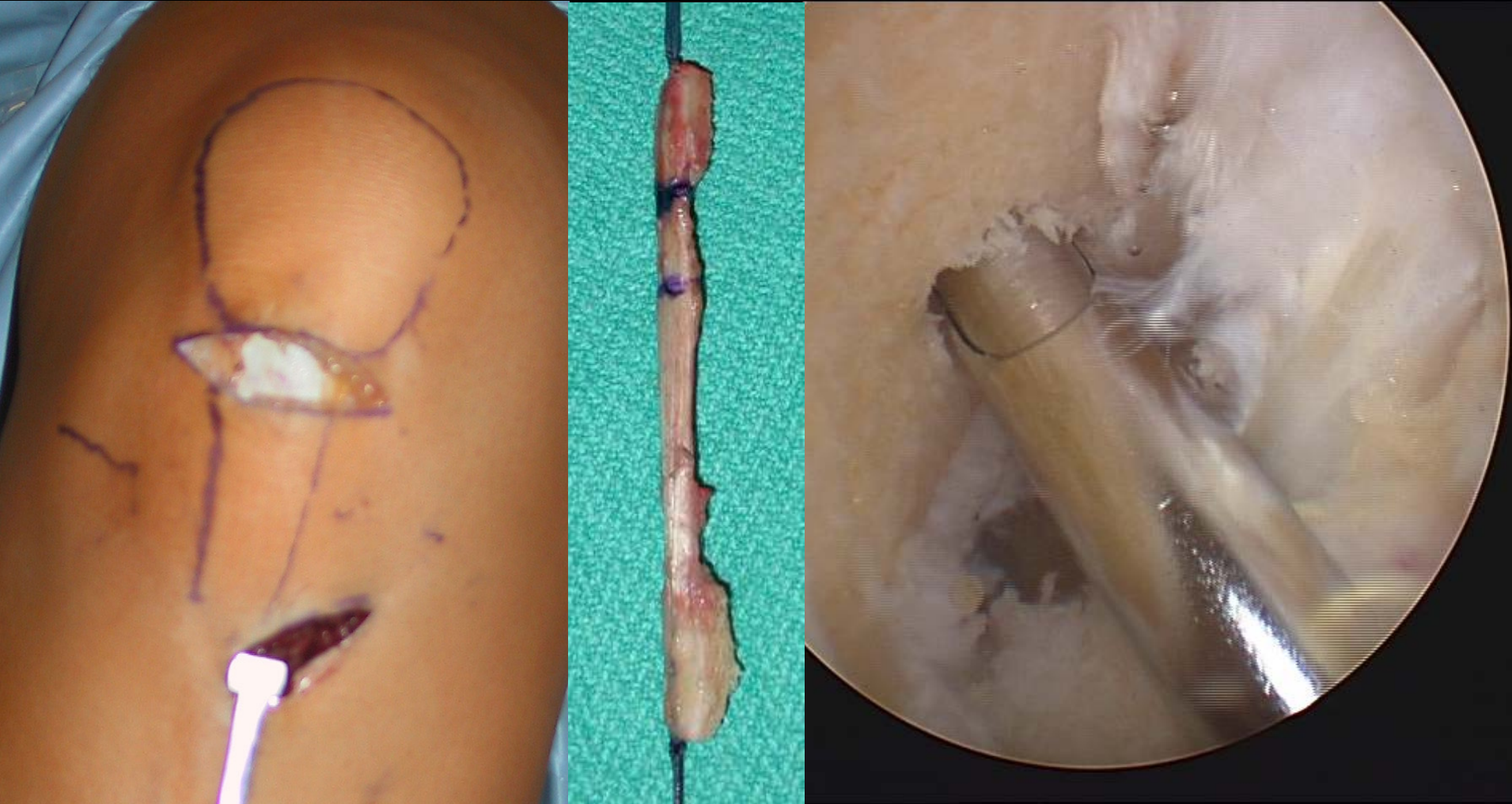
KOSMETIK  
ENTNAHMEMORBIDTÄT (TAGESCHIRURGIE )  
ROSENBERG  
PINCIEWSKI

SEMITENDINOSUS + ENDOBUTTON





# SINGLE INCISIONS TECHNIK



FEMORALER INSERTIONSPUNKT TENDENZIELL zu HOCH (HIGH NOON)

# DOUBLE INCISION MINI-INVASIVE TECHNIQUE for BTB HARVESTING 1ST SUPERIORITY in REDUCING ANTERIOR KNEE PAIN FOLLOWING ACL RECONSTRUCTION

EKDAHL M et al

AM J. SPORTS MED.

2009

**n 21      DOUBLE INCISION**

**N 19      SINGLE INCISION**

---

**THE DOUBLE INCISION APPROACH SIGNIFICANTLY  
REDUCES the MID TERM INCIDENCE of ANTERIOR  
KNEE PAIN**

**ADDITIONALLY this TECHNIQUE MARKEDLY  
REDUCED the OCCURENCE of SENSORY  
DISORDERS and the EXTENT of HYPOSTESIA**

PURNELL M

SPORTS MED ARTHROSC. 2009

DRAIN O. et al.

REV.CHIR 2007

LEVY HY. et al.

ARTHROSCOPY 2000

KARTUS J et al

AM J SPORTS MED 2000



# FOUNDATION of SCIENTIFIC SOCIETIES related to

## ARTHROSCOPY and KNEE SURGERY

- AOSSM 1964
  - ANA 1981
  - AGA 1983
  - ESKA 1984
  - ISK
  - IAA
- ISAKOS 1995
- 
- ```
graph LR; ISK --> ISAKOS; IAA --> ISAKOS
```
- The diagram shows two yellow lines originating from the right side of 'ISK' and the right side of 'IAA', converging towards the left side of 'ISAKOS', indicating a merger or combination of these two societies into ISAKOS.

