The Meniscus

Postgraduate lecture 2012

A. C. W. Hui

Historical landmarks

- Don King 1936
  - Characteristics of meniscal tears
- Smillie 1944
  - "Unimportant vestigial organs"
- Fairbank 1948
  - Radiological changes after menisectomy
- Watanabe 1962
  - First arthroscopic menisectomy

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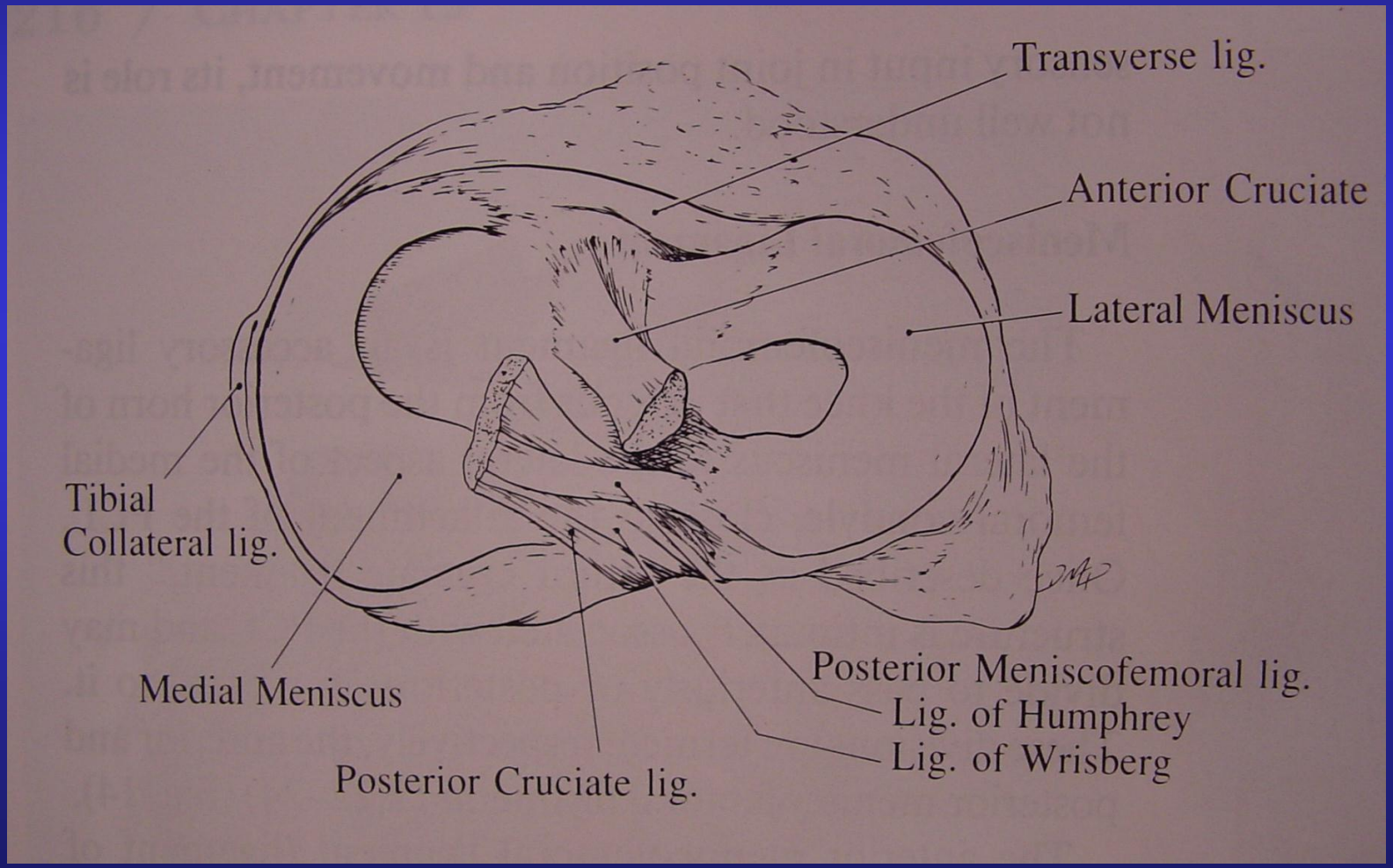
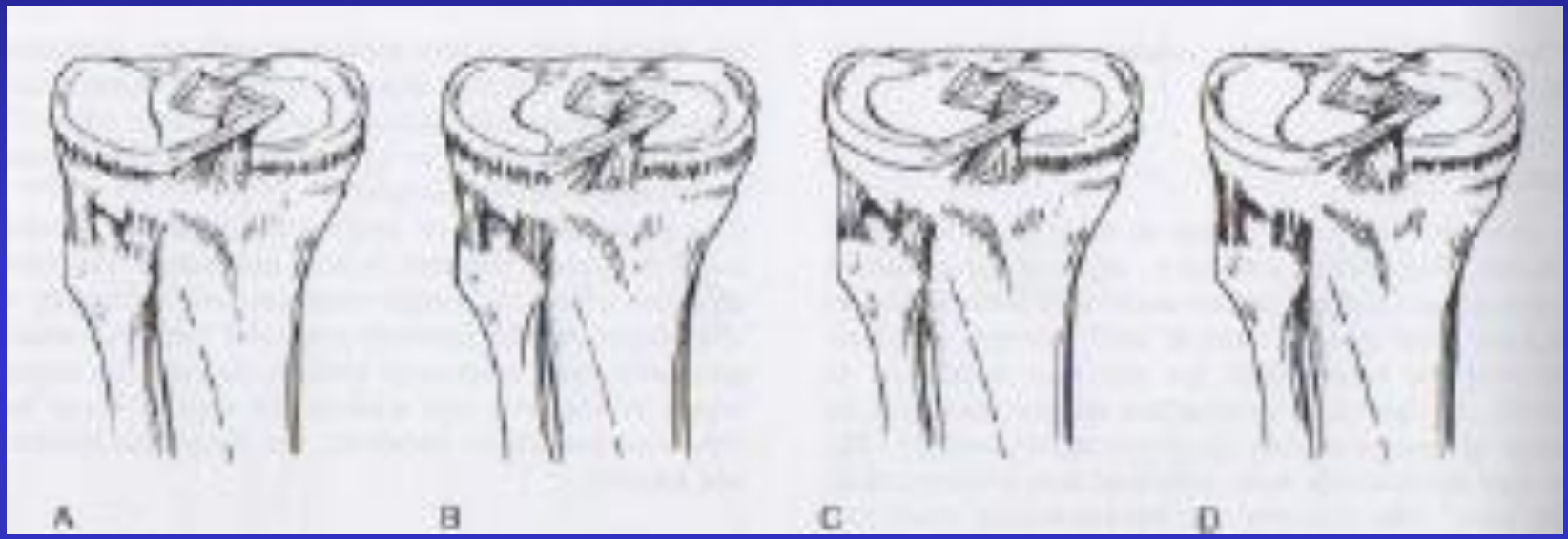
Meniscus

- Anatomy and histology
- Kinematics
- Pathology
- Treatment

Gross anatomy

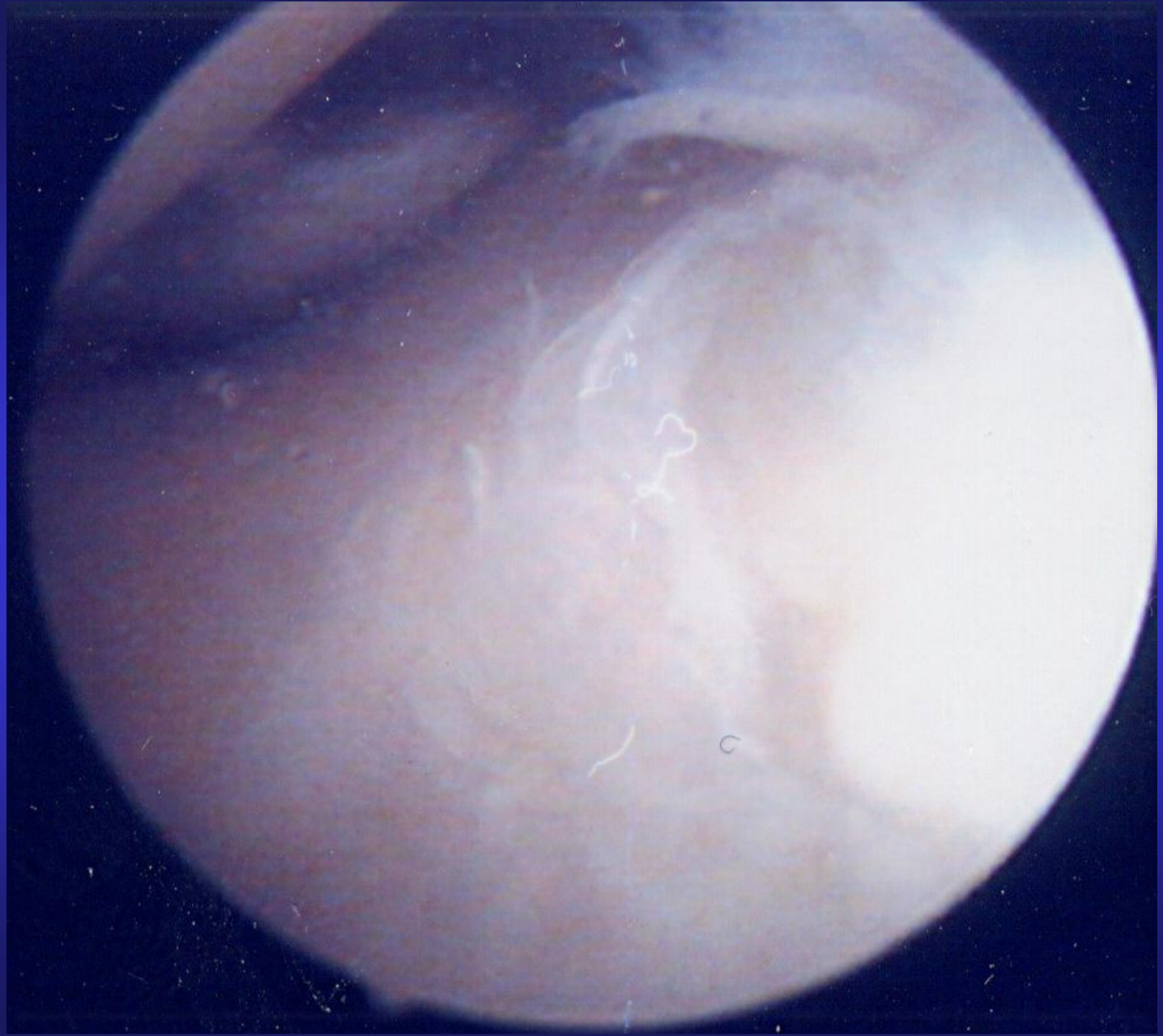


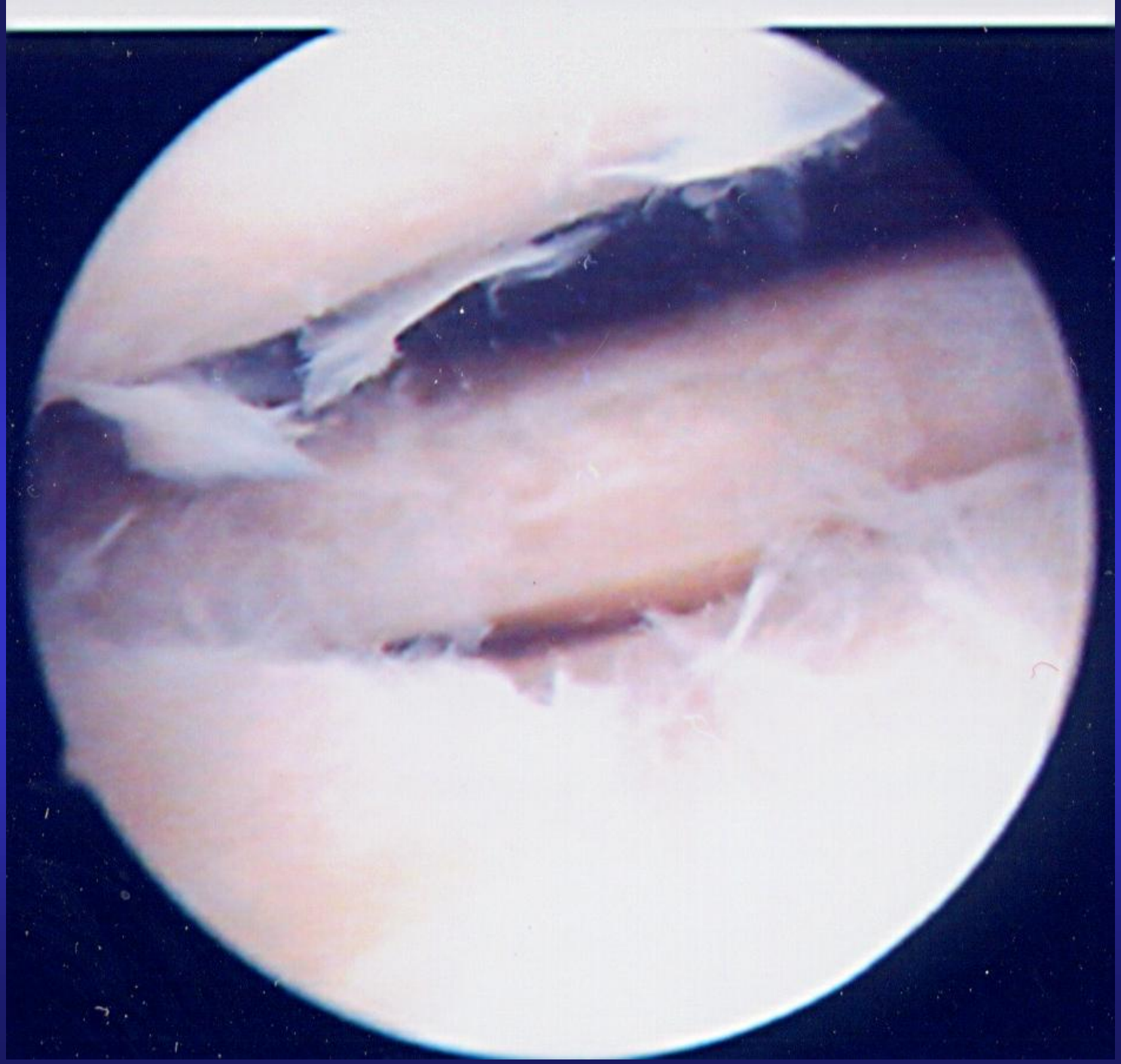
Lateral discoid meniscus



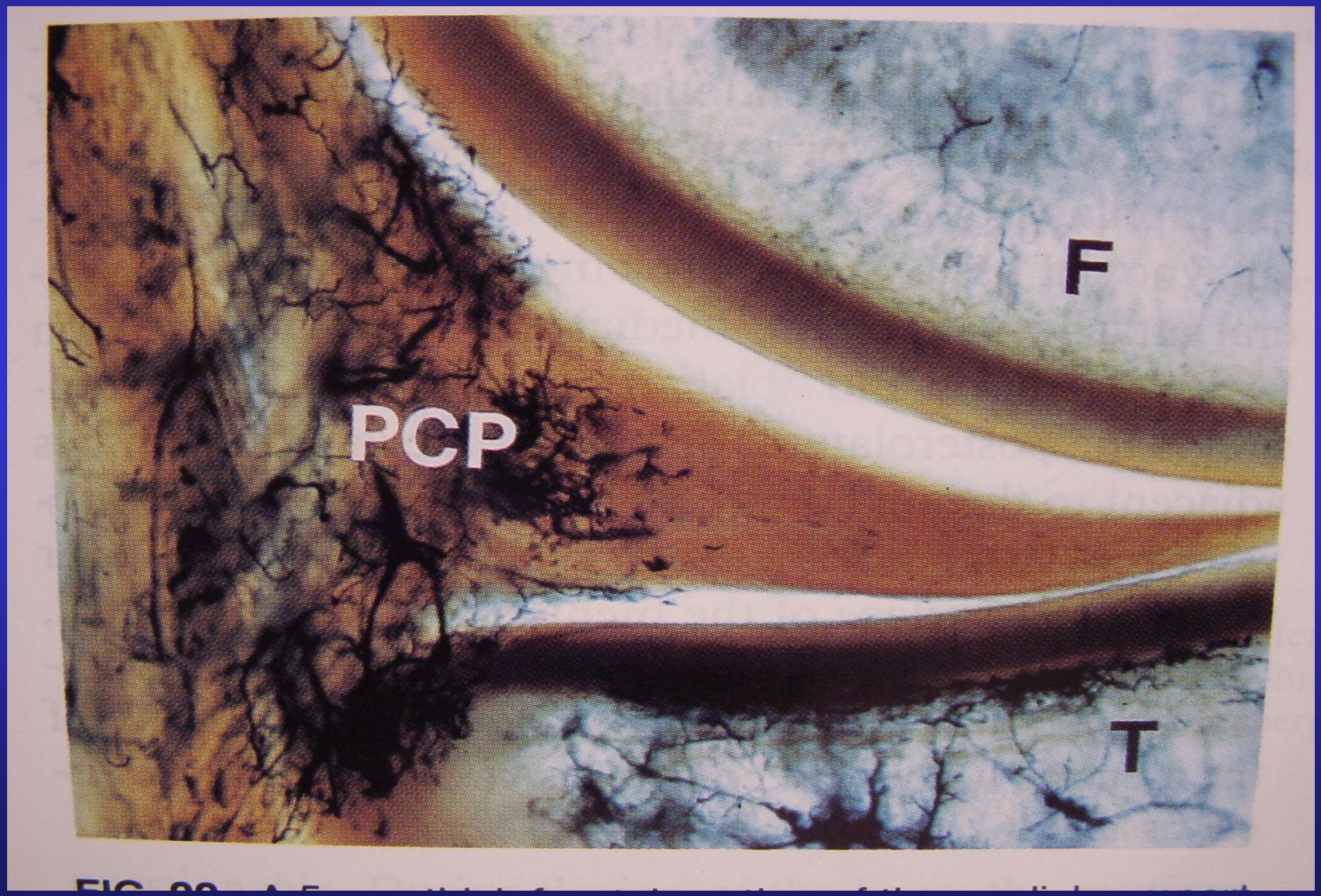
Type I II III (Wrisberg) IV (Wrisberg)

