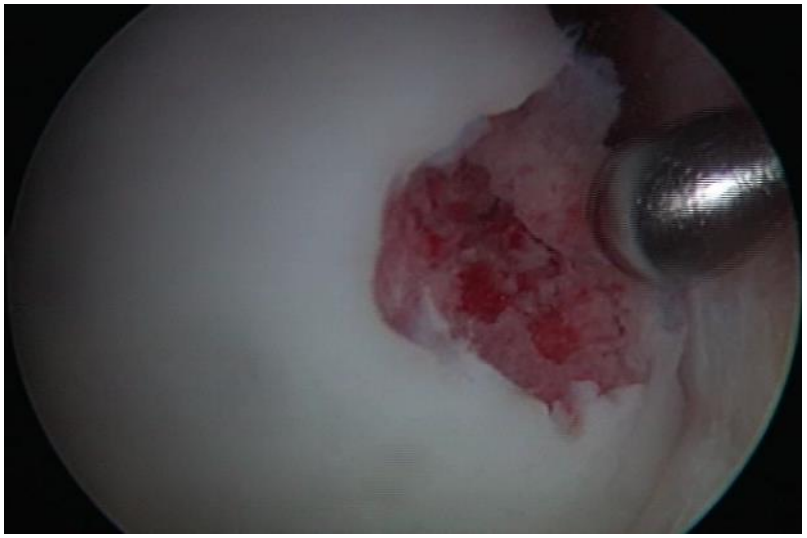
# Is any advantage of AMIC in isolated chondral injuries of femoral condyles?



**Dr. Andreas Panagopoulos, MD, Ph.D.**

**Assistant Professor, Medical School, Patras University**

**Sports Medicine Fellow, University of Leeds, UK**

**Shoulder & Elbow Fellow, King's College University, UK**

# Epidemiology of cartilage damage

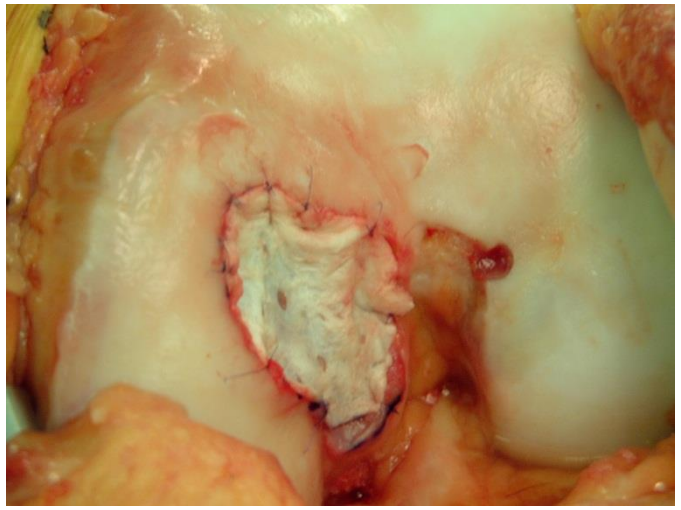
- Curl et al. described 53,569 hyaline cartilage lesions in 19,827 patients undergoing knee arthroscopy[1]
- A survey of 993 consecutive knee arthroscopies demonstrated evidence of articular cartilage abnormality in 66%[2]
- Articular cartilage defects of the femoral condyles have been observed in up to 50% of athletes undergoing ACL reconstruction[3]

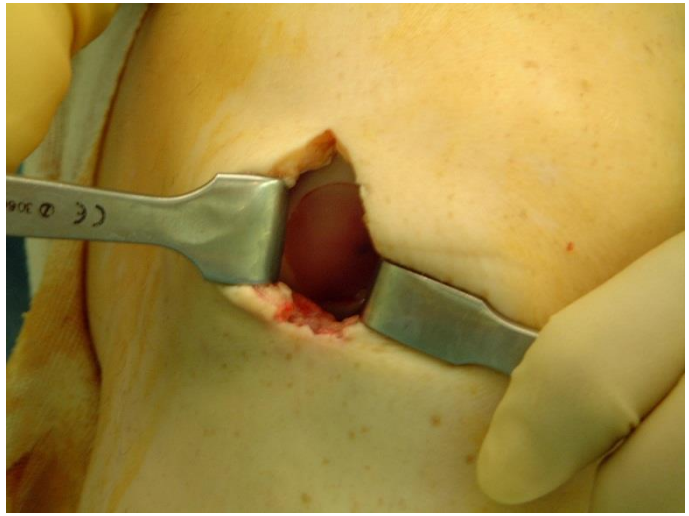

*1. Curl WW, et al. Arthroscopy. 1997*
*2. Aroen A, et al. Am J Sports Med. 2004*
*3. Piasecki DP, et al. Am J Sports Med. 2003*

# Two major problems

The **first** is to fill the defect void with a tissue that has the same mechanical properties as articular cartilage.

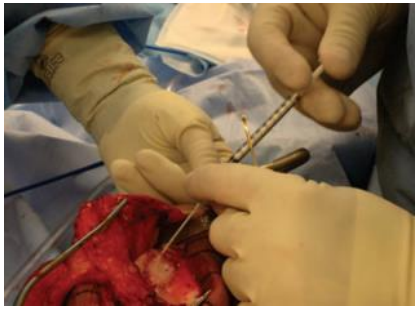
The **second** is to promote successful integration between the repair tissue and the native articular cartilage.