# AGA PITTSBURGH FELLOWSHIP





VKZB TRANSPLANTAT sollte der ANATOMIE des ORIGINÄREN VKZB möglichst NAHEKOMMEN

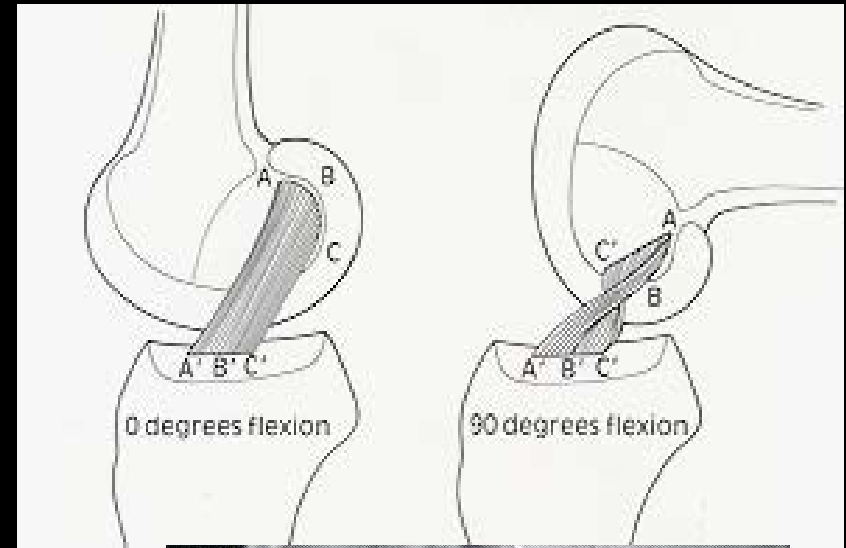


- Anteromedial bundle

- AM tight in flexion

*Sepega JBJS 90 & Amis*

*JBJS 91*



- Posterolateral bundle

- PL bundle tight in extension

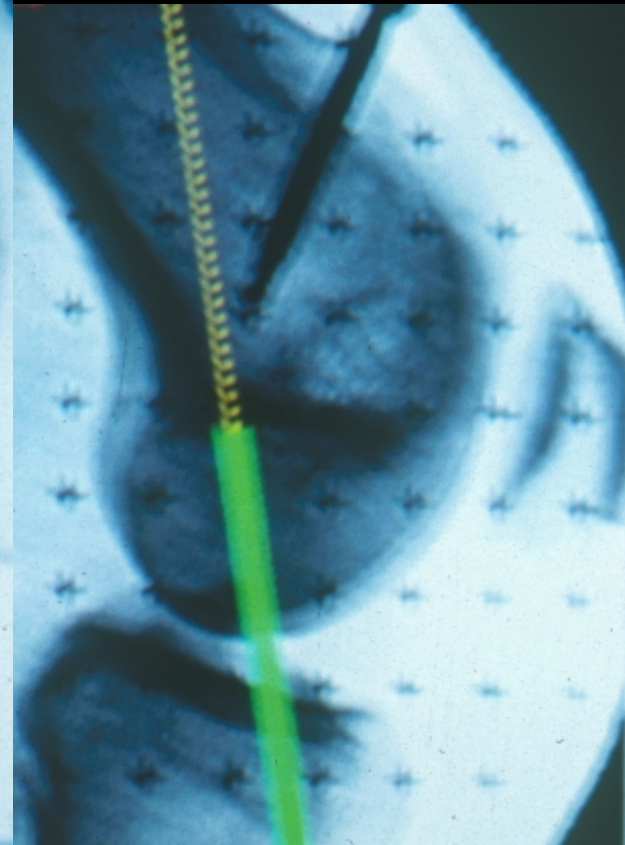
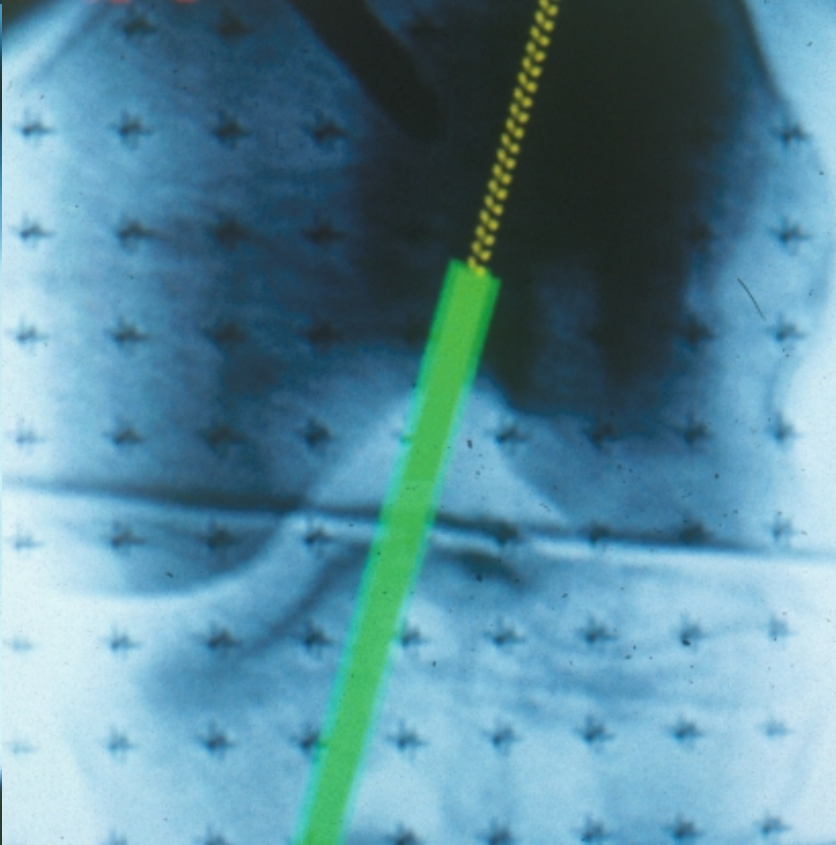
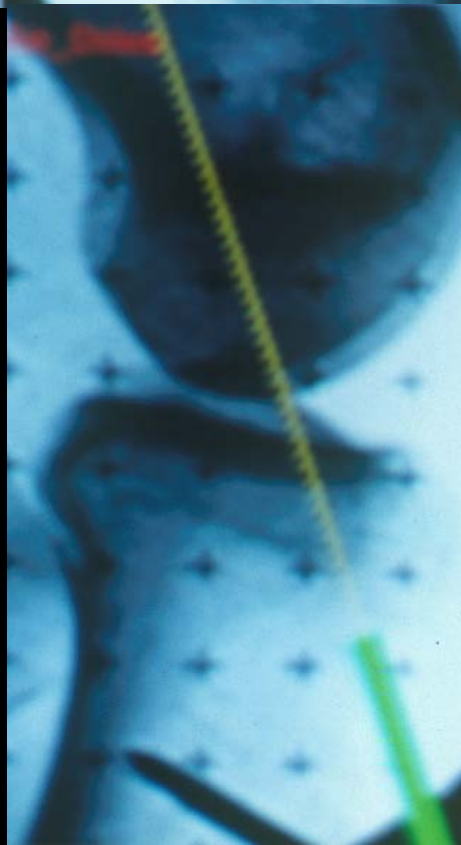
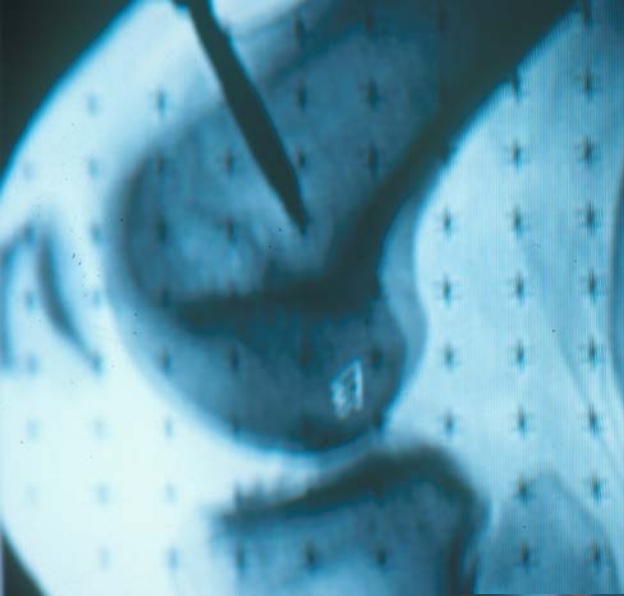