Lateral discoid meniscus

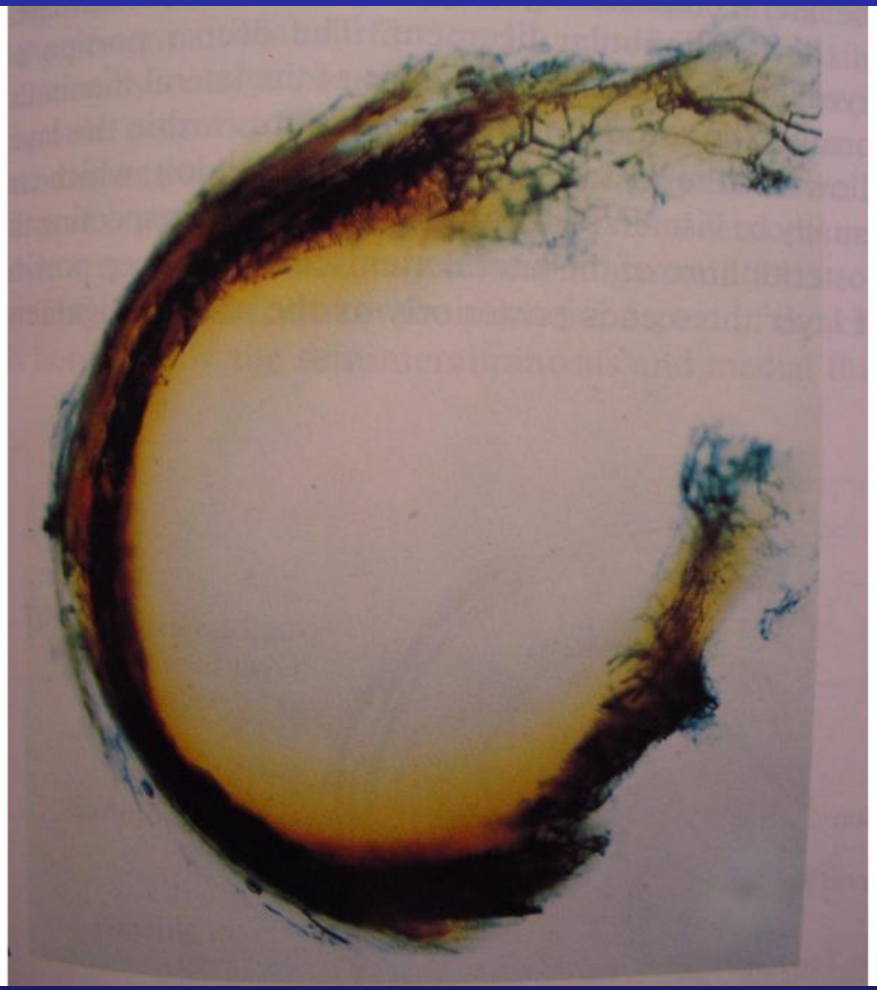




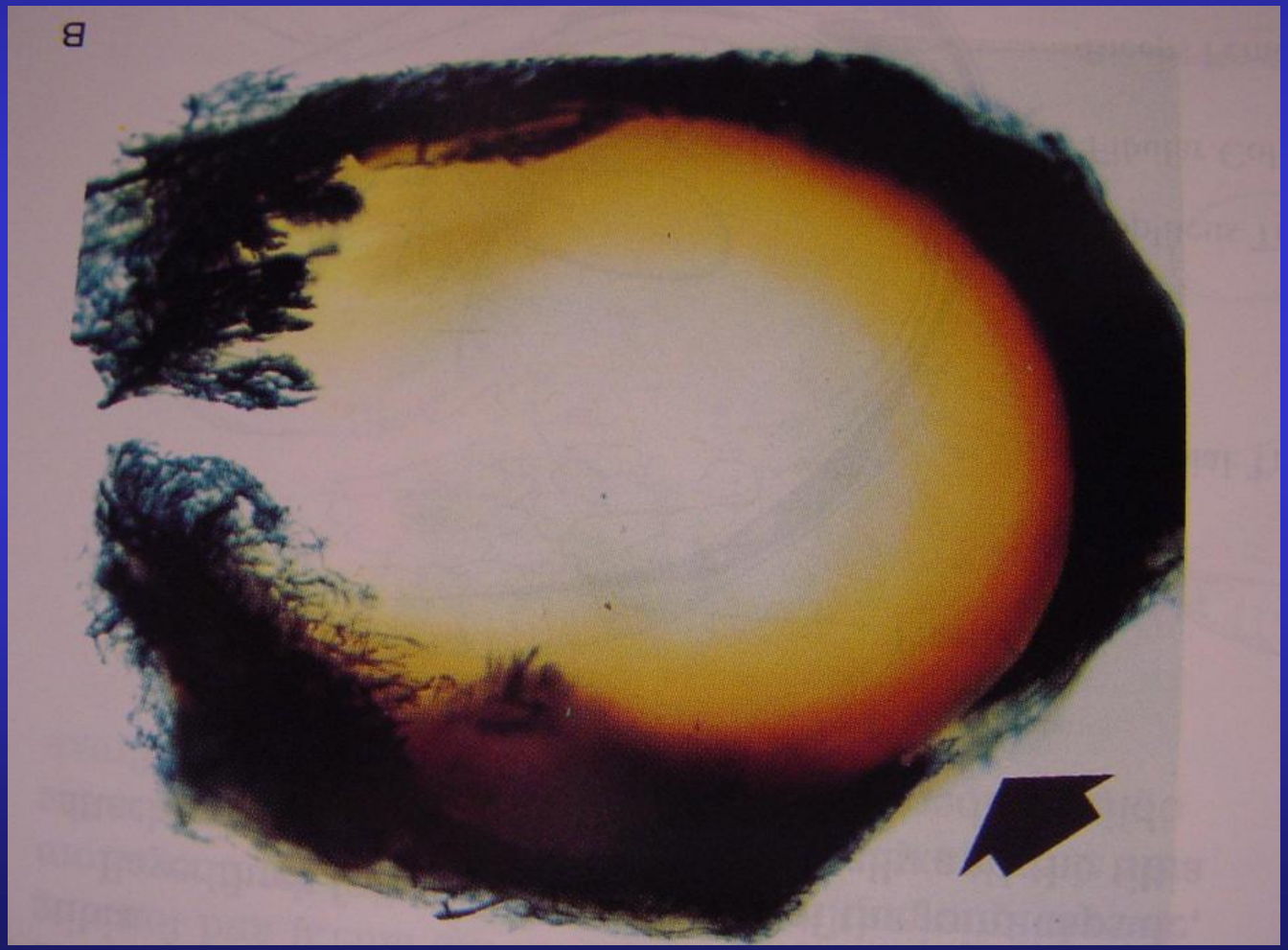
Vascular anatomy



Vascular anatomy medial meniscus

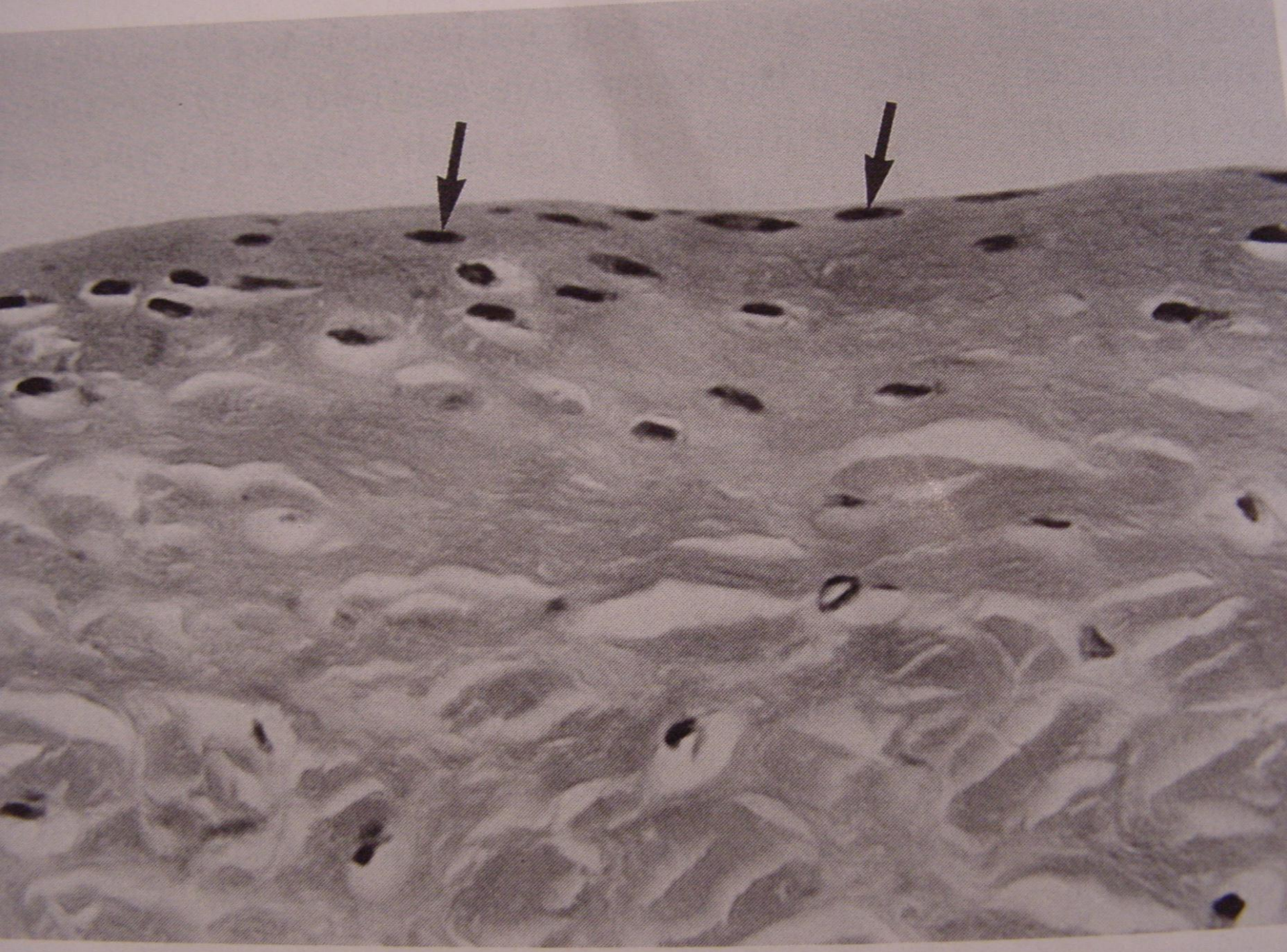


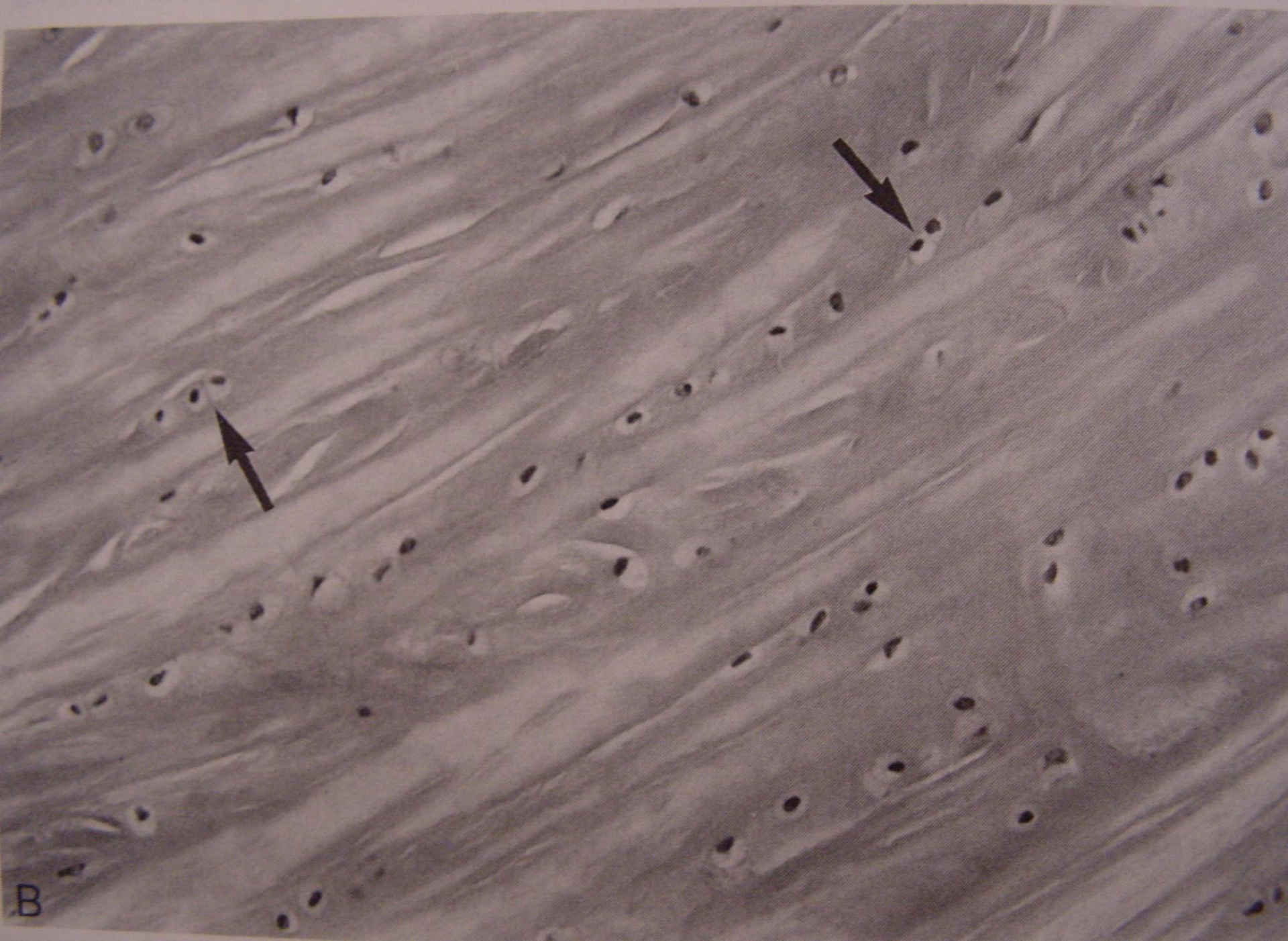
Vascular anatomy lateral meniscus



Micro-anatomy

- Cells
  - Fibrochondrocytes
- Matrix
  - Proteoglycans
  - Collagen (type I)




B

Collagen matrix

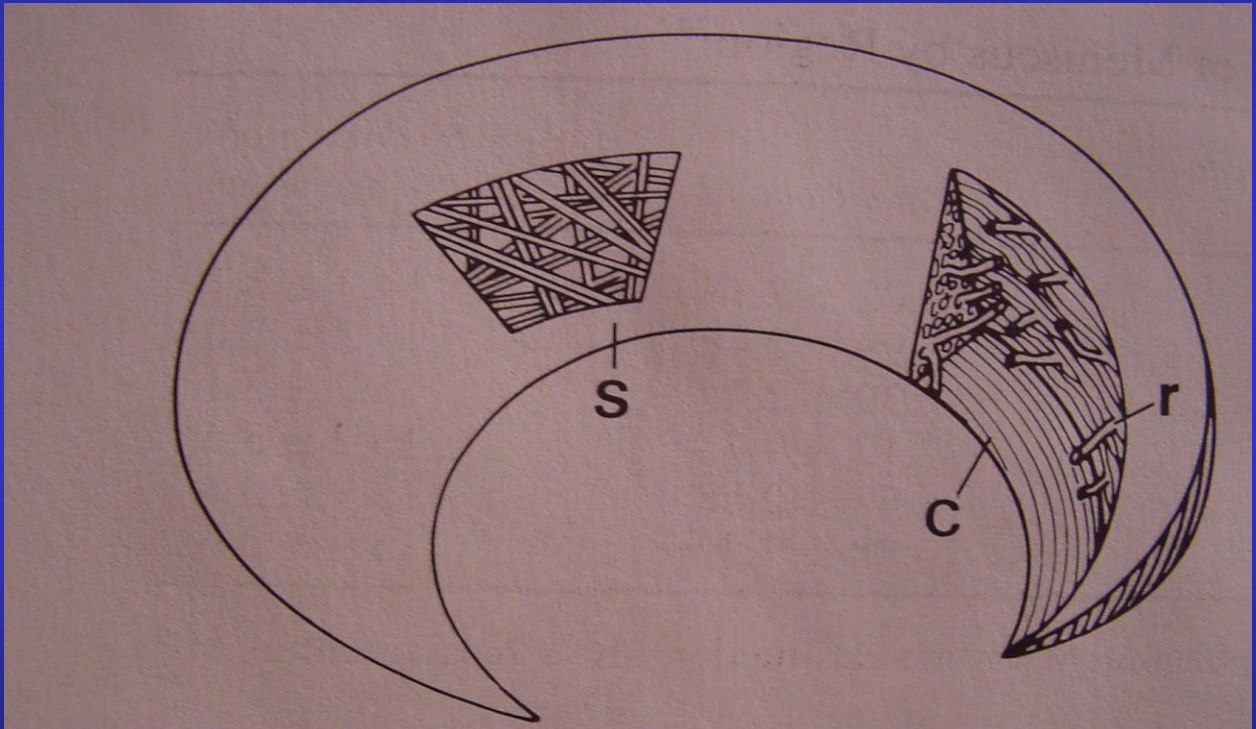


FIG. 2. Collagen ultrastructure of the meniscus, showing the surface (s) and deep zone (c) fiber orientations. Radial fibers (r) are also shown.