# Treatment options

1. Arthroscopic lavage & debridement
2. Bone marrow stimulation
3. Cell-based therapy
4. Osteochondral autograft transfer
5. Scaffolds
6. Allografts
7. Osteotomy



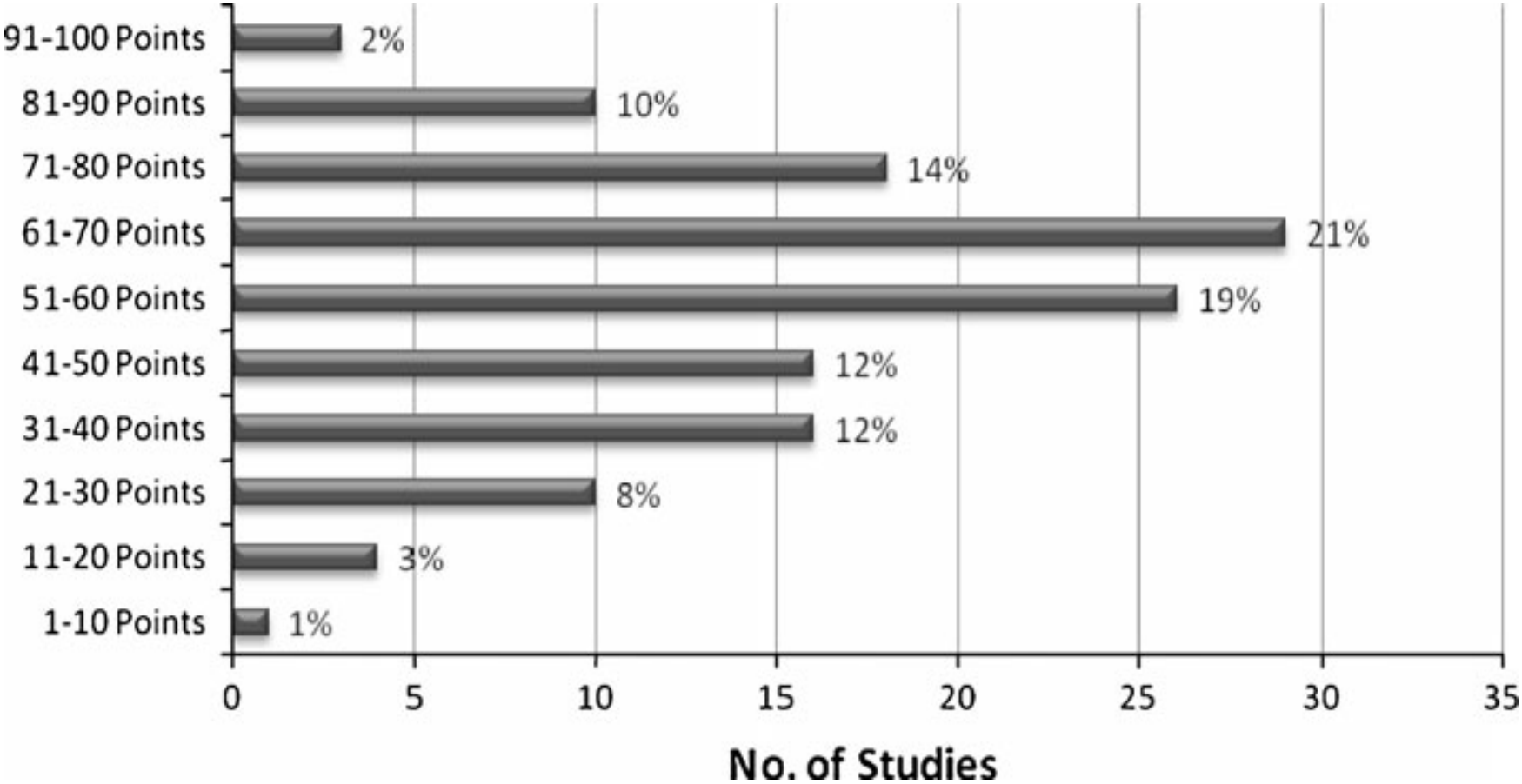
Knee Surg Sports Traumatol Arthrosc (2011) 19:543–552
DOI 10.1007/s00167-010-1271-5

KNEE

# We do not have evidence based methods for the treatment of cartilage defects in the knee

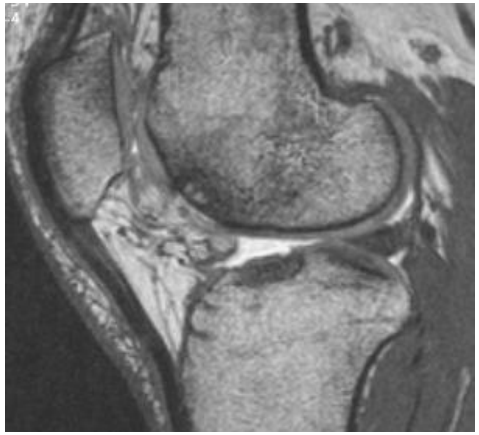
Jan P. Benthien · Manuela Schwaninger · Peter Behrens

**modified Coleman methodological score**



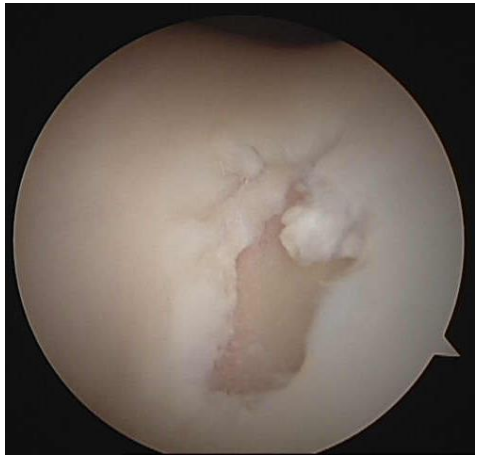
# Bone marrow stimulation

Symptomatic, focal high-grade chondral lesions of the weightbearing femoral condyles, trochlea, and patella in active patients