ACL  
BIOMECHANICS  
TUNNEL PLACEMENT  
ROBOTIC SYSTEM



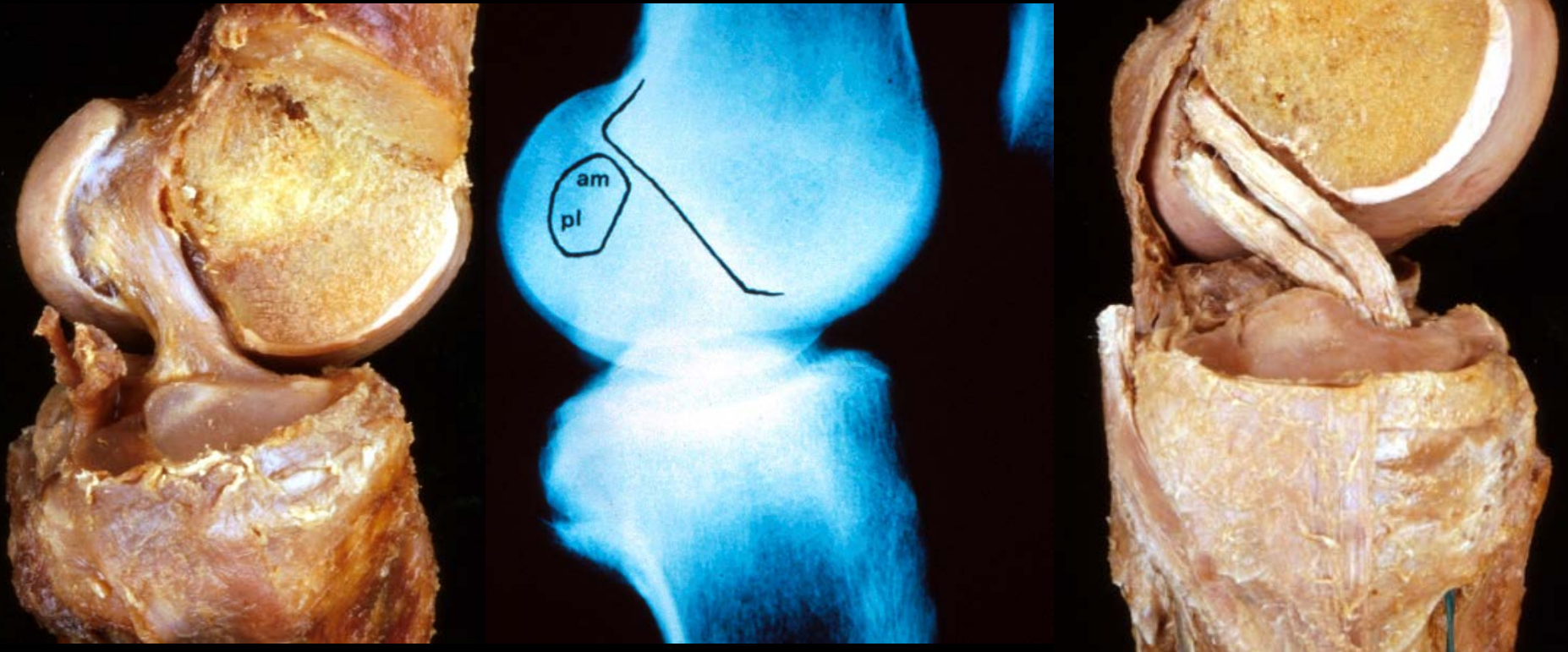
# navigation



# VKZB TRANSPLANTAT TUNNELPLATZIERUNG

## ANATOMIE – MULTIAXIALE FASERSTRUKTUR

- ① ANTEROMEDIALES BÜNDEL
- ② POSTEROLATERALES BÜNDEL

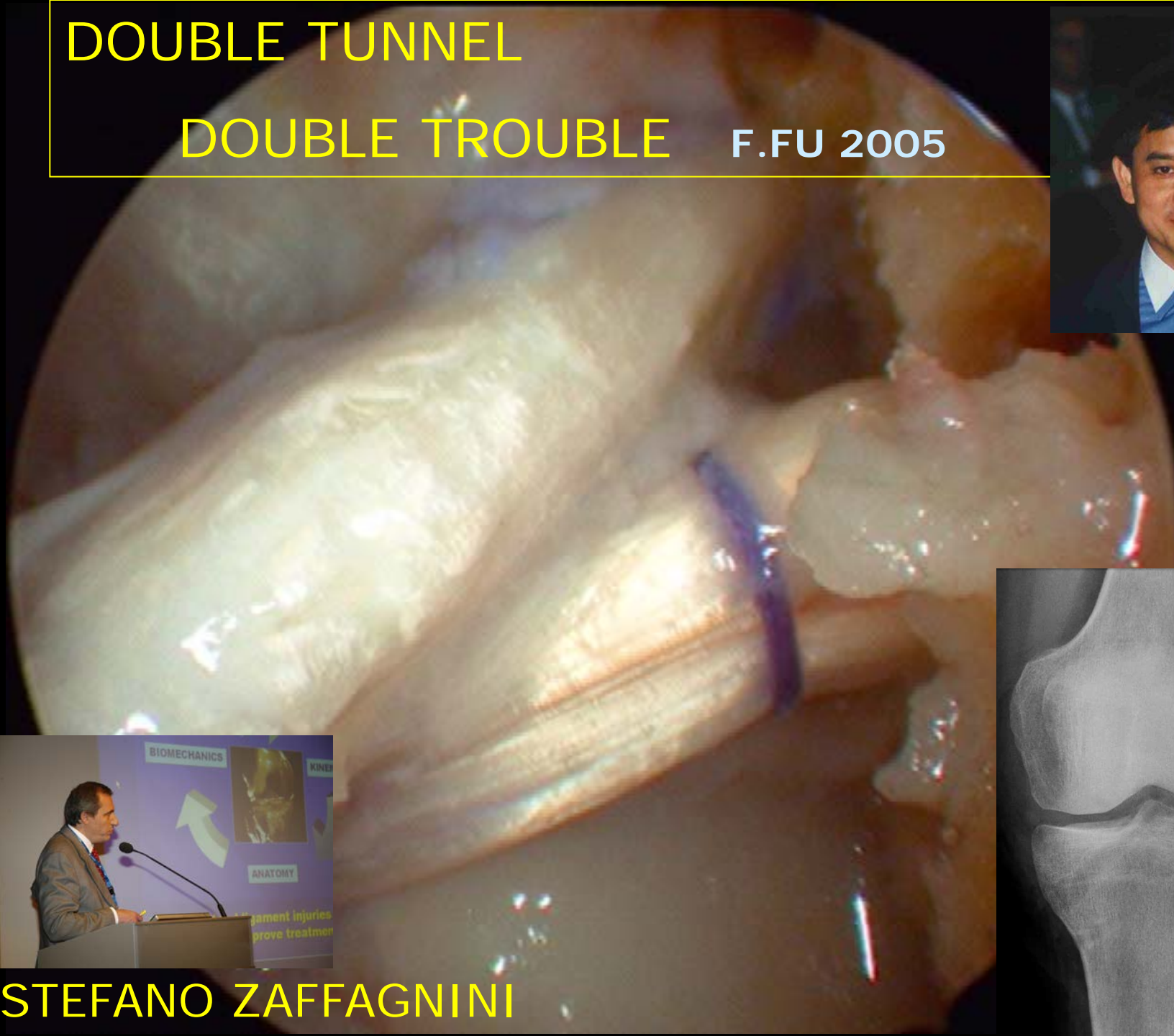
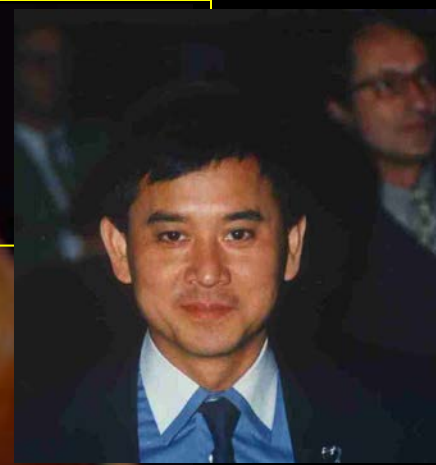