Mechanical properties

- Resists tensile (hoop), shear and compressive stresses
- Movement enhances dynamic conformity
- Increases surface contact area
- Secondary restraint to translation / shear

Loading forces

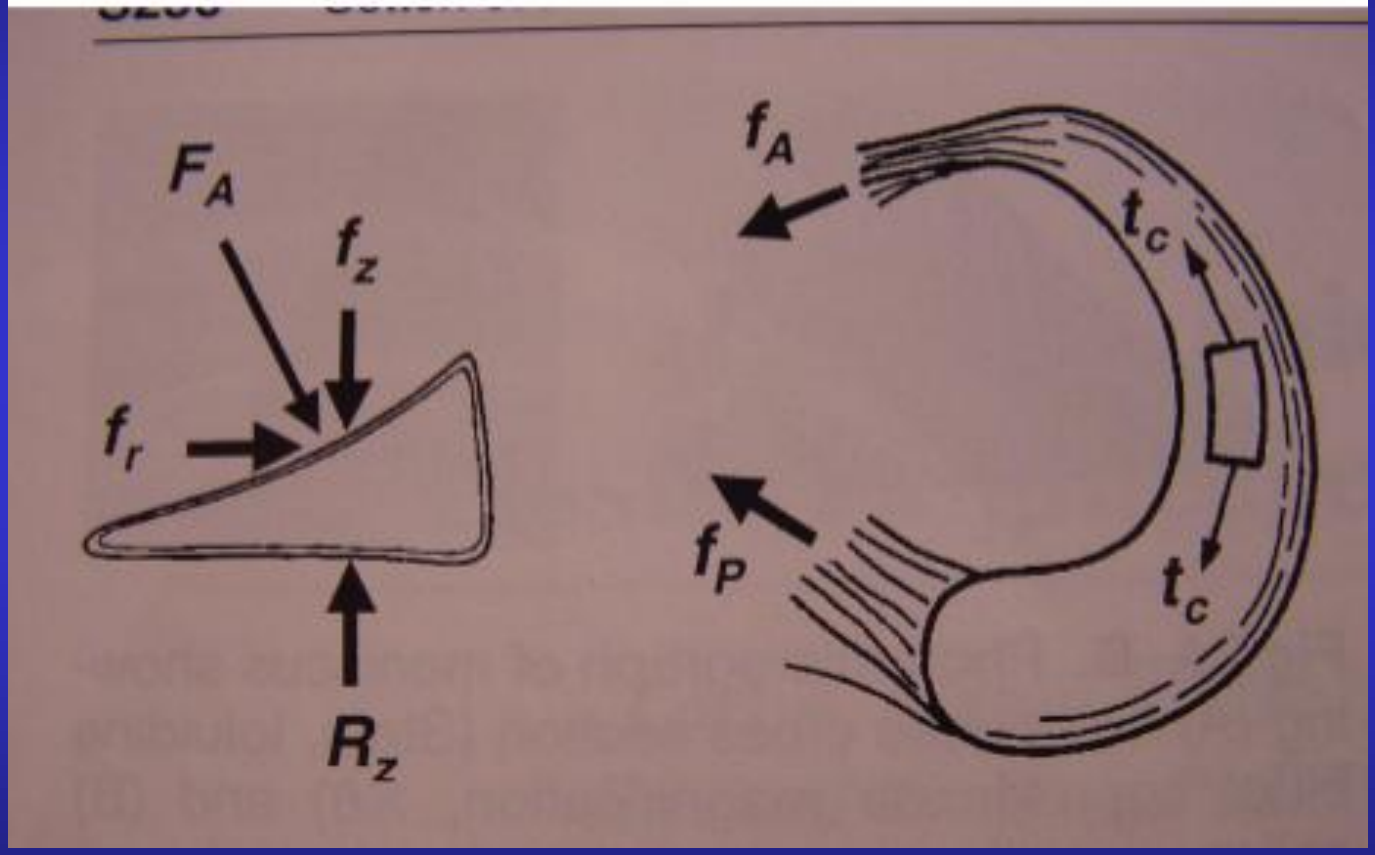


FIG. 11

Apparatus for articular survey (see text).

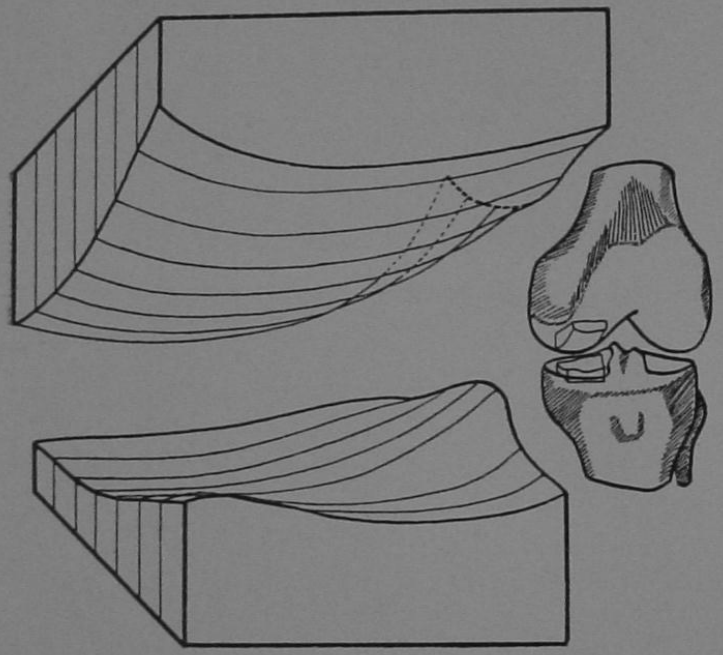


FIG. 12

Coronal section outlines of the medial condyles — interval between each section 3 mms.

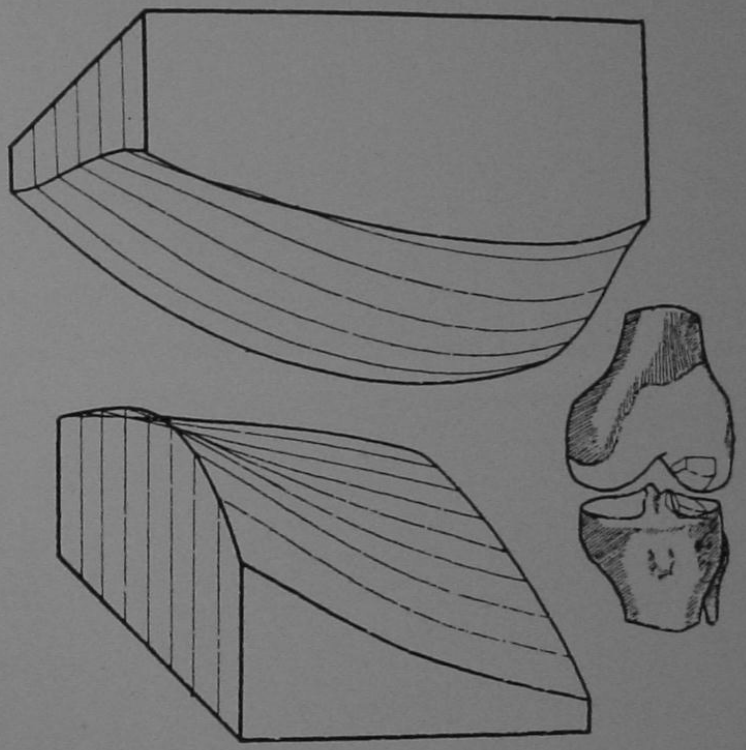
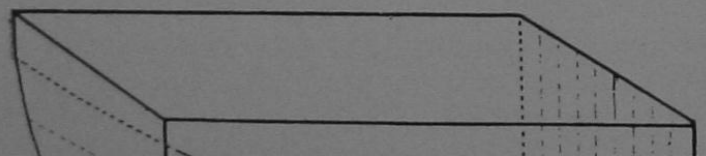
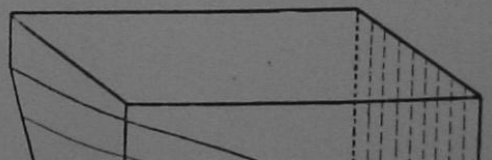


FIG. 13

Coronal section outlines of the lateral condyles—interval between each section 3 mms.





Maximum flexion

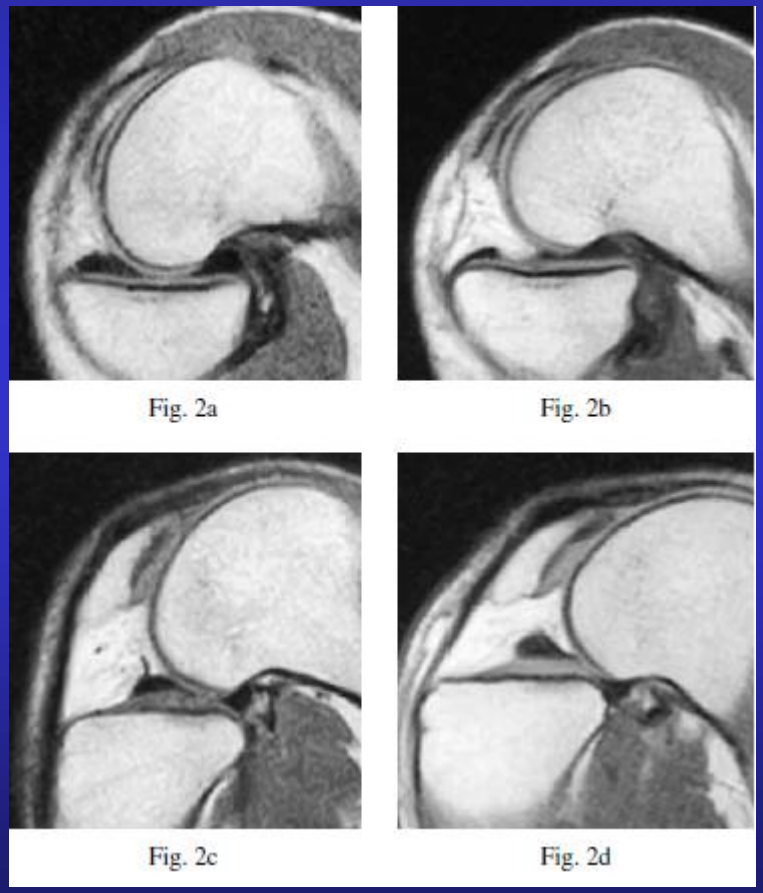
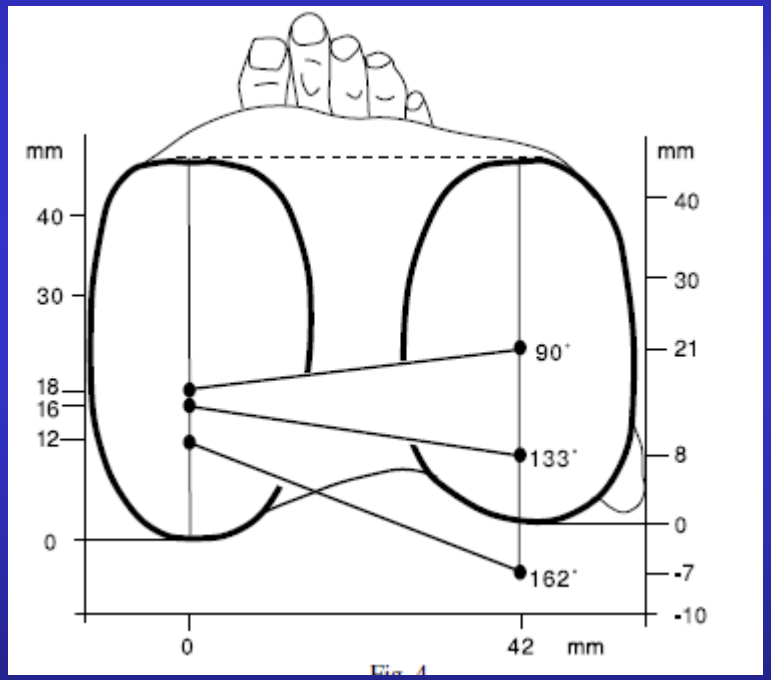