Incidental cartilage lesions

A defect size **of <4 $cm^2$**



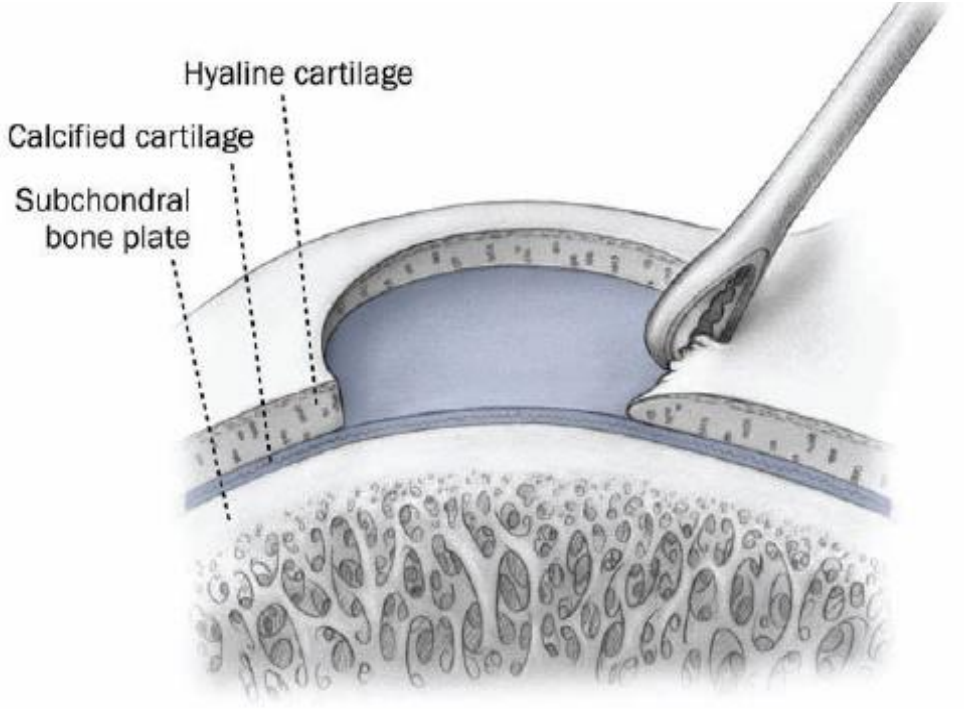
A short preoperative duration of symptoms (optimally, less than 12 months)

Optimal patient age should be **< 45 years-old**

*Mithoefer K, et al, JBJS 2006*

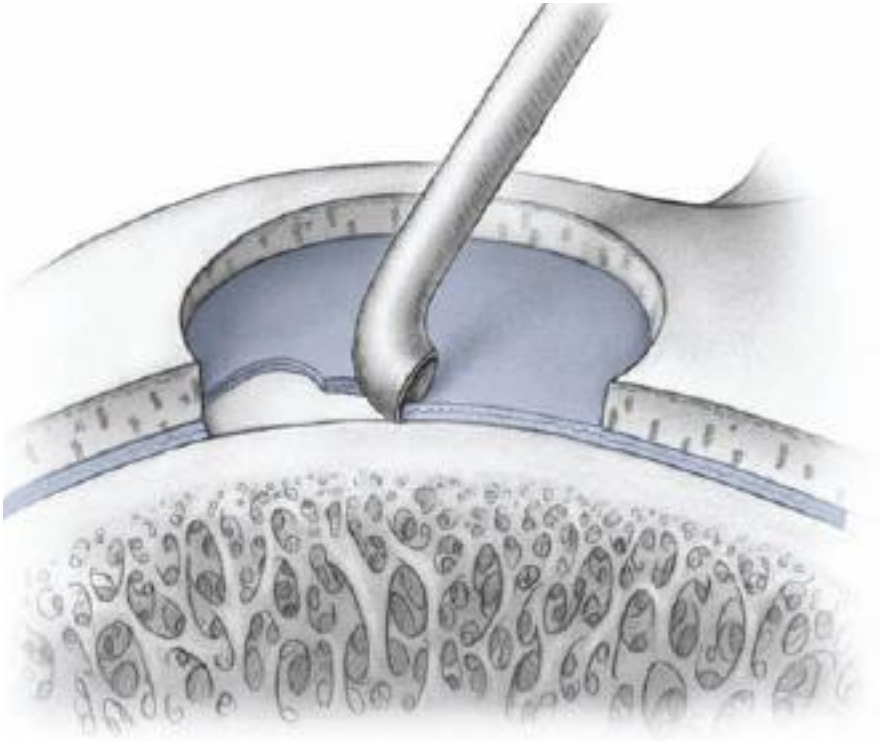
# Surgical technique

Debridement, with use of an arthroscopic shaver, of any loose cartilage flaps to create a stable peripheral cartilage margin