# DOUBLE TUNNEL

## DOUBLE TROUBLE

F.FU 2005



# STEFANO ZAFFAGNINI

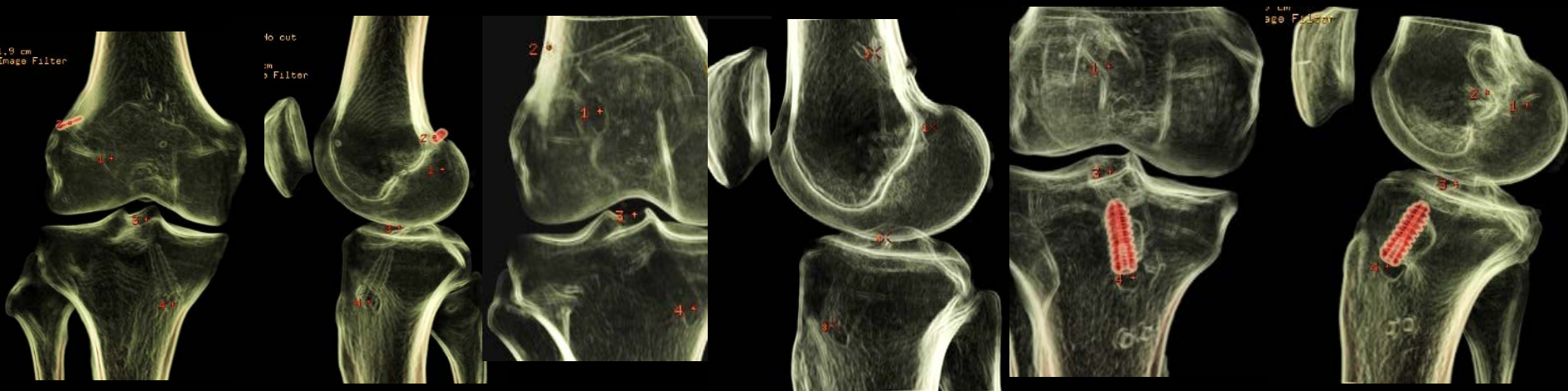
# TUNNEL PLACEMENT

## RETURN to BIOMECHANIC ANATOMY

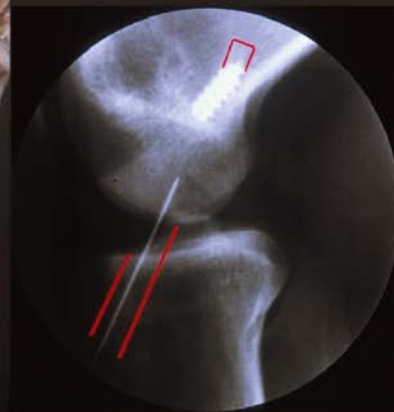
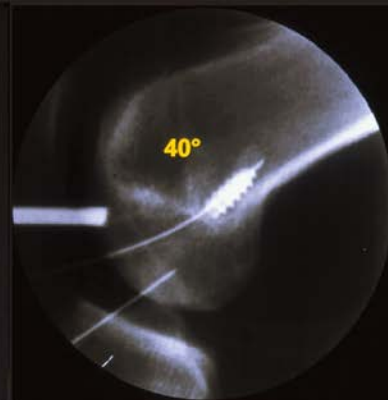
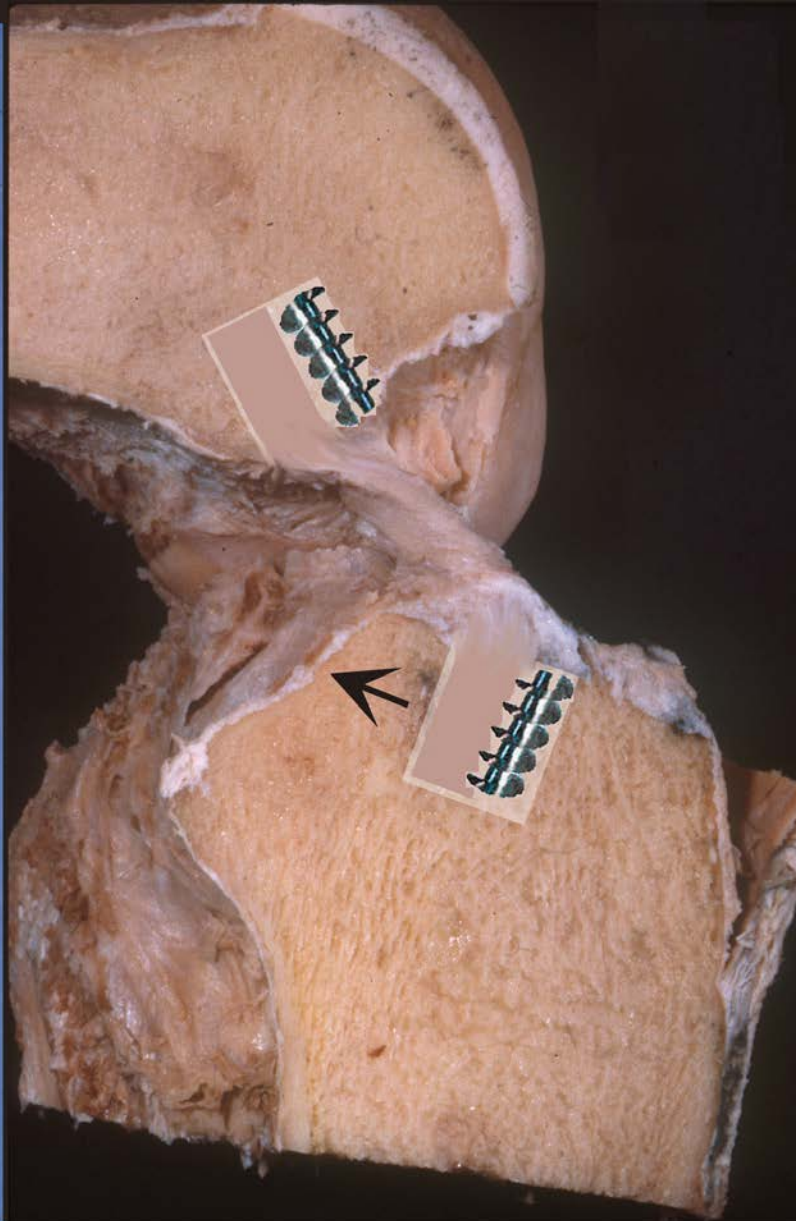
### INFLUENCE of FREDDIE FU

THE EFFECTIVENESS of SKELETAL IMAGING for QUALITY ASSESSMENT in CRUCIATE LIGAMENT RECONSTRUCTION: RELIABILITY and VALIDITY of RADIOGRAPHS and COMPUTED TOMOGRAPHY.