Fig. 2a

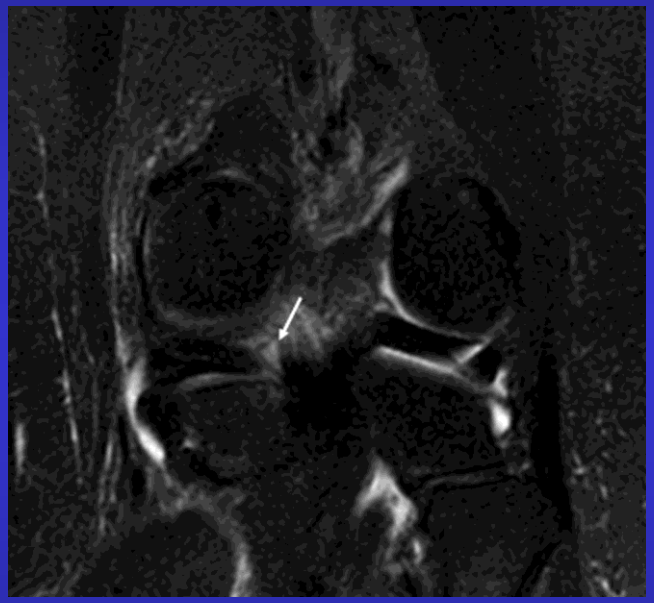
Fig. 2b

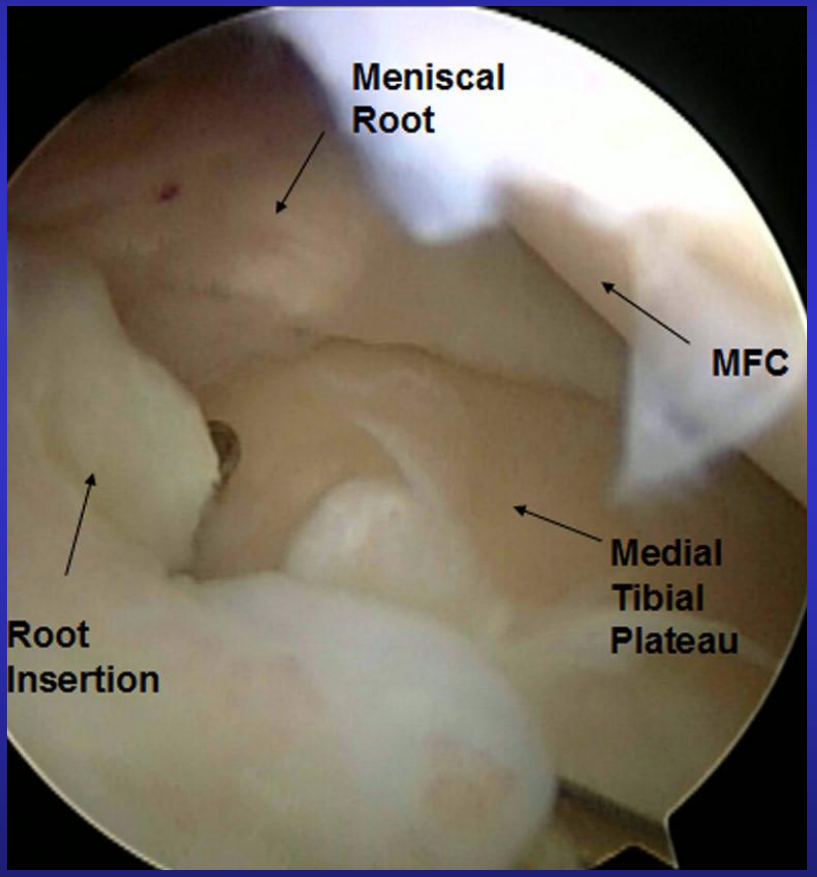
Fig. 2c

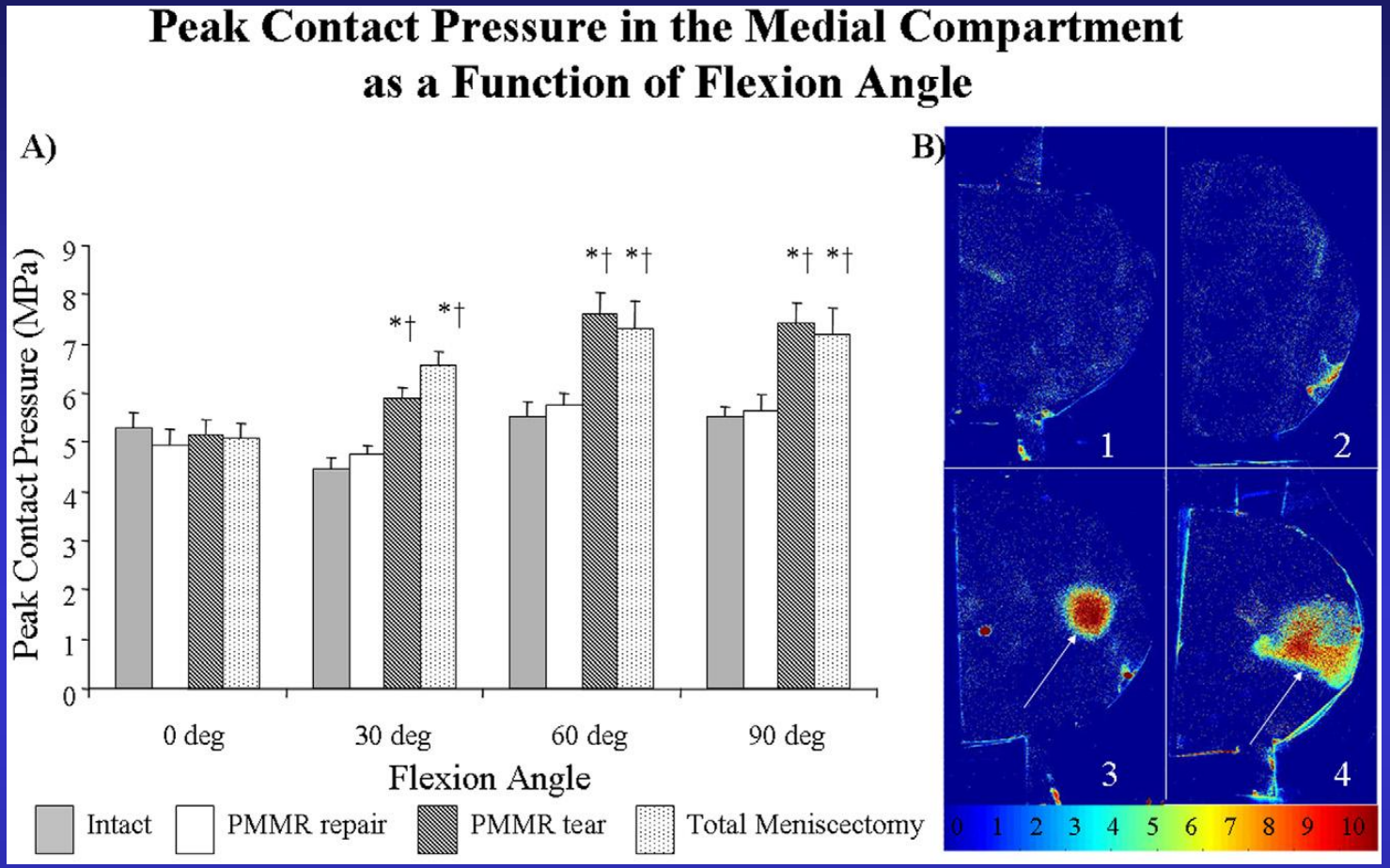
Fig. 2d



Meniscal root tears





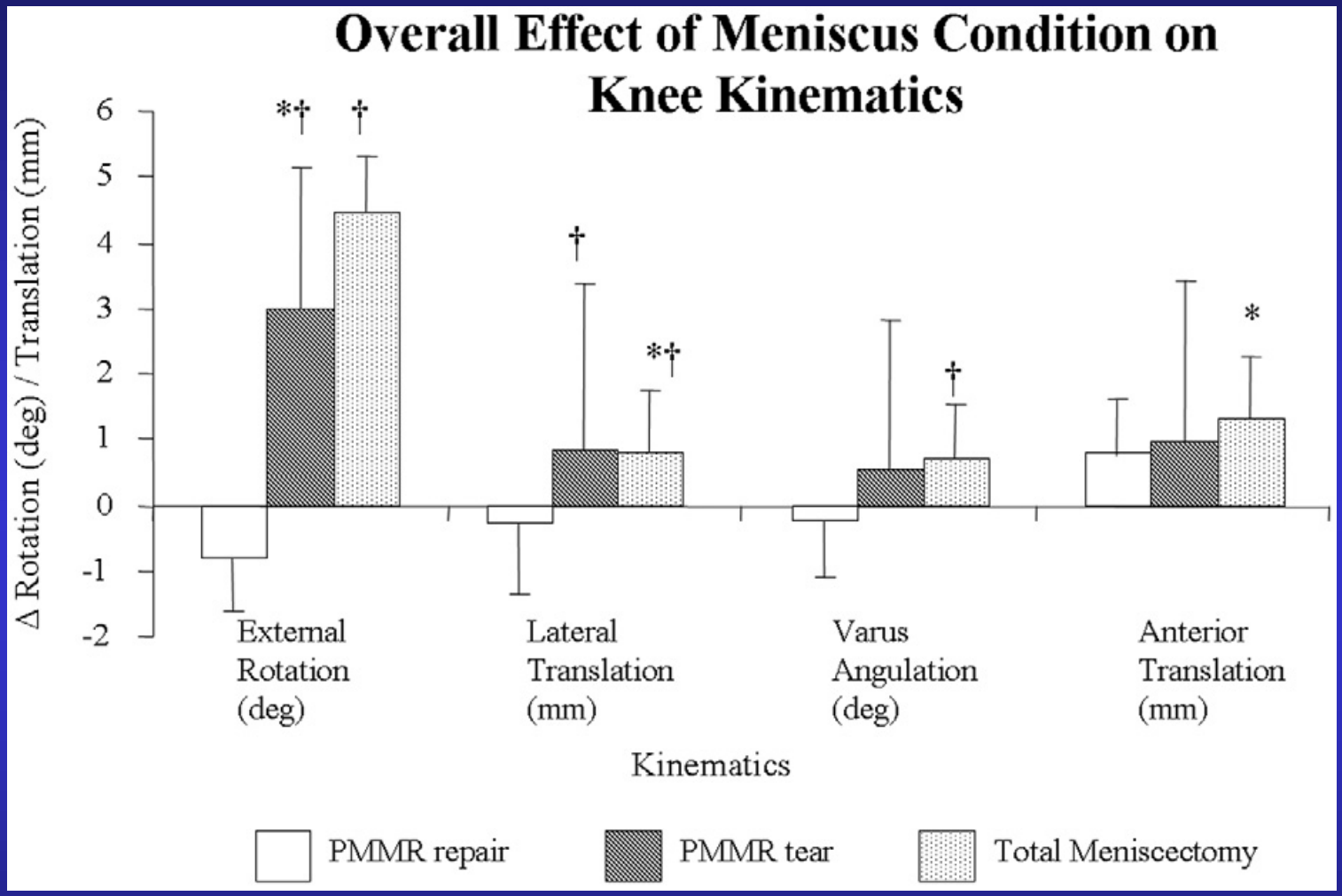


Biomechanical Consequences of a Tear of the Posterior Root of the Medial Meniscus

Similar to Total Meniscectomy

By Robert Allaire, MD, Muturi Muriuki, PhD, Lars Gilbertson, MD, and Christopher D. Harner, MD

Investigation performed at the University of Pittsburgh, Pittsburgh, Pennsylvania


Overall Effect of Meniscus Condition on Knee Kinematics
Δ Rotation (deg) / Translation (mm)
6
5
4
3
2
1
0
-1
-2
*†
†
†
*†
†
*
External Rotation (deg)
Lateral Translation (mm)
Varus Angulation (deg)
Anterior Translation (mm)
Kinematics
PMMR repair
PMMR tear
Total Meniscectomy

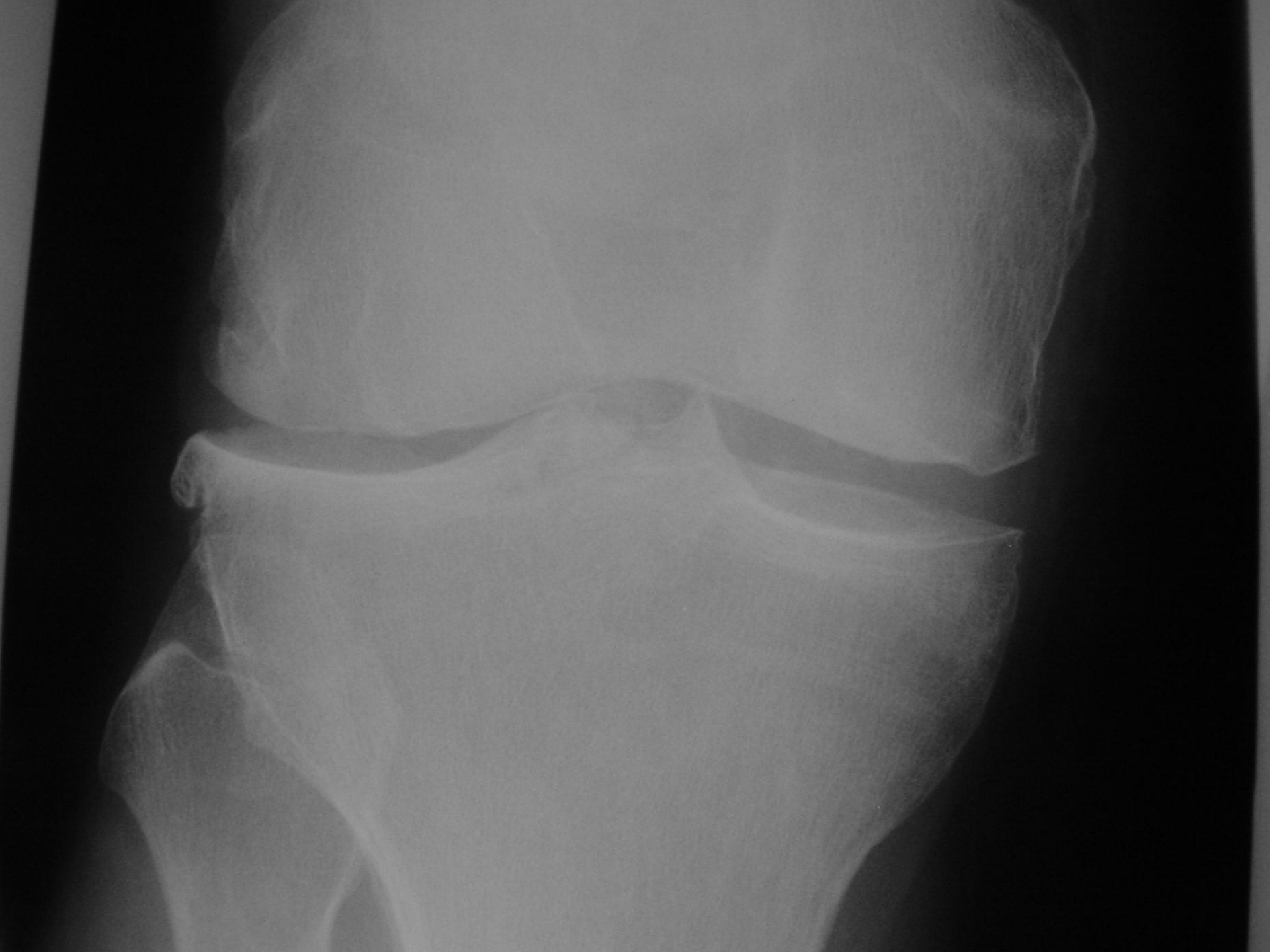
KNEE JOINT CHANGES AFTER MENISCECTOMY

T. J. Fairbank, London, England

paper records an investigation of changes found in the knee joint at in
m three months to fourteen years after meniscectomy. In a search of the lit
ference to these changes has been found. Vandendorp, Bastien, and Vande
observed in a few subjects that there was narrowing of the joint spa
of the femoral and tibial condyles on the operated side of the joint, bu
explanation of their findings.

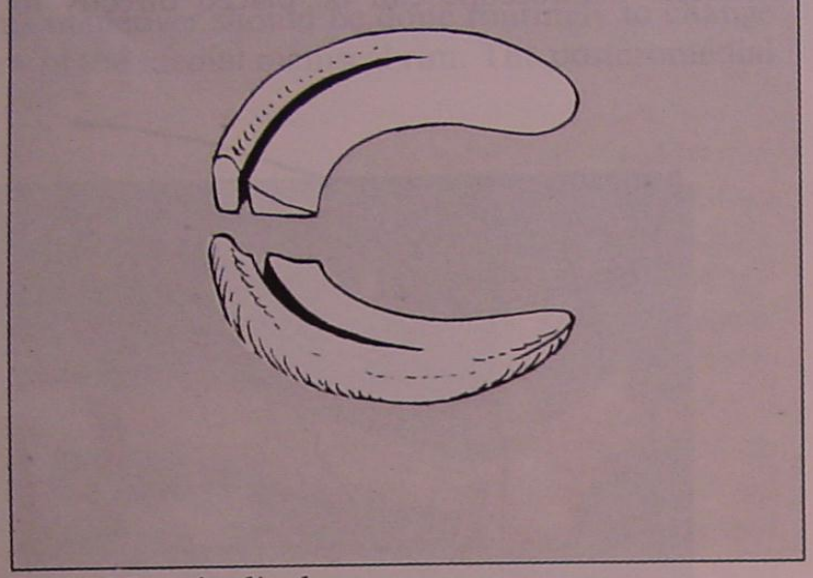
RADIOLOGICAL STUDY

excluding all cases with definite osteoarthritis, a comparison was made b
perative and post-operative X-ray films in one hundred and seven ca

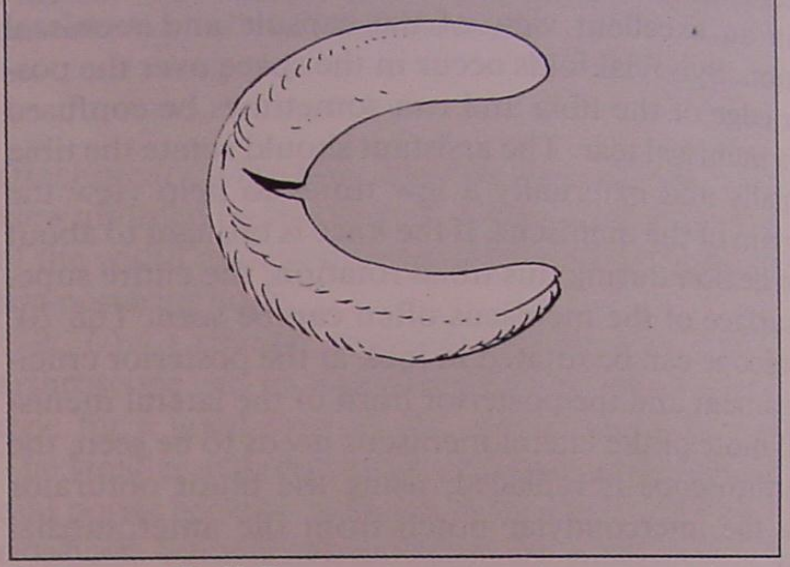


Meniscal tears

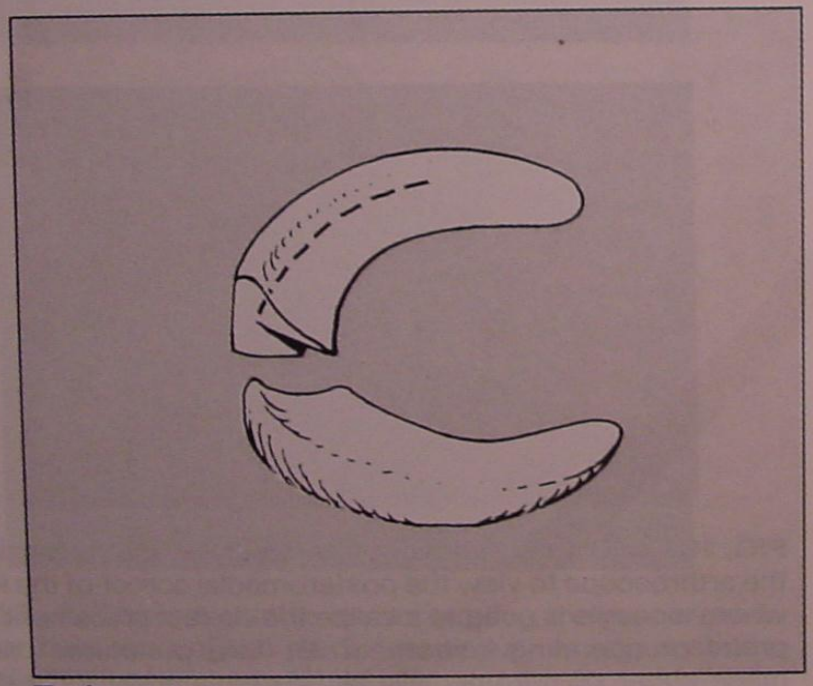
- ACUTE:
  - Perpheral detachment (bucket handle)
  - Radial (root tears)
  - Longitudinal/vertical (partial or full thickness)
- DEGENERATE:
  - Under-surface partial
  - Horizontal cleavage
  - Flap



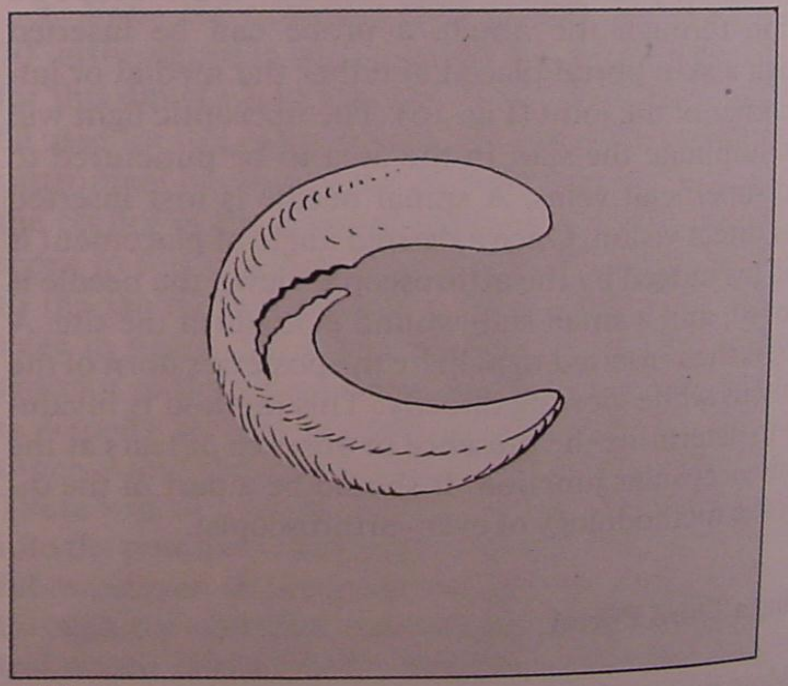
Vertical Longitudinal



Transverse (Radial)