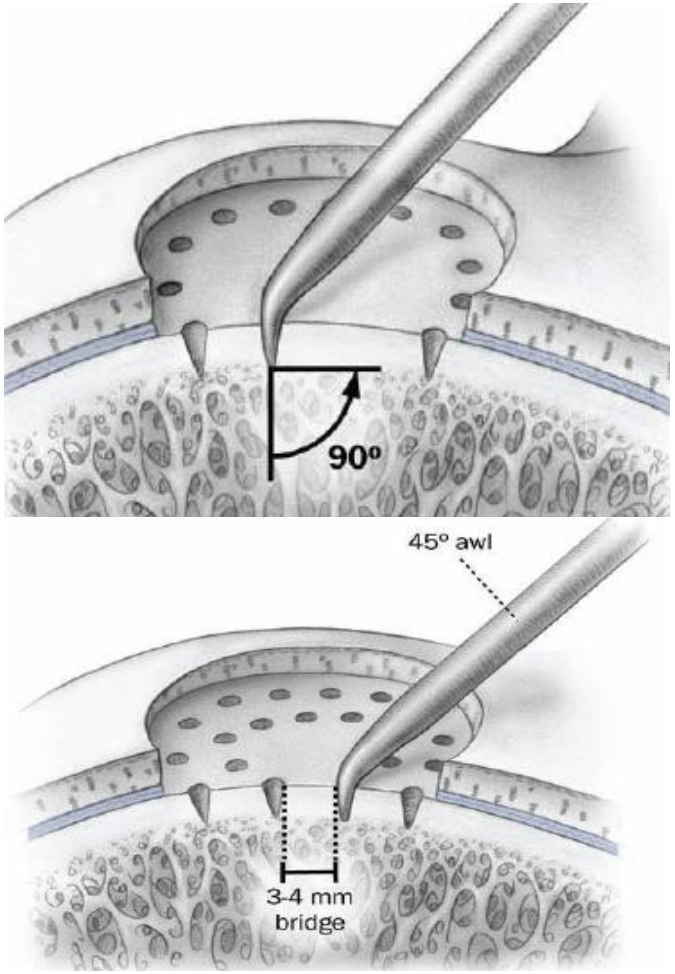

# Surgical technique

débridement of the calcified cartilage layer with use of a curet to provide manual feedback control



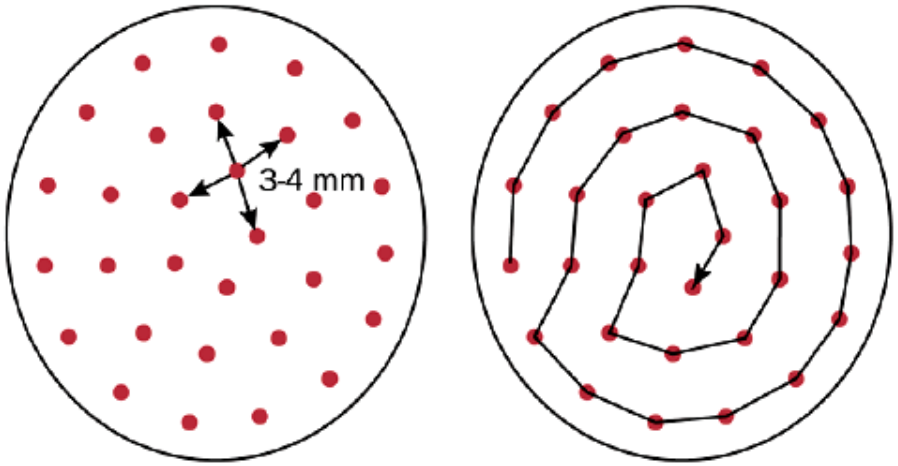
# Surgical technique

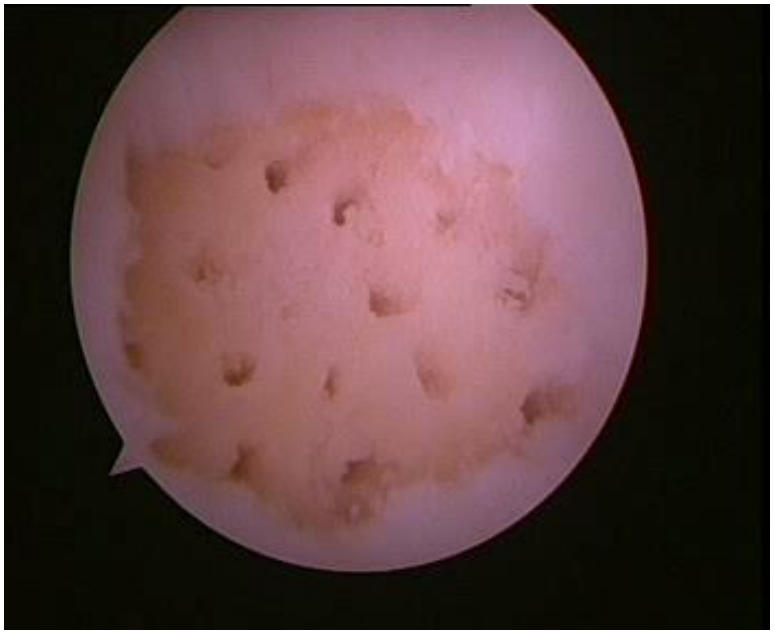
the adequate depth of subchondral bone  penetration and width of osseous bridges between the individual microfracture holes




# Surgical technique

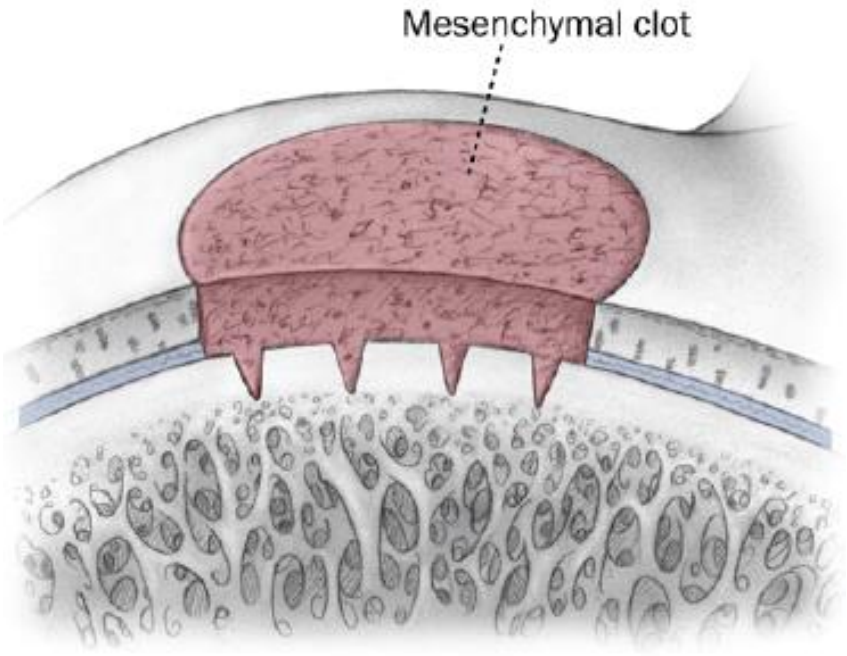
the adequate depth of subchondral bone penetration and width of osseous bridges between the individual microfracture holes