Osti M, Krawinkel A, Benedetto KP. Arch Orthop Trauma Surg. 2014







G. CERULLI  
2008

ACL  
ALL-INSIDE



TRANSIBIAL



ANTEROMEDIAL



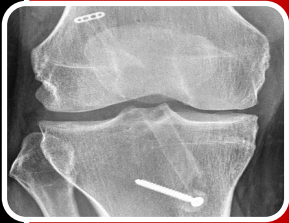
RETRODRILL



# CONSEQUENCE of different DRILLING TECHNIQUE

Osti M, Krawinkel A, Ostermann M, Benedetto KP.

Am.J Sports.Med 2015



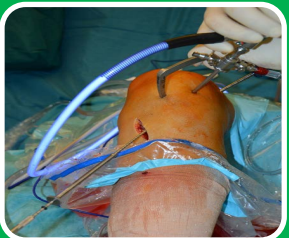
## *TRANSTIBIAL DRILLING*

- ROTATION INSTABILITY
- EXTRA-ANATOMICAL FEMORAL TUNNEL
- „ SIMPLE OPERATION „
- SINGLE-INCISION



## *ANTEROMEDIAL DRILLING*

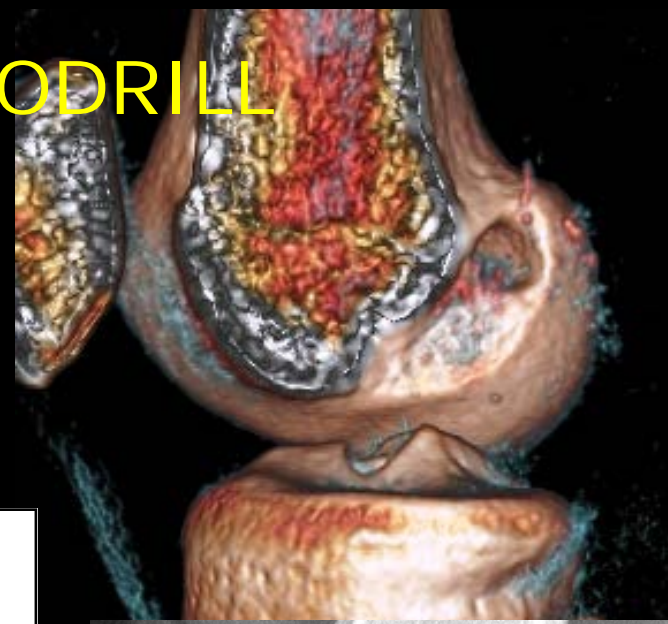
- LENGTH and TIGHT of FEMUR -- TOURNIQUET
- KNEE FLEXION  $> 120^\circ$
- MEDIAL FEMUR CONDYLE at RISC
- SHORT FEMORAL TUNNEL LENGTH
- POSTERIOR TUNNEL BLOW-OUT



## *RETROGRADE DRILLING*

- MINIMAL INVASIVE
- MINIMUM BONE LOSS
- IMPROVED OSTEOINTEGRATION of GRAFTS
- INDEPENDENT PLACEMENT
- REVISION RECONSTRUCTION