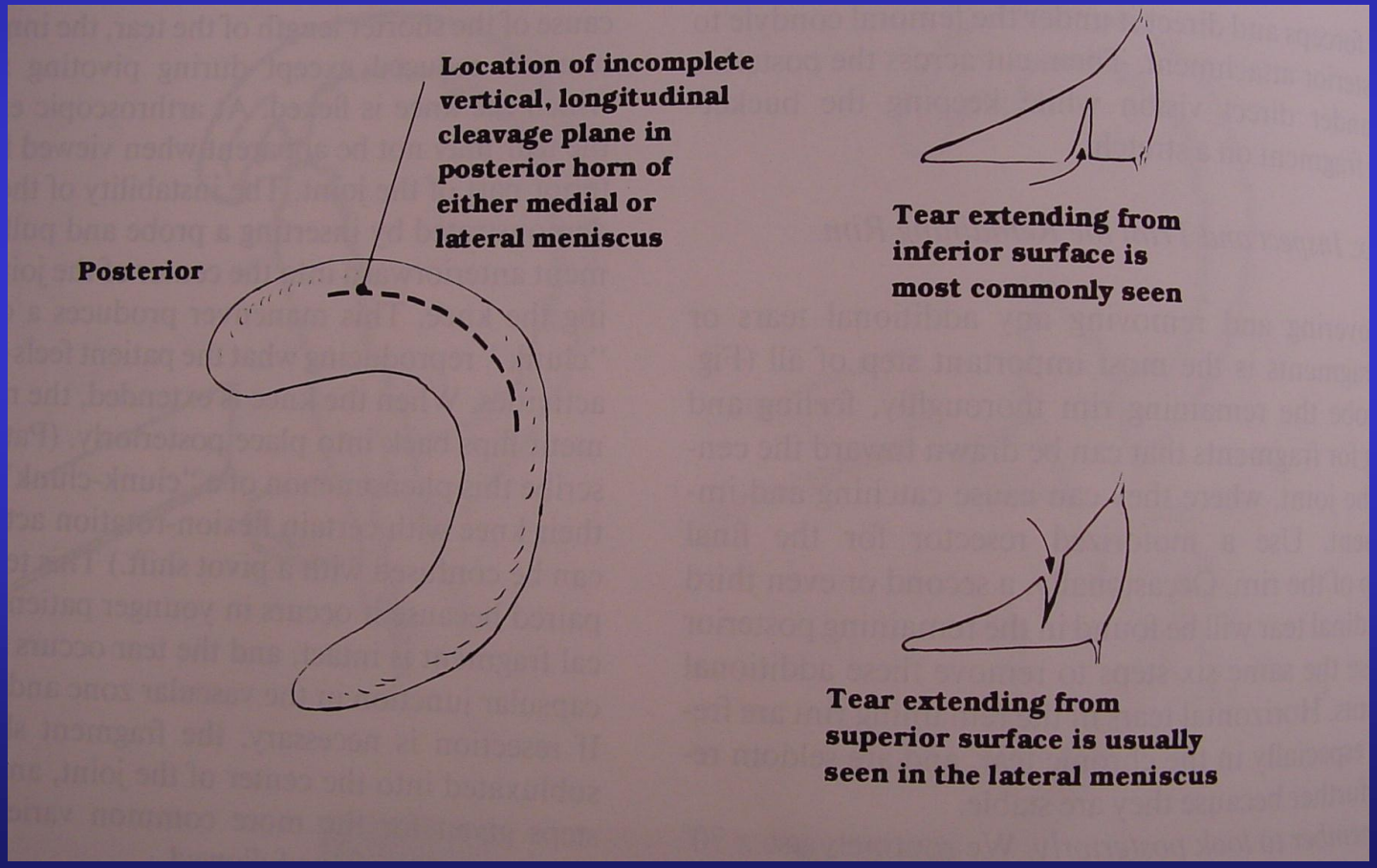
Horizontal

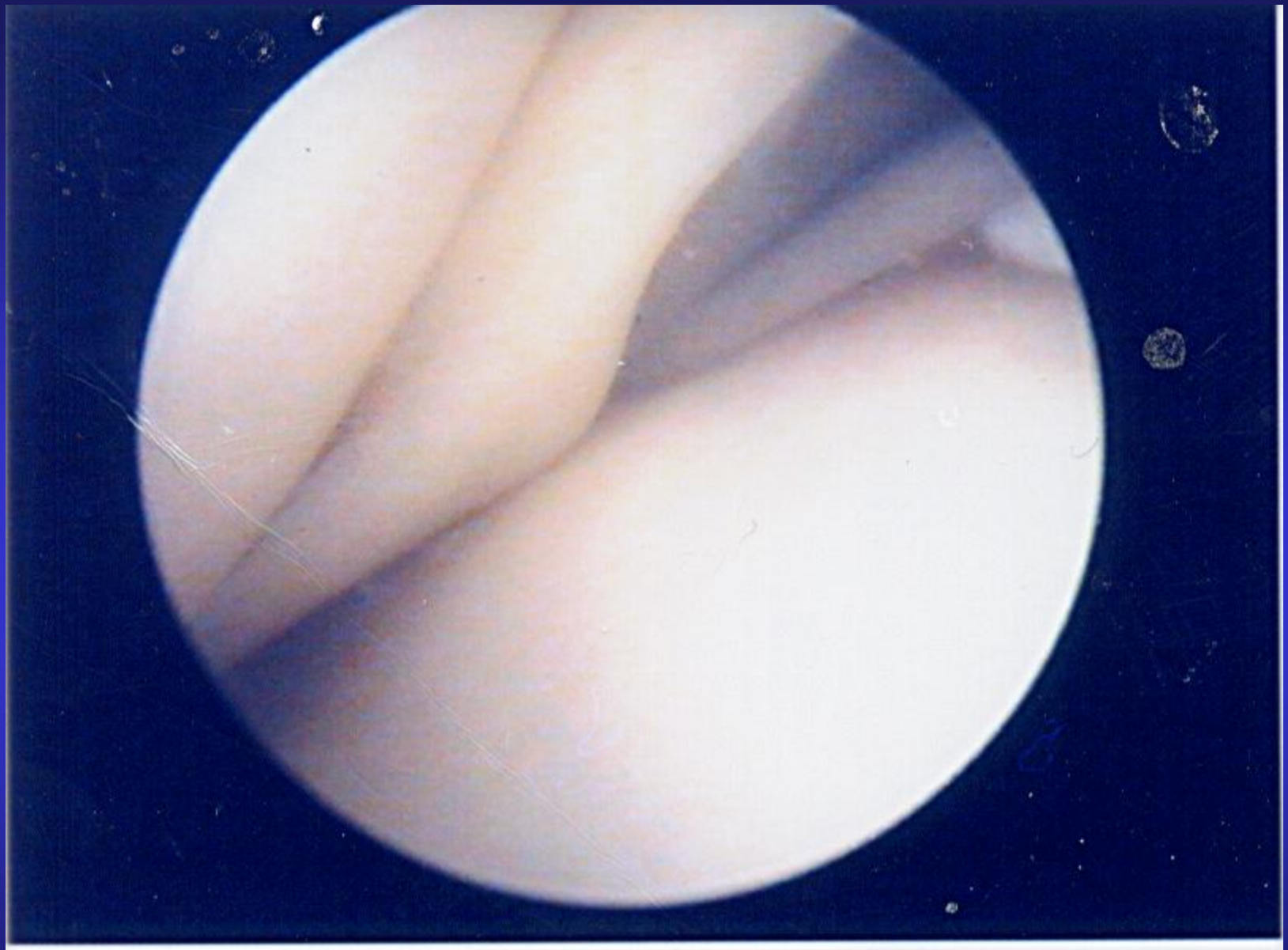


Oblique

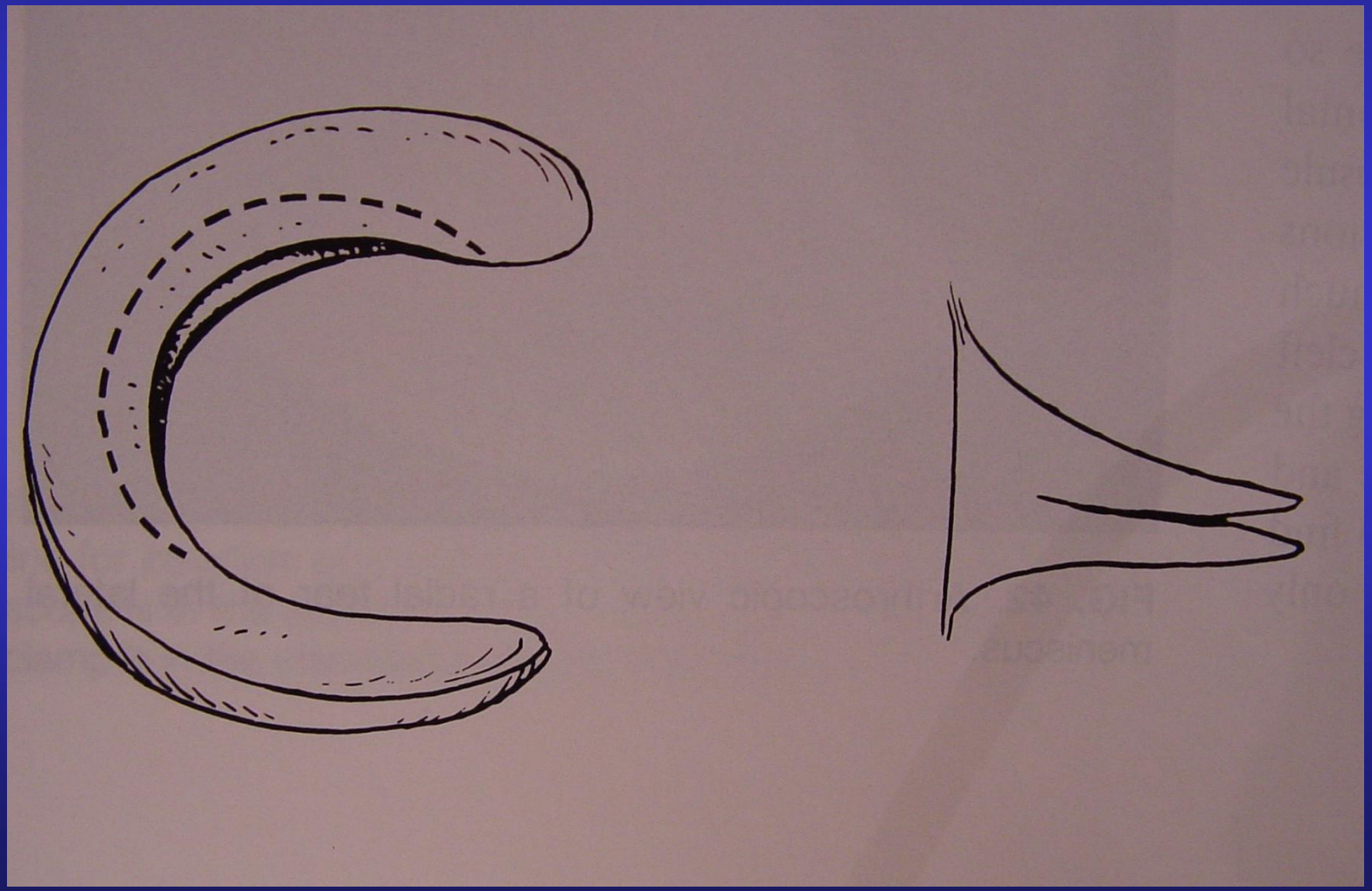
FIG. 18. Representation of the four major types of meniscal tears.