# Surgical technique

adequacy of the microfractures by noting the release of fat droplets and blood from the individual holes




# Rehabilitation

## Femoral condyle

| | WEIGHT BEARING | BRACE | ROM | THERAPEUTIC EXERCISE |
|---|---|---|---|---|
| **PHASE I**<br>**0 - 8 weeks** | Touchdown weight bearing (20-30%) for the first 6-8 weeks. | None | Use of a CPM for 6-8 hours/day - set at a rate of 1 cycle/ minute, advancing 10 ° daily - begin at a level of flexion that is comfortable for the patient - advance to full flexion as tolerated | **Passive** stretching/exercise for the first 6 - 8 weeks, quad/hamstring isometrics |
| **PHASE II**<br>**8 - 12 weeks** | Gradual return to full weight | None | Gain full and pain-free | Progressive active strengthening |
| **PHASE III**<br>**12 weeks and beyond** | Full | None | Full and pain-free | Return to full activities, including cutting, turning, and jumping |

# Clinical studies

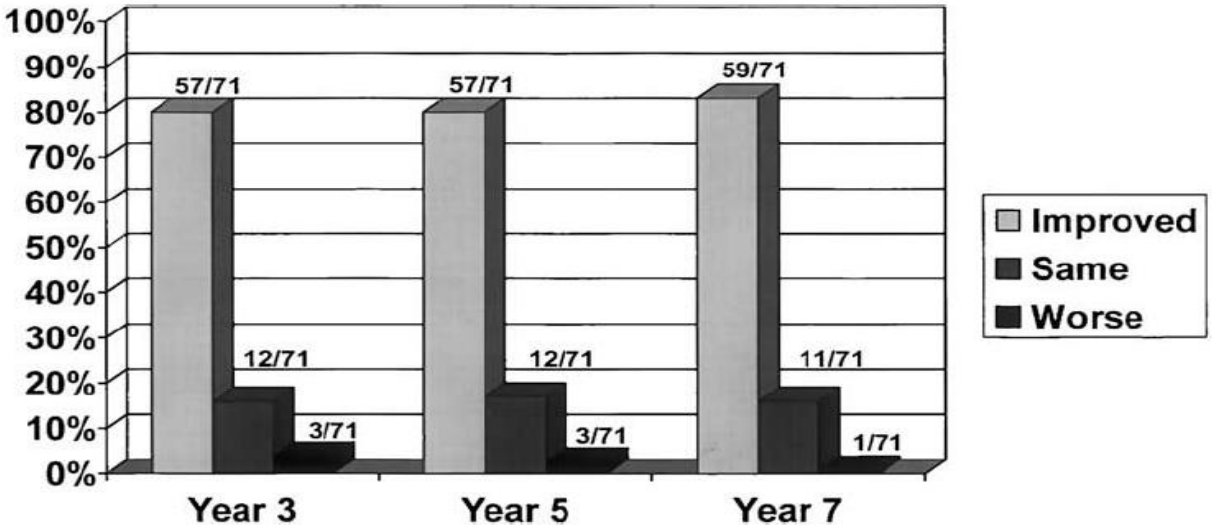
The overall clinical results of the microfracture arthroplasty have shown improved knee function in 70% to 95% of patients

1. Steadman JR, et al Oper Tech Orthop. 1997;7:300-4.
2. Steadman JR, et al Knee Surg. 2003;16:83-6.
3. Steadman JR, et al Arthroscopy. 2003;19:477-84.
4. Kreuz PC, et al. Osteoarthritis Cartilage. 2006;14:1119-25.

# Outcomes of Microfracture for Traumatic Chondral Defects of the Knee: Average 11-Year Follow-up

J. Richard Steadman, M.D., Karen K. Briggs, M.B.A., Juan J. Rodrigo, M.D., Mininder S. Kocher, M.D., M.P.H., Thomas J. Gill, M.D., and William G. Rodkey, D.V.M.

*Arthroscopy: The Journal of Arthroscopic and Related Surgery, Vol 19, No 5 (May-June), 2003: pp 477-484*




Over the 7- to 17-year follow-up period (average, 11.3 years), patients < **45 years** who underwent **MF** for full-thickness chondral defects, without associated meniscus or ligament pathology, showed statistically significant improvement in function

# Clinical studies

**High-Impact Athletics After Knee Articular Cartilage Repair: A Prospective Evaluation of the Microfracture Technique**

Kai Mithoefer, Riley J. Williams, III, Russell F. Warren, Thomas L. Wickiewicz and Robert G. Marx

*Am. J. Sports Med.* 2006; 34; 1413 originally published online May 30, 2006;

**32 athletes** with single articular cartilage lesions of the knee

66% reported good or excellent results and 44% were able to regularly participate in high-impact pivoting sports,
**57%** of these at the preoperative level.

Return to high-impact sports was significantly higher in athletes with age <40 years, lesion size <200 mm2, preoperative symptoms <12 months, and no prior surgical intervention.