# SINGLE BUNDLE RETRODRILL ALL INSIDE





HKZB



Gregory C. Fanelli EDITOR



# Posterior Cruciate Ligament Injuries

A Practical Guide  
to Management



Springer

M. STROBEL

J. BERGFELD

K.P. BENEDETTO

R. La PRADE

R.P. JAKOB

A. GÄCHTER

P. LOBENHOFFER

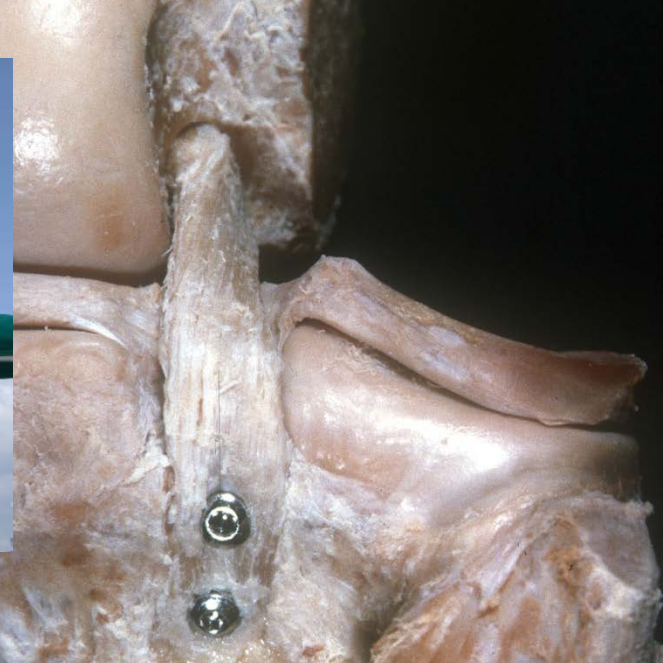
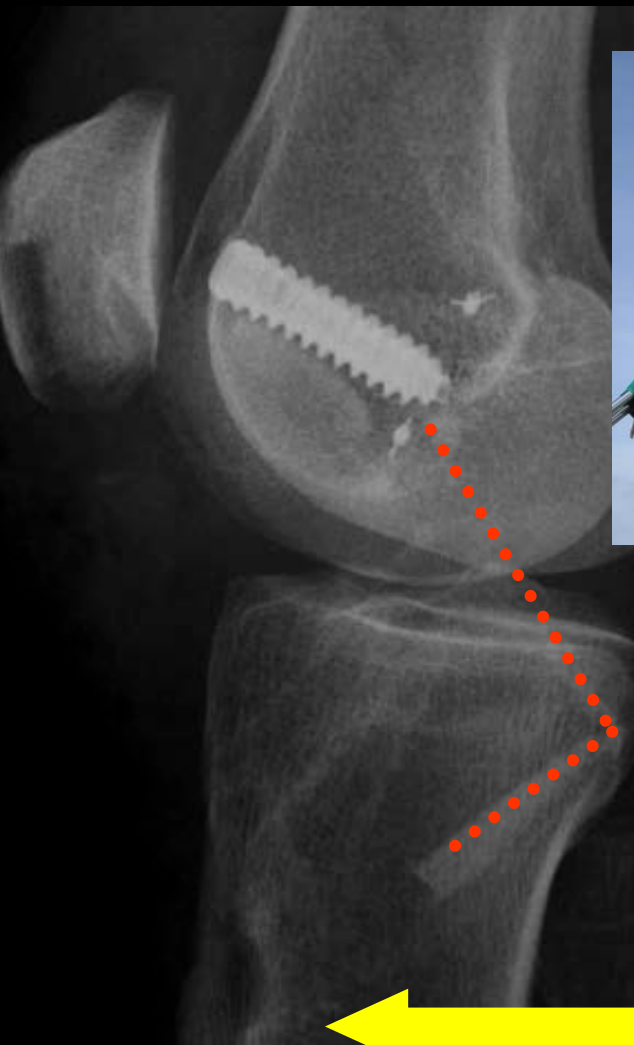
Ch. HARNER