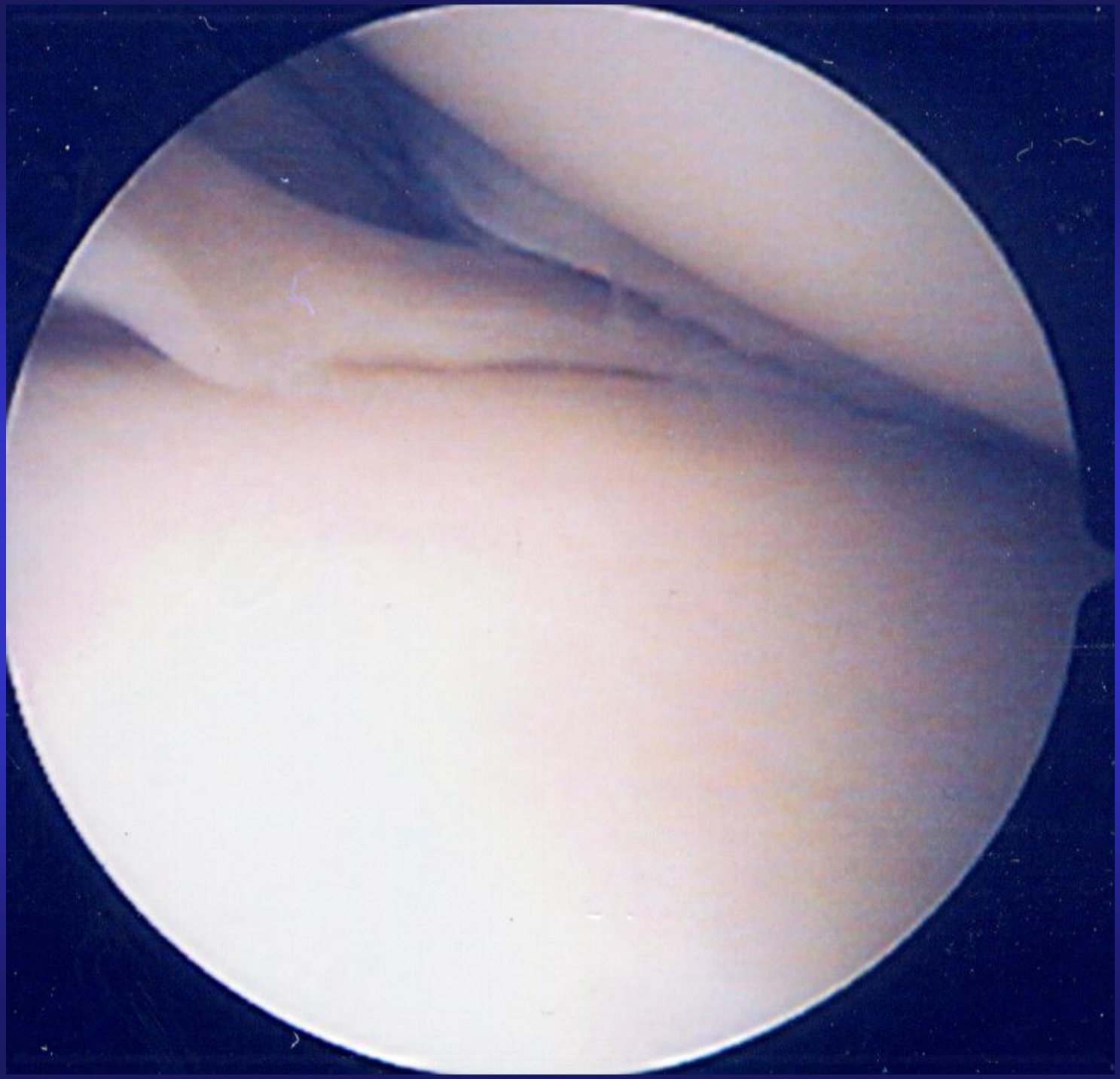
Undersurface/partial tear



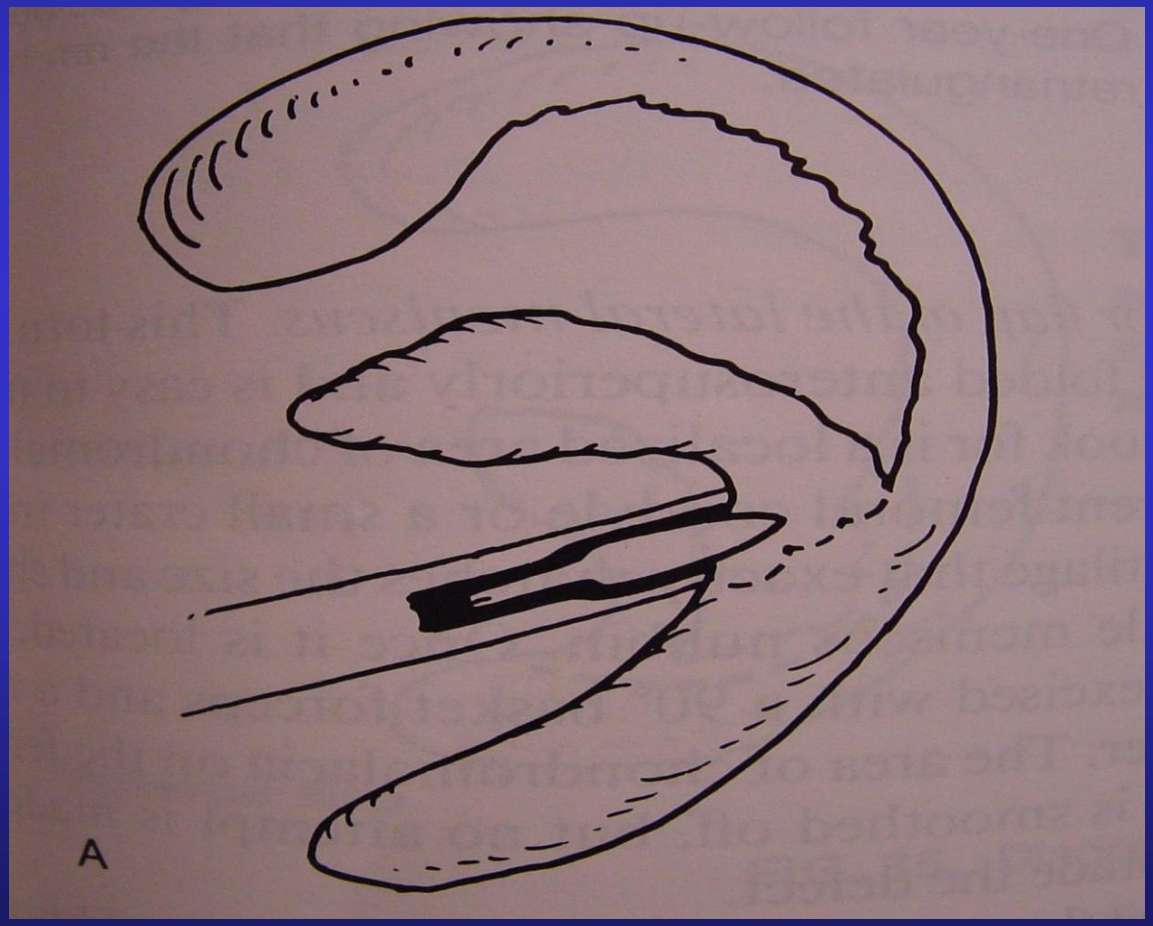

MIDDLESBROUGH GENERAL HOS

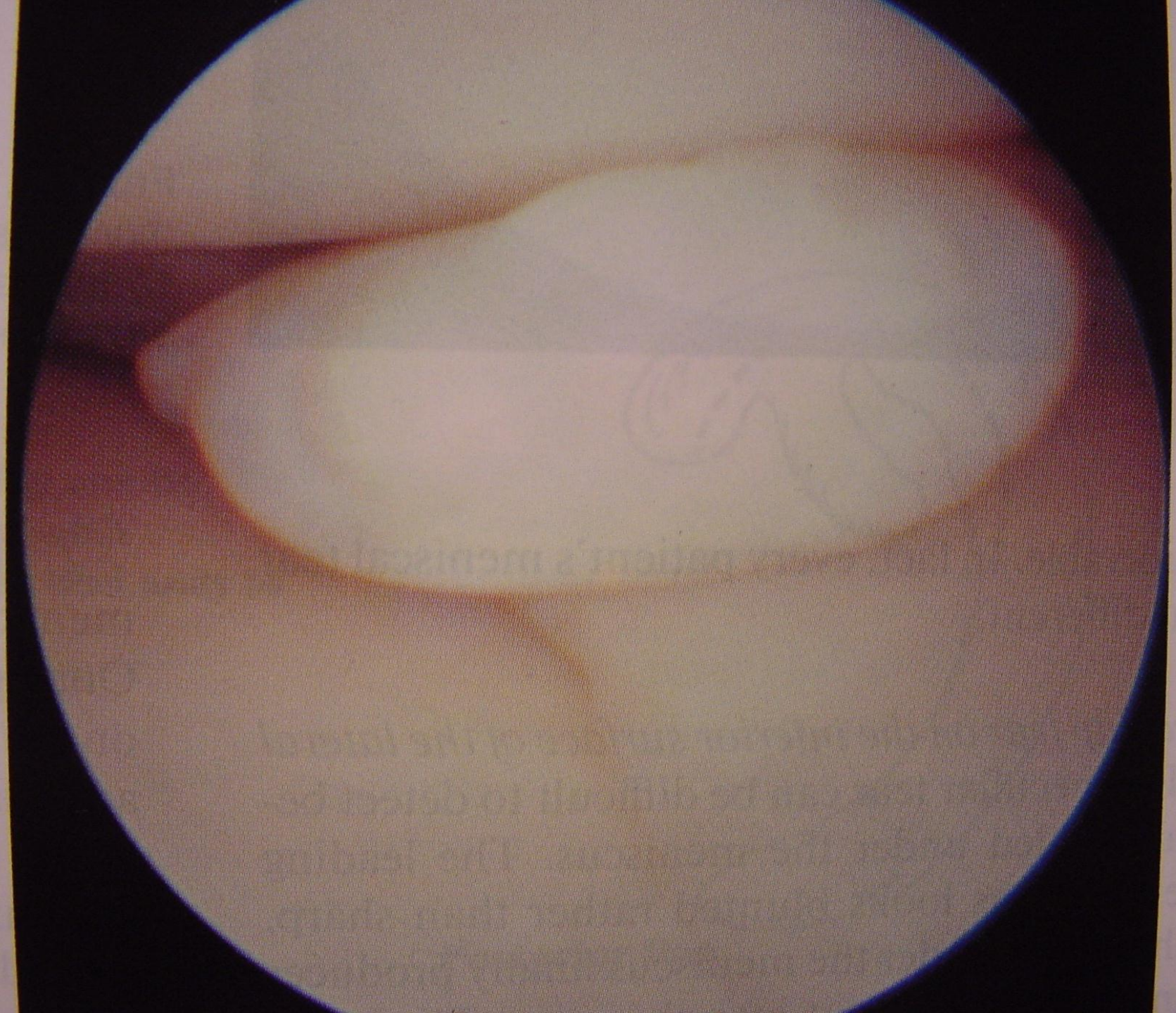
Cleavage/horizontal tear

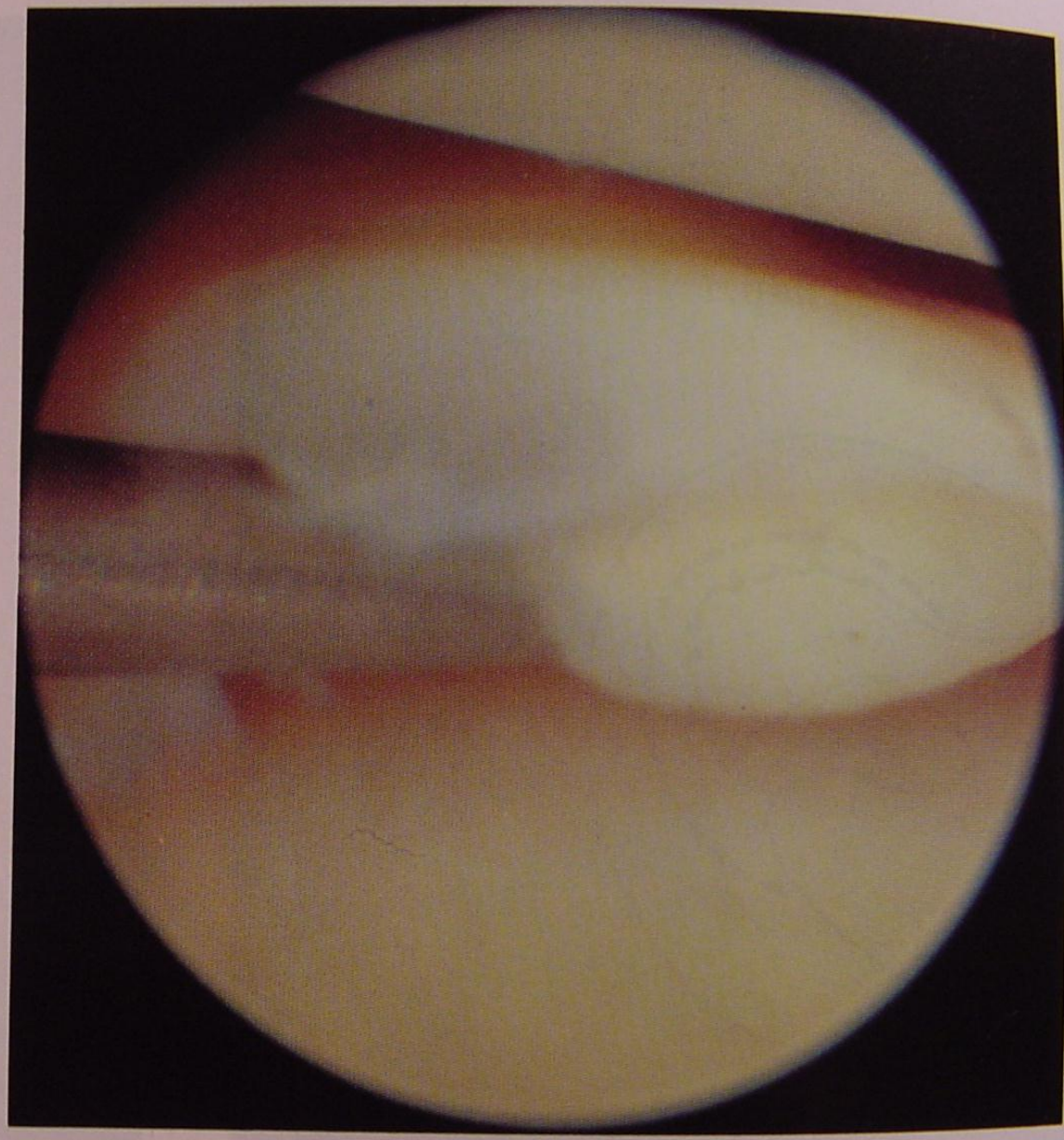




Flap tear







Presentation

Symptoms

- Pain
- Swelling
- Locking

Signs

- Localised tenderness
- Quads wasting
- Effusion
- Blocked extension
- ? McMurray's/ Appley's tests

Diagnosis

- Clinical diagnosis approaches 80% in specialist knee surgeon
- X-rays to exclude other pathology
- MRI – 98% sensitive for medial meniscus, 80% for lateral meniscus*


180
SP
SL
FoV 16
252

Rationale of treatment

- Failure to heal
- Results of partial menisectomy is good
- Total menisectomy leads to OA
- Results of meniscal repair is 80% successful

Meniscal excision

Appropriate in

- Older patients with less physical demands
- Central tears, degenerate tears, flap tears or old sclerotic tears
- Other co-existing pathology e.g. OA
- Unstable knee that are to be treated conservatively


£50
Bank of England

Treatment options

- Conservative treatment
- Partial menisectomy
- Repair
- Transplant or implant

Editorial

THE KNEE AFTER MENISCECTOMY

M. F. Macnicol, N. P. Thomas

- >90% excellent or good if no other pathology
- 62% if other articular degeneration
- Satifactory if grade I or II
- Only 7% good results and 25% poor in III & IV

Arthroscopy for OA and "locking"

The New England
Journal of Medicine

VOLUME 347 JULY 11, 2002 NUMBER 2

A CONTROLLED TRIAL OF ARTHROSCOPIC SURGERY FOR OSTEOARTHRITIS OF THE KNEE

J. BRUCE MOSELEY, M.D., KIMBERLY O'MALLEY, PH.D., NANCY J. PETERSEN, PH.D., TERRI J. MENKE, PH.D., BARUCH A. BRODY, PH.D., DAVID H. KUYKENDALL, PH.D., JOHN C. HOLLINGSWORTH, DR.P.H., CAROL M. ASHTON, M.D., M.P.H., AND NELDA P. WRAY, M.D., M.P.H.

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 SEPTEMBER 11, 2008 VOL. 359 NO. 11

A Randomized Trial of Arthroscopic Surgery for Osteoarthritis of the Knee

Alexandra Kirkley, M.D.,* Trevor B. Birmingham, Ph.D., Robert B. Litchfield, M.D., J. Robert Giffin, M.D., Kevin R. Willits, M.D., Cindy J. Wong, M.Sc., Brian G. Feagan, M.D., Allan Donner, Ph.D., Sharon H. Griffin, C.S.S., Linda M. D'Ascanio, B.Sc.N., Janet E. Pope, M.D., and Peter J. Fowler, M.D.

Degenerate meniscal tears + OA

Topic: B. Knee Surgery

Title: Treatment of meniscal tears in the osteoarthritic knee

Author(s): B.C. Hanusch, S. Harrison, K. Tsang, A. Khunda, A.C. Hui [Middlesbrough]

Institute(s): James Cook University Hospital, Trauma and Orthopaedic Surgery, Middlesbrough, United Kingdom

143 patients with the diagnosis of a meniscal tear and orthoarthritis of the knee were identified fr the reports of all knee MRI in 2005. They were sent a questionnaire to capture data on treatment and mechanism of injury and were asked to complete the WOMAC knee osteoarthritis index and EQ-5D to assess functional and health outcomes. Data on treatment was also obtained from the patients hospital notes.

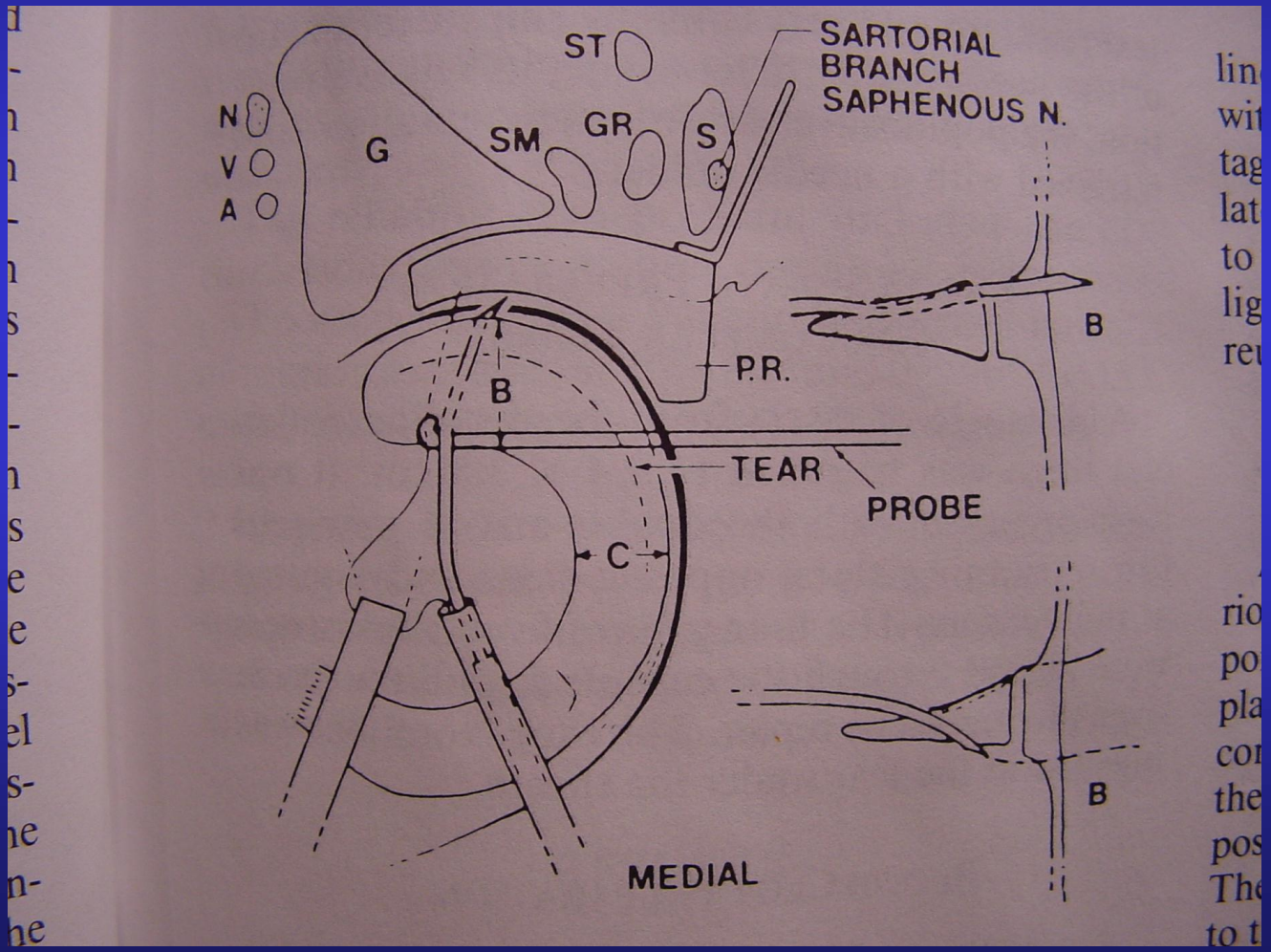
This study found no significant difference in functional and health outcomes between operative a non-operative treatment methods for degenerate meniscal tears. Further controlled trial need to b undertaken to establish if the high rate of arthroscopy in this group of patients is justified.