# Evidence-Based Status of Microfracture Technique: A Systematic Review of Level I and II Studies

Deepak Goyal, M.B.B.S., M.S.(Orthop), D.N.B.(Orthop), M.N.A.M.S.,
Sohrab Keyhani, M.D.,
Eng Hin Lee, M.D., F.R.C.S.C., F.R.C.S.(Edin), F.R.C.S.(Glasg), F.A.M.S., and
James Hoi Po Hui, M.D., F.R.C.S.(Edin)

*Arthroscopy: The Journal of Arthroscopic and Related Surgery, Vol 29, No 9 (September), 2013: pp 1579-1588*

15 Level I or II evidence studies

The use of MF for the treatment of small lesions in patients with **low postoperative demands** was observed to result in good clinical outcomes at short-term follow-up.

Beyond **5 years** postoperatively, treatment **failure** after MF could be expected regardless of lesion size.

Younger patients showed better clinical outcomes

# Survival Analysis of Microfracture in the Osteoarthritic Knee—Minimum 10-Year Follow-up

Dae Kyung Bae, M.D., Sang Jun Song, M.D., Kyoung Ho Yoon, M.D., Dong Beom Heo, M.D., and Tae Jin Kim, M.D.

**Arthroscopy: 2013**

Average age at the time of MF was 61.3 years.

50% of the patients were doing well **without pain or TKA** until 12 years after surgery

survival rate was 88.8%, 78.4%, 67.9%, and 45.6% at 5, 7, 10, & 12 years,

Of 134 knees, 51 (38.1%) proceeded to TKA a mean of 6.8 years after MF

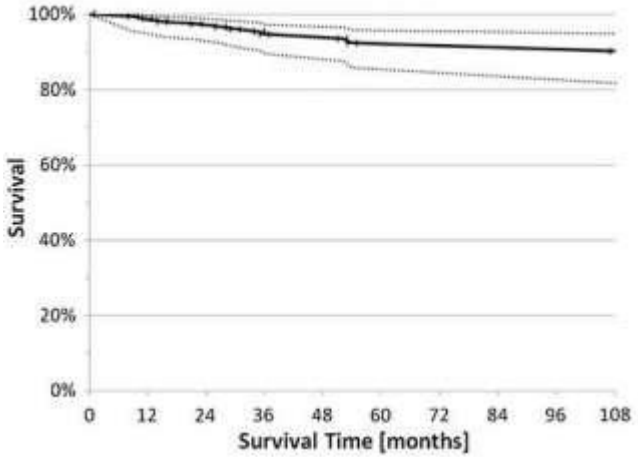
Clin Orthop Relat Res (2010) 468:147–157
DOI 10.1007/s11999-009-0998-0

SYMPOSIUM: PAPERS PRESENTED AT THE ANNUAL MEETINGS OF THE KNEE SOCIETY

# Autologous Chondrocyte Implantation for Joint Preservation in Patients with Early Osteoarthritis

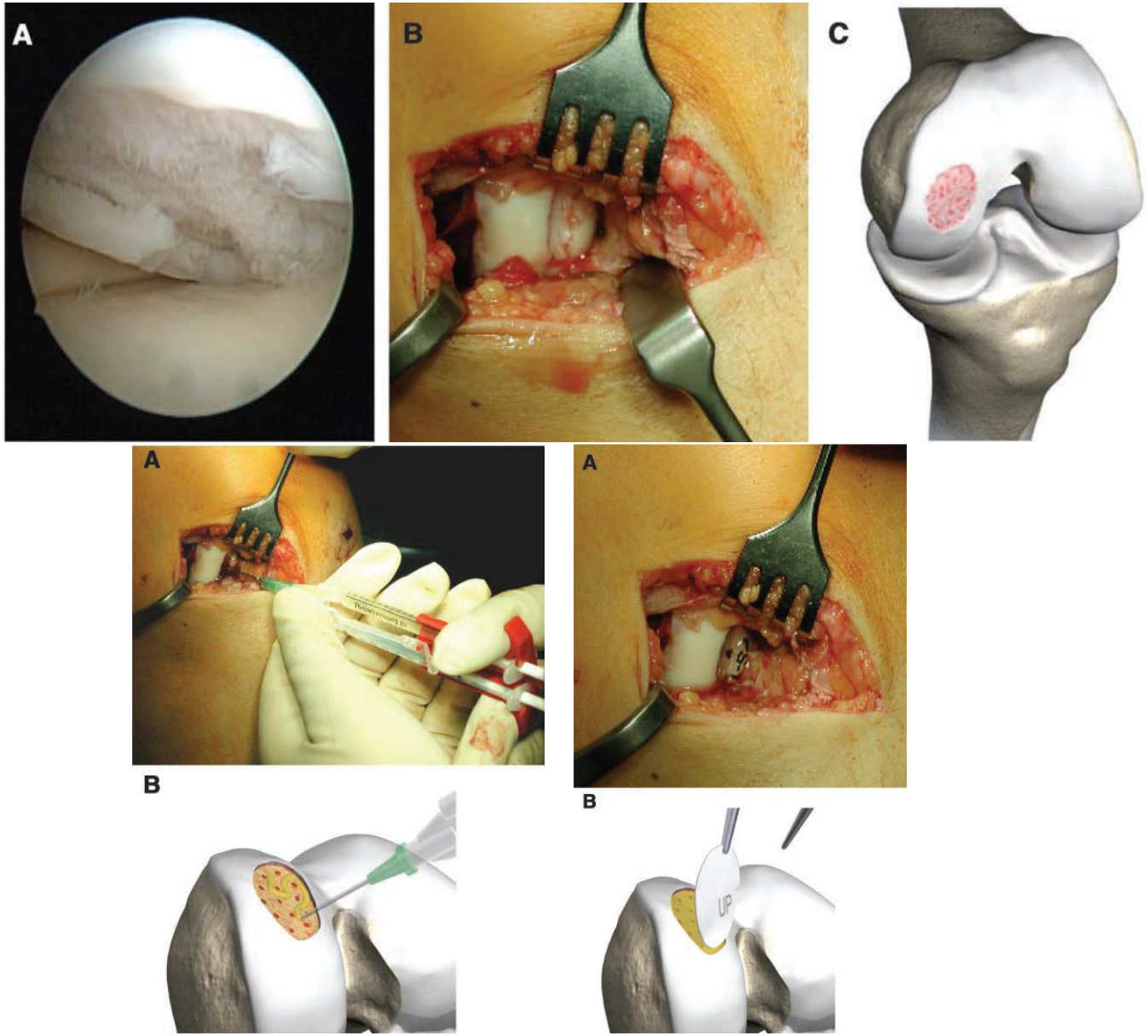
Tom Minas MD, MS, Andreas H. Gomoll MD,
Shahram Solhpour MD, Ralf Rosenberger MD,
Christian Probst BS, Tim Bryant RN