L. ENGEBRETSEN

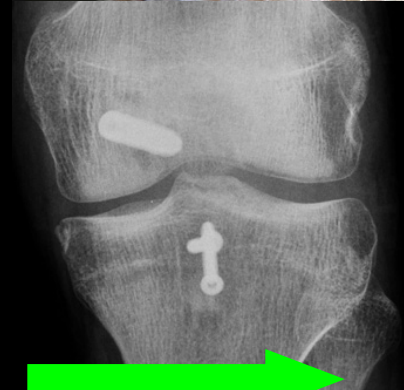
J. BARTLETT

# TRANSTIBIALE TECHNIK beinhaltet KILLER TURN

# INLAY TECHNIK vermeidet KILLER TURN



GRAFT FAILURE  
GRAFT THINNING  
INCREASE in  
GRAFT LENGTH

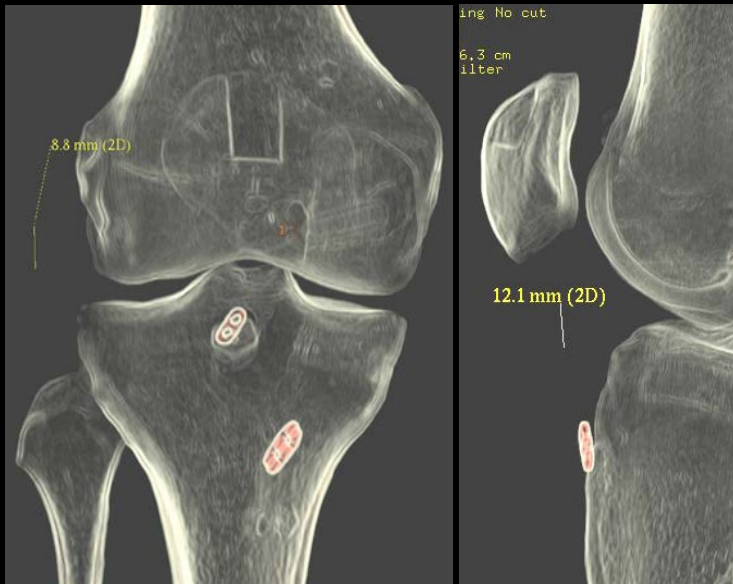


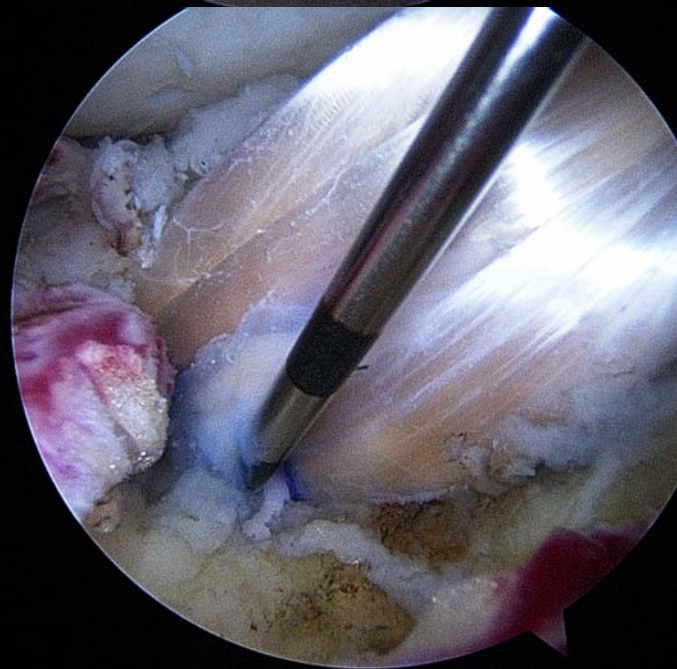
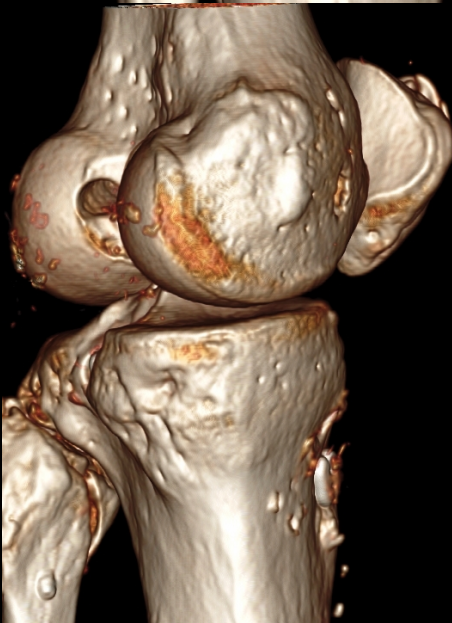
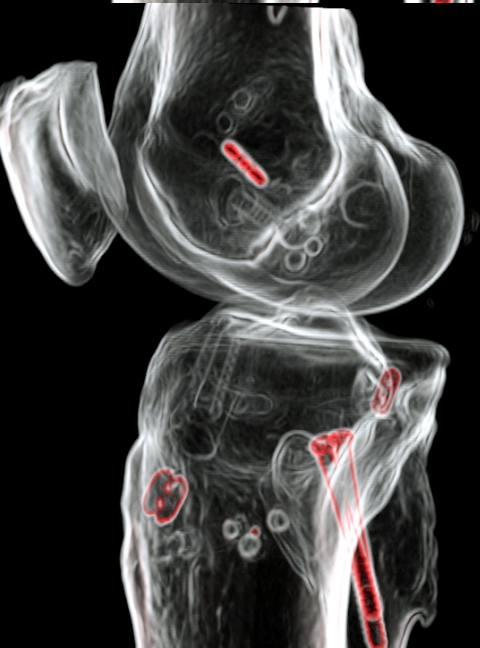
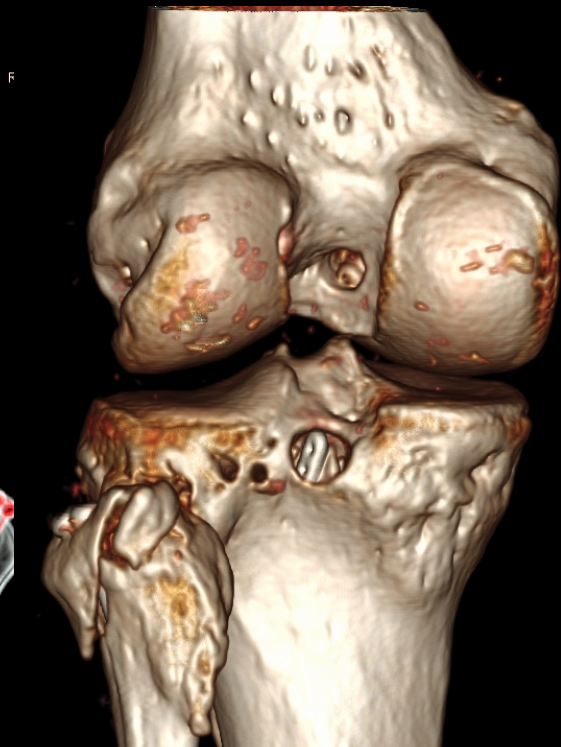
BERGFELD  
MARKOLF

MORE

LESS Am J Sports Med 2001  
JBJS 2002









# TODAY

- BIOMECHANIK DES KNIEGELENKES -  
besseres VERSTÄNDNIS
- TUNNEL PLATZIERUNG  
Vorteil -- Nachteil
- TRANSPLANTATENTNAHME  
donor site morbidity

TRANSPLANTATFIXATION