Meniscal repair

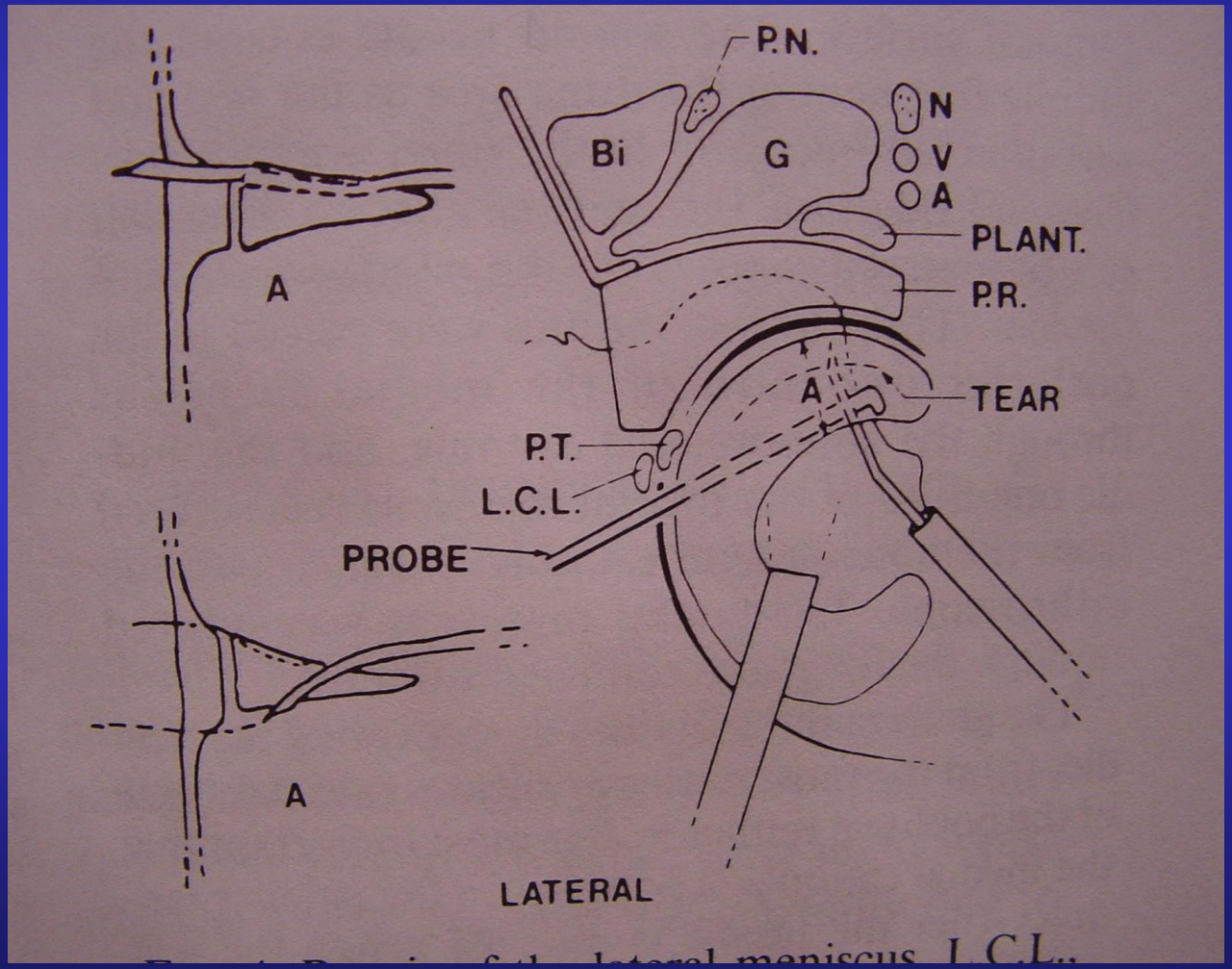
Consider repair in

- Younger patients
- Peripheral tears
- Older active patients with no other pathology in the knee

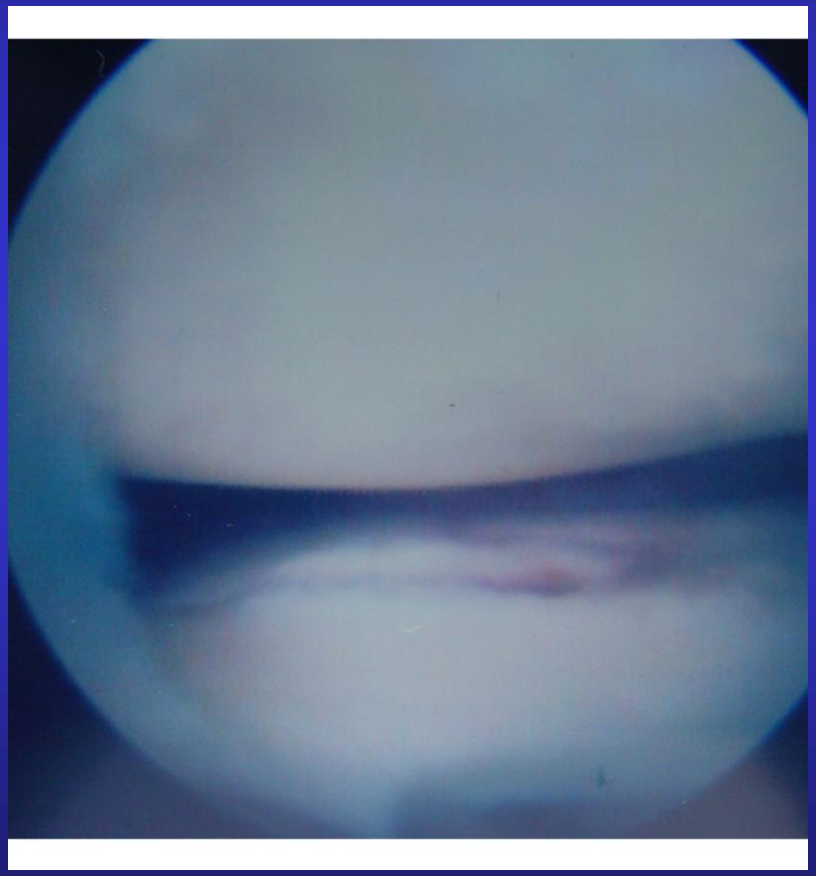
Meniscal suturing (medial)

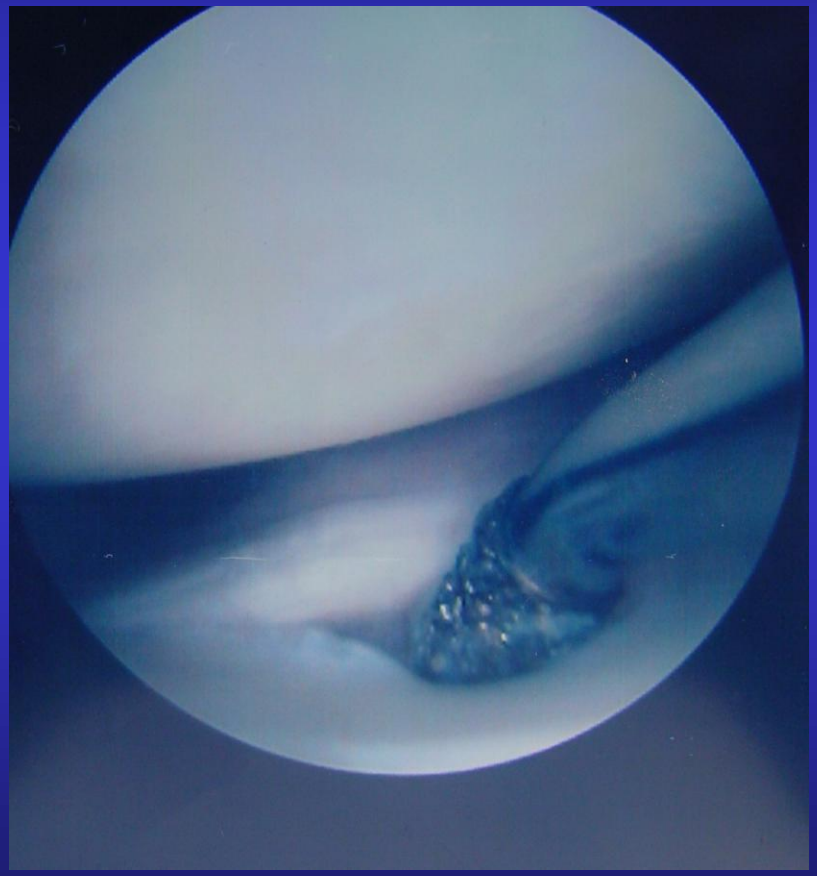


Meniscal suturing (lateral)