2.1 defects per knee were treated with an average defect size of **4.9 $cm^2$** and a total treated surface area of **10.4 $cm^2$** per knee joint




Our data demonstrate that ACI results in clinically relevant reductions in pain and improvement in function, while apparently delaying the need for **knee arthroplasty** for over 5 years in 92% of patients

**A** = Autologous **M** = Matrix **I**= Induced **C** = Chondrogenesis

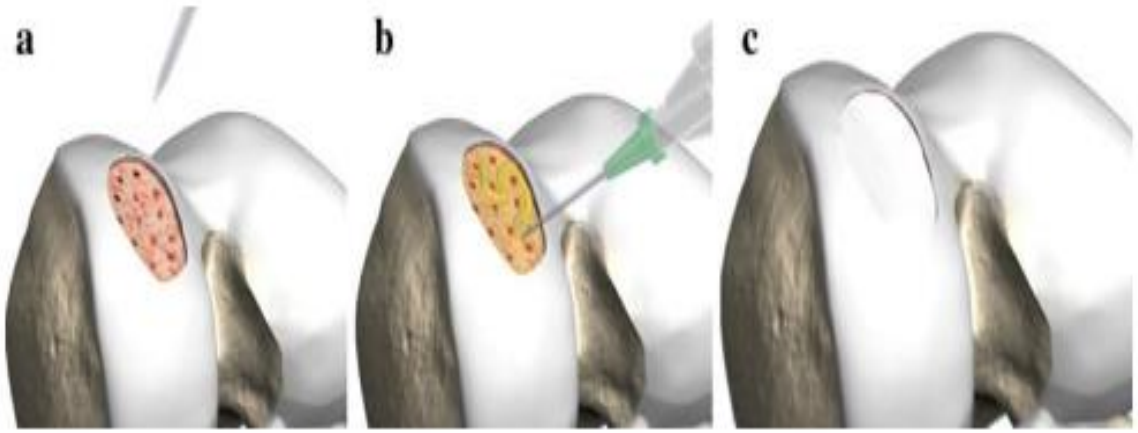


Knee Surg Sports Traumatol Arthrosc (2011) 19:1316–1319
DOI 10.1007/s00167-010-1356-1

KNEE

# The treatment of chondral and osteochondral defects of the knee with autologous matrix-induced chondrogenesis (AMIC): method description and recent developments

**Jan Philipp Benthien · Peter Behrens**



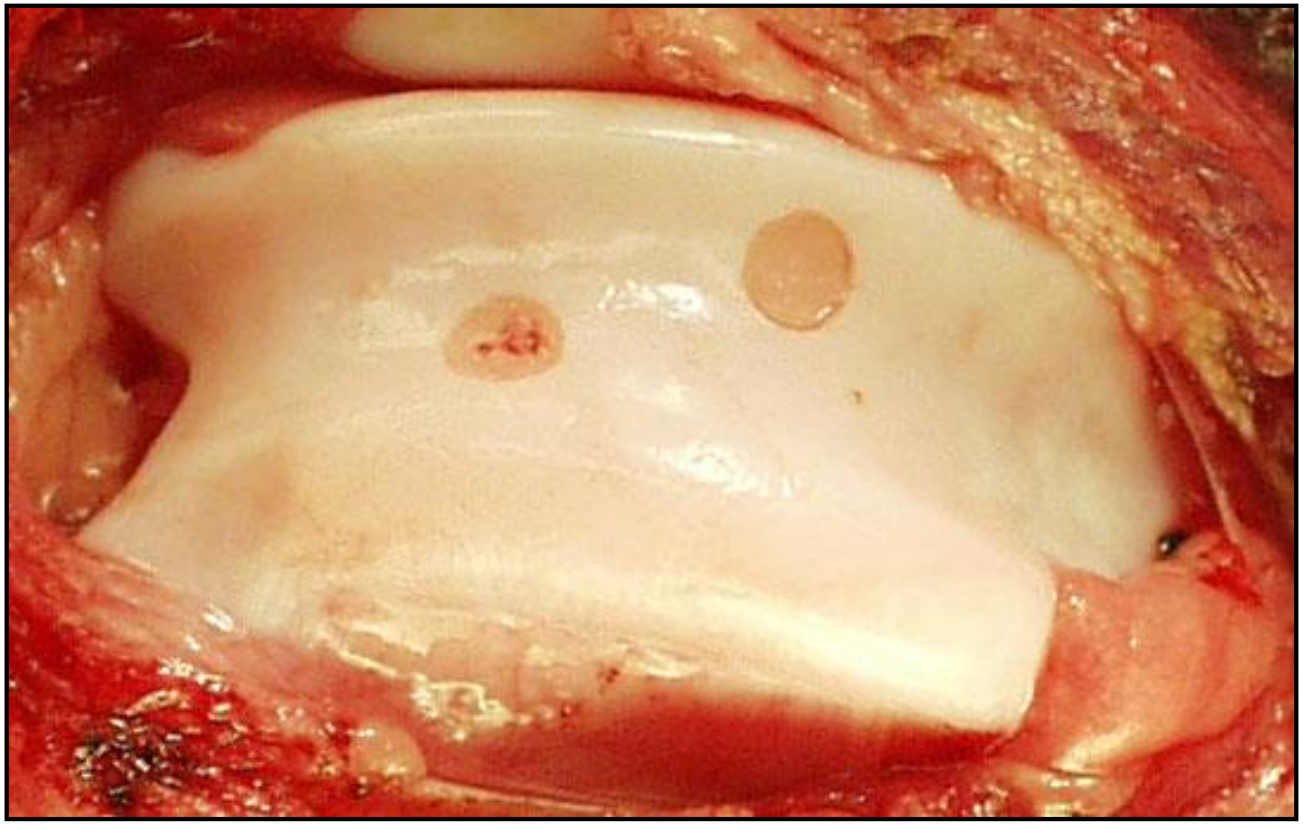

# Why AMIC?


- Single stage procedure
- Provides a matrix to form fibrocartilage
- Protects and stabilizes the blood clot
- Promotes migration and adhesion of progenitor cells
- Prevents bleeding into the joint
- No donor site morbidity, No cell culture
- Costs are moderate

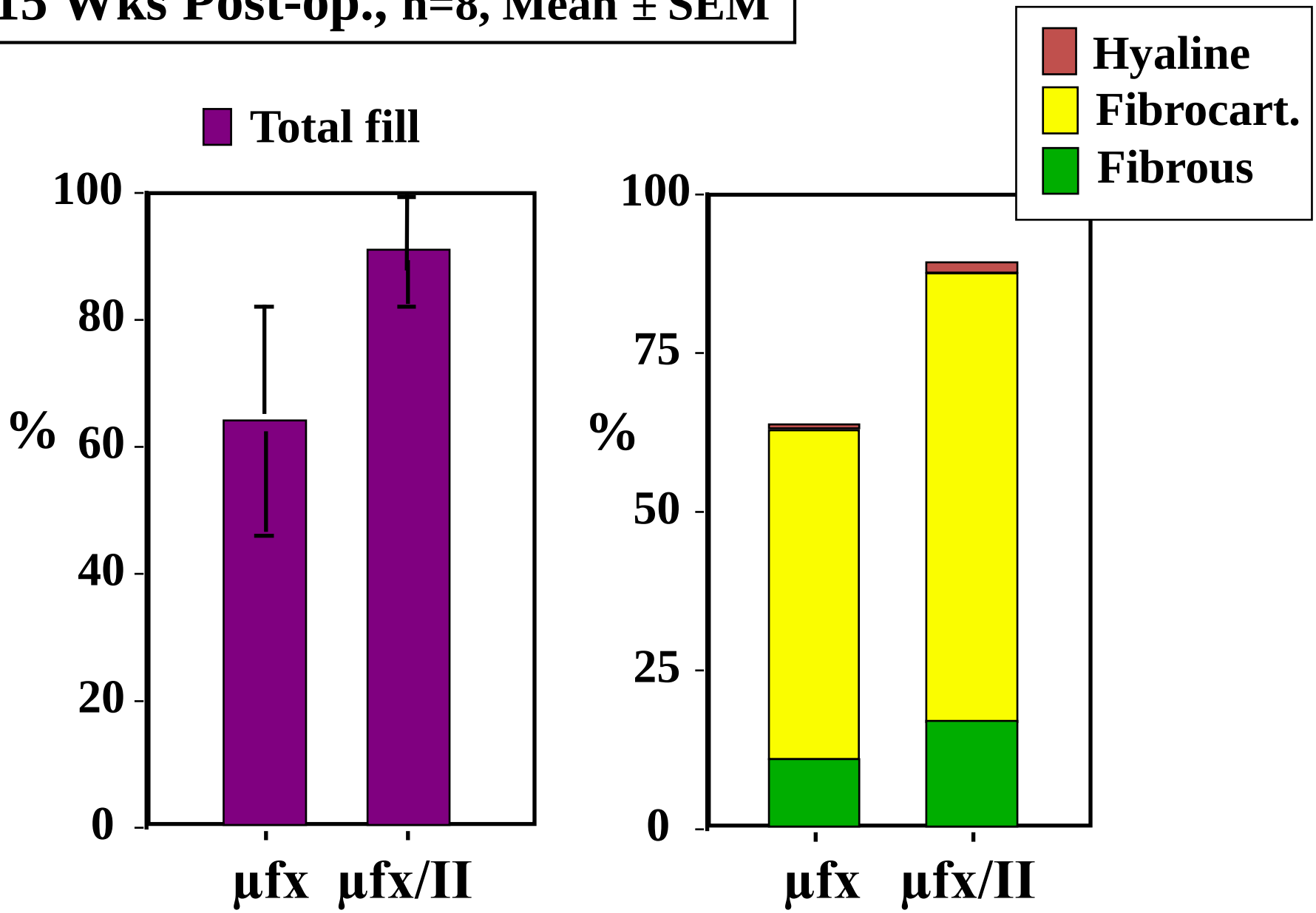
*Journal of Orthopaedic Research*
**18:**781-789 The Journal of Bone and Joint Surgery, Inc.


# Healing of Canine Articular Cartilage Defects Treated with Microfracture, a Type-II Collagen Matrix, or Cultured Autologous Chondrocytes