DIE KENNTNIS der **ANATOMIE** ist die  
GRUNDLAGE für die DIAGNOSTIK

DAS VERSTÄNDNIS der **BIOMECHANIK**  
ist die GRUNDLAGE für die KLASSIFIKATION  
und ERSTELLUNG des THERAPIEKONZEPTES  
und DESSEN UMSETZUNG

DAS WISSEN UM DIE **BIOLOGIE**  
ERÖFFNET den BLICK in die ZUKUNFT



# TOMORROW

- EINFLUSS der TRANSPLANTAT BIOLOGIE  
beschleunigte EINHEILUNG

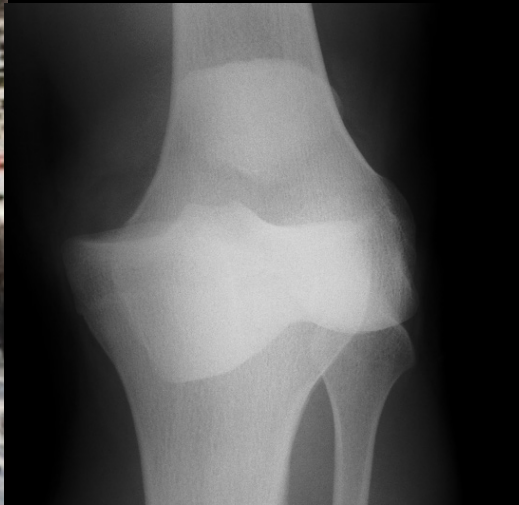
MIMICING multiaxiale FASER STRUKTUR ??

WANN ist ein a GRAFT ein NORMALES KZB ??

Was ist ein OBJECTIVER PARAMETER für die  
BIOLOGISCHE HEILUNG --- MRI ???

Wie verhindern wir die EINTWICKLUNG einer  
OSTEOARTHROSE ??

# VIELEN DANK



KNEE SURGERY still is EXCITING and a CHALLENGE