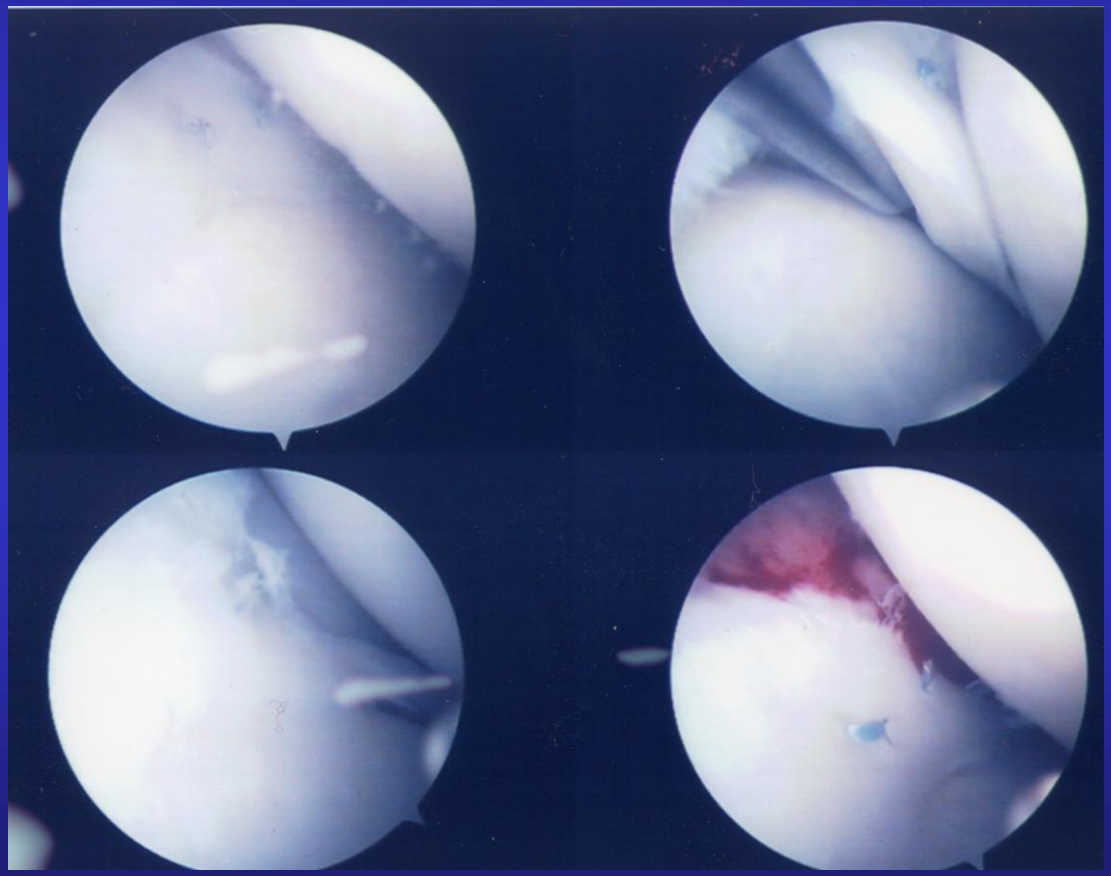
Meniscal suturing - rasping

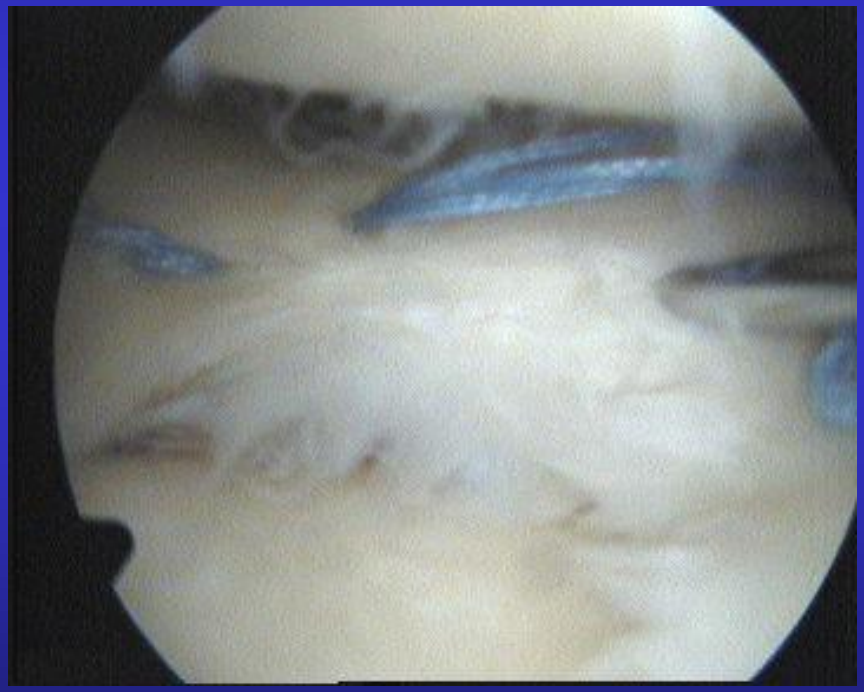


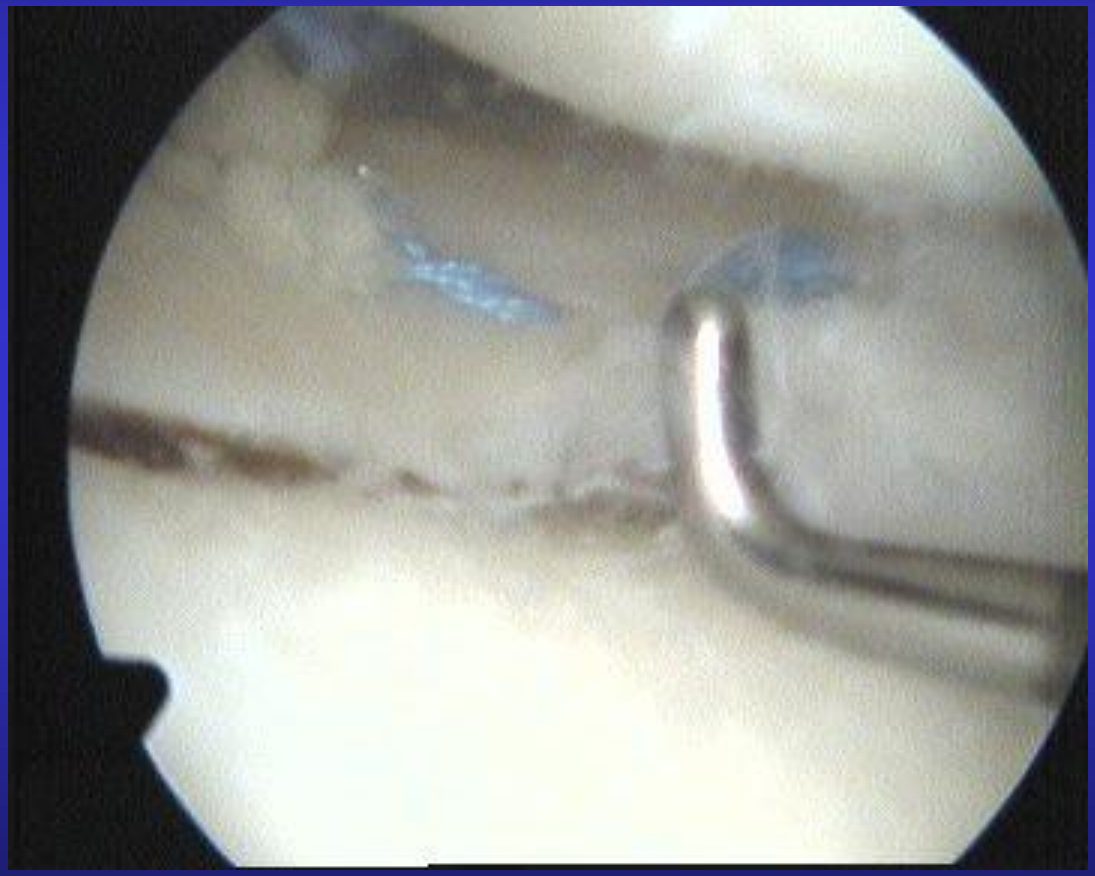


Insertion of ticron sutures

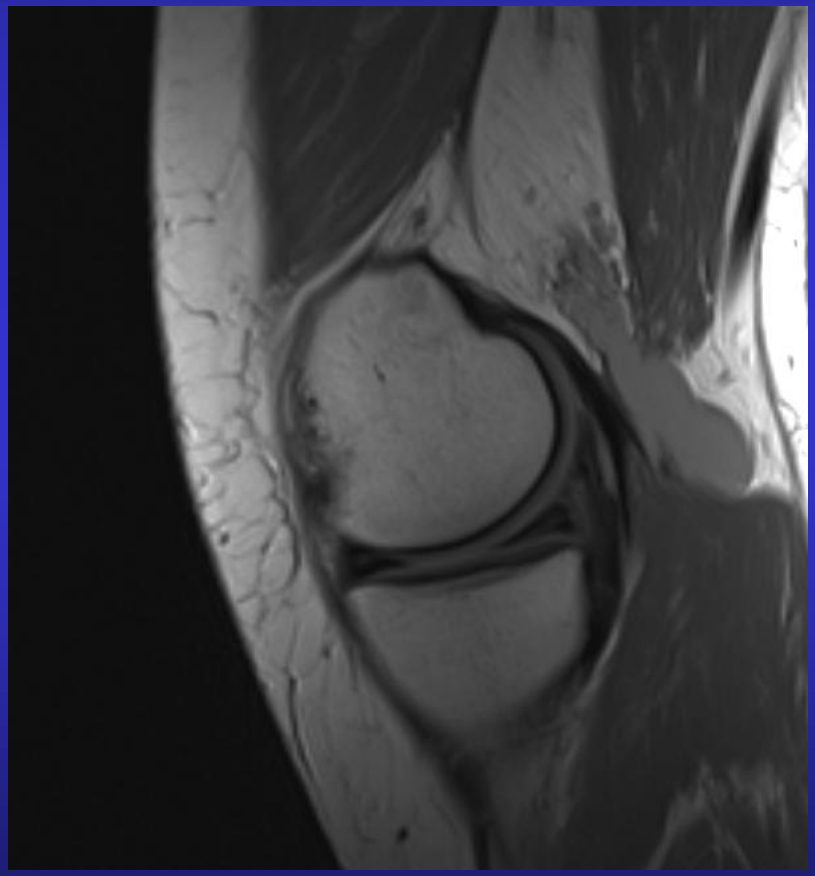
Meniscal suturing

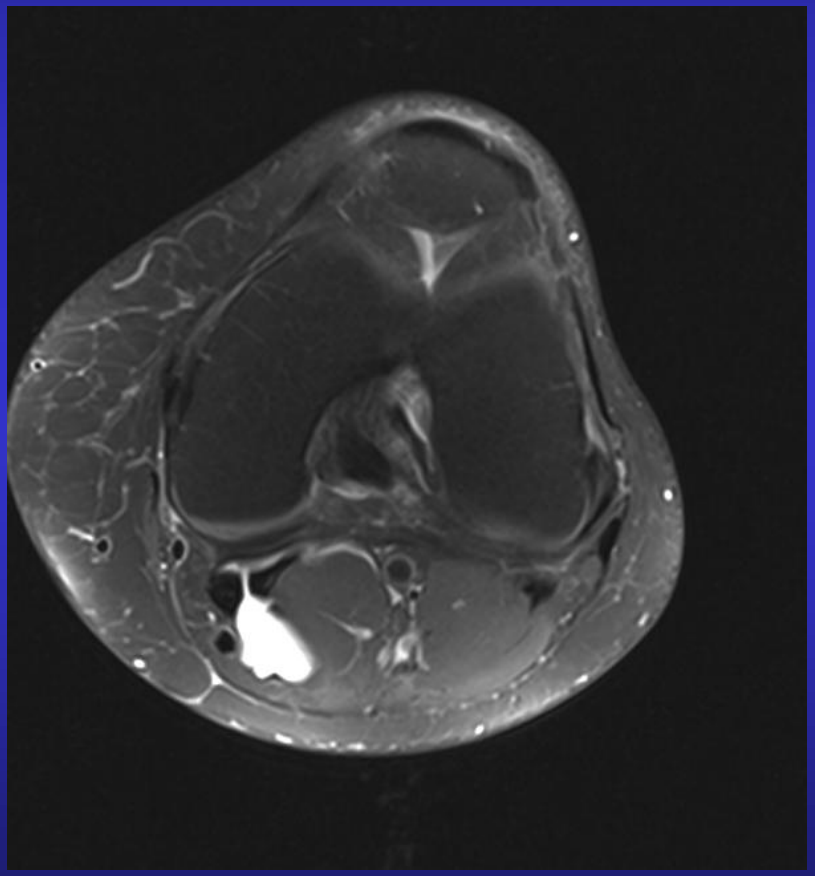






Meniscal cyst





The future

- More conservative approach
- Meniscal allograft
- Collagen meniscal scaffold

Meniscal allograft

Long-term survival of concurrent meniscus allograft transplantation and repair of the articular cartilage

A PROSPECTIVE TWO- TO 12-YEAR FOLLOW-UP REPORT

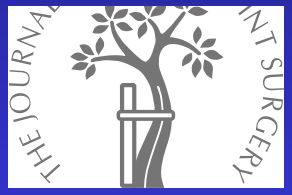
K. R. Stone,
W. S. Adelson,
J. R. Pelsis,
A. W. Walgenbach,
T. J. Turek

From The Stone Research Foundation, San Francisco, California, United States

We describe 119 meniscal allograft transplantations performed concurrently with articular cartilage repair in 115 patients with severe articular cartilage damage. In all, 53 (46.1%) of the patients were over the age of 50 at the time of surgery. The mean follow-up was for 5.8 years (2 months to 12.3 years), with 25 procedures (20.1%) failing at a mean of 4.6 years (2 months to 10.4 years). Of these, 18 progressed to knee replacement at a mean of 5.1 years (1.3 to 10.4). The Kaplan-Meier estimated mean survival time for the whole series was 9.9 years (SD 0.4). Cox's proportional hazards model was used to assess the effect of covariates on survival, with age at the time of surgery ($p = 0.026$) and number of previous operations ($p = 0.006$) found to be significant.

The survival of the transplant was not affected by gender, the severity of cartilage damage, axial alignment, the degree of narrowing of the joint space or medial *versus* lateral allograft transplantation. Patients experienced significant improvements at all periods of follow-up in subjective outcome measures of pain, activity and function (all p-values < 0.05), with the exception of the seven-year Tegner index score ($p = 0.076$).

Allograft



Comparison of medial and lateral meniscal transplantation with regard to extrusion of the allograft, and its correlation with clinical outcome

Y-G. Koh,
H-K. Moon,
Y-C. Kim,
Y-S. Park,
S-B. Jo,
S-K. Kwon

From Yonsei Sarang Hospital, Bucheon, Korea

We compared extrusion of the allograft after medial and lateral meniscal allograft transplantation and examined the correlation between the extent of extrusion and the clinical outcome. A total of 73 lateral and 26 medial meniscus allografts were evaluated by MRI at a mean of 32 months (24 to 59) in 99 patients (67 men, 32 women) with a mean age of 35 years (21 to 52). The absolute values and the proportional widths of extruded menisci as a percentage were measured in coronal images that showed maximum extrusion. Functional assessments were performed using Lysholm scores. The mean extrusion was 4.7 mm (1.8 to 7.7) for lateral menisci and 2.9 mm (1.2 to 6.5) for medial menisci ($p < 0.001$), and the mean percentage extrusions were 52.0% (23.8% to 81.8%) and 31.2% (11.6% to 63.4%), respectively ($p < 0.001$). Mean Lysholm scores increased significantly from 49.0 (10 to 83) pre-operatively to 86.6 (33 to 99) at final follow-up for lateral menisci ($p = 0.001$) and from 50.9 (15 to 88) to 88.3 (32 to 100) for medial menisci ($p < 0.001$). The final mean Lysholm scores were similar in the two groups ($p = 0.312$). Furthermore, Lysholm scores were not found to be correlated with degree of extrusion ($p = 0.242$).

Thus, transplanted lateral menisci extrude more significantly than transplanted medial

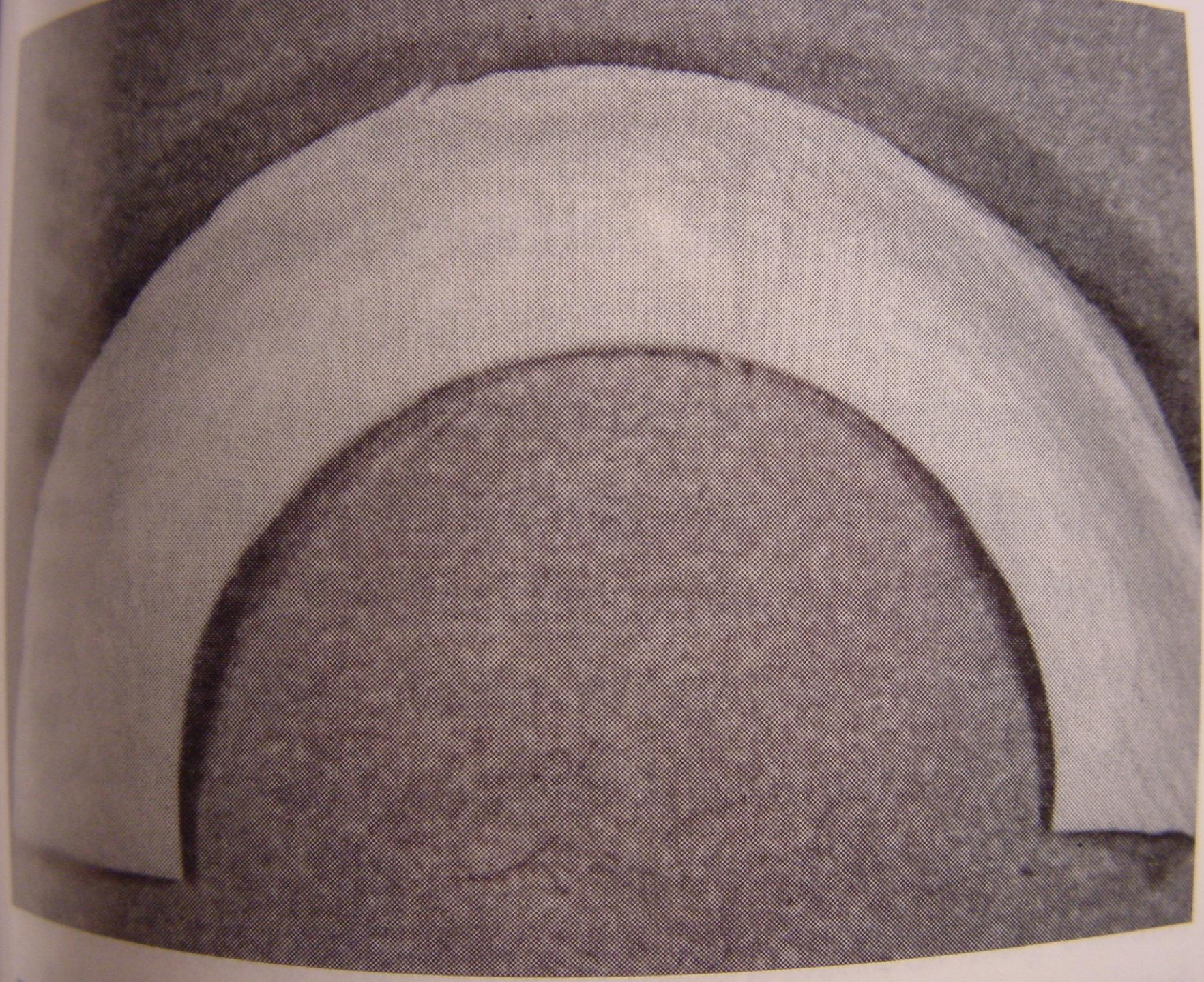
Meniscal Collagen Implant

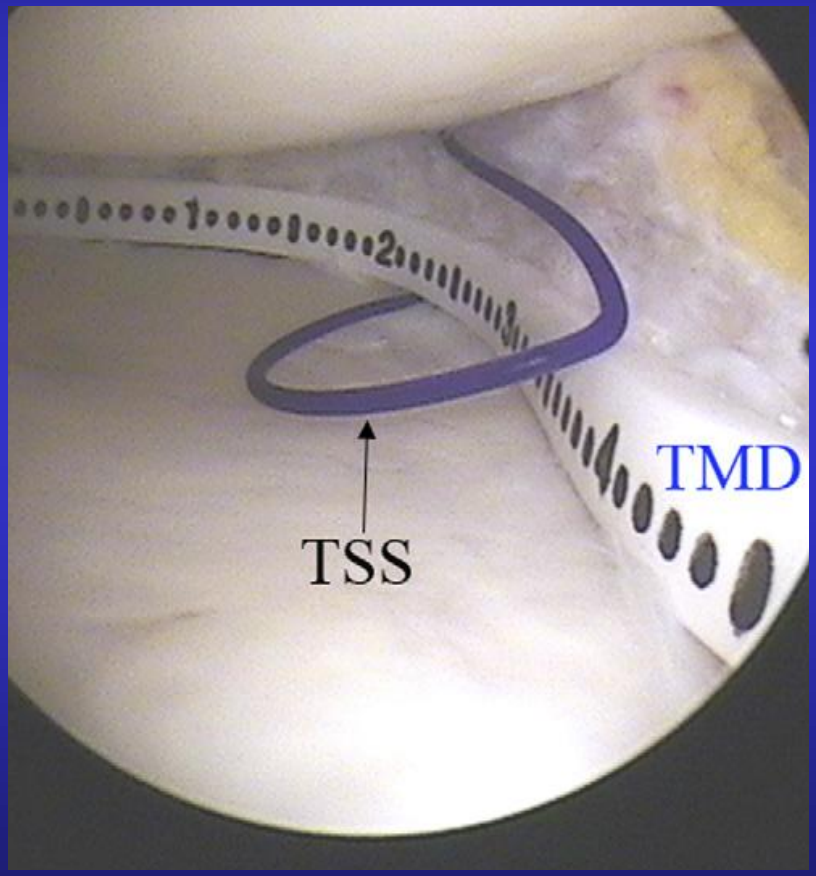
Comparison of the Collagen Meniscus Implant with Partial Meniscectomy

A Prospective Randomized Trial

By William G. Rodkey, DVM, Kenneth E. DeHaven, MD, William H. Montgomery III, MD, Champ L. Baker Jr., MD, Charles L. Beck Jr., MD, Scott E. Hormel, MD, J. Richard Steadman, MD, Brian J. Cole, MD, and Karen K. Briggs, MPH

Investigation performed at the Steadman Hawkins Research Foundation, Vail, Colorado

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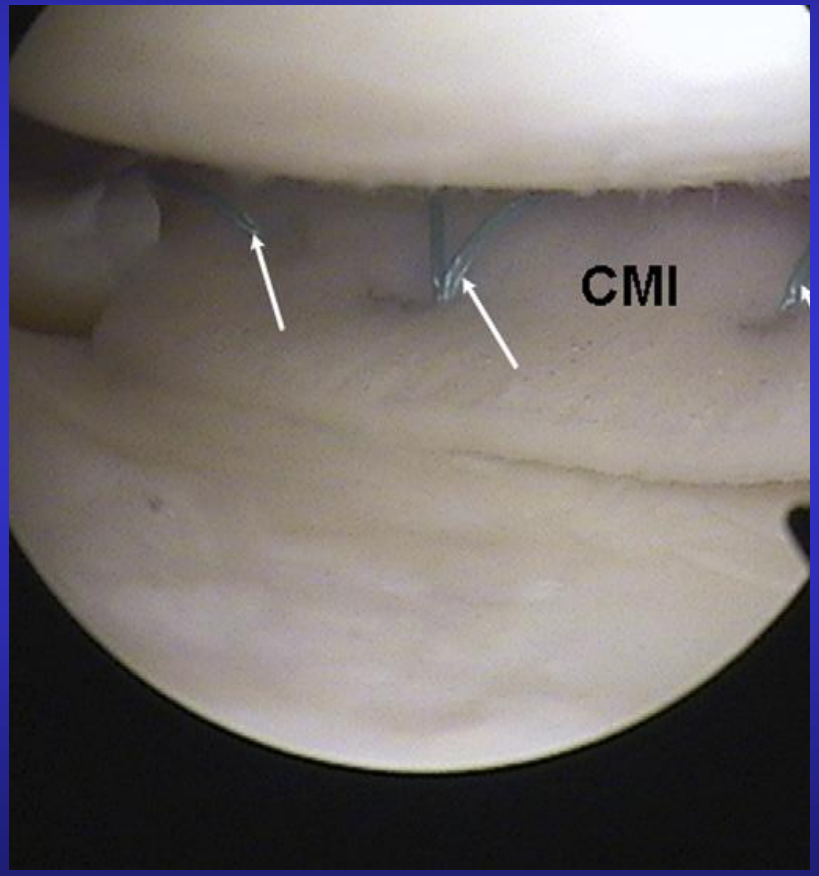
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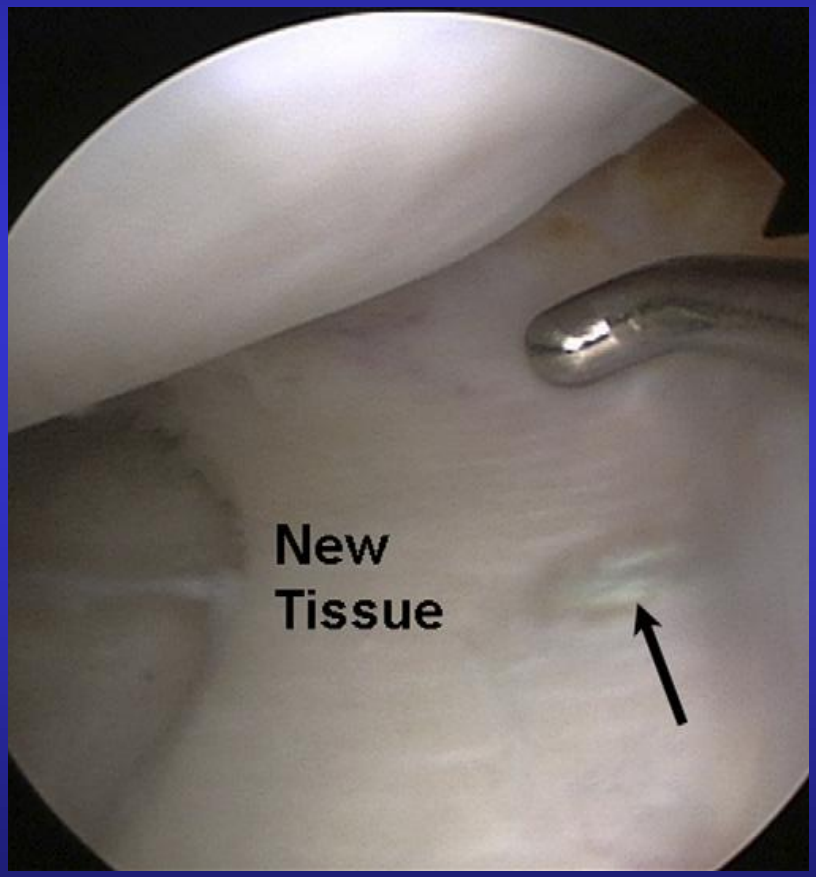
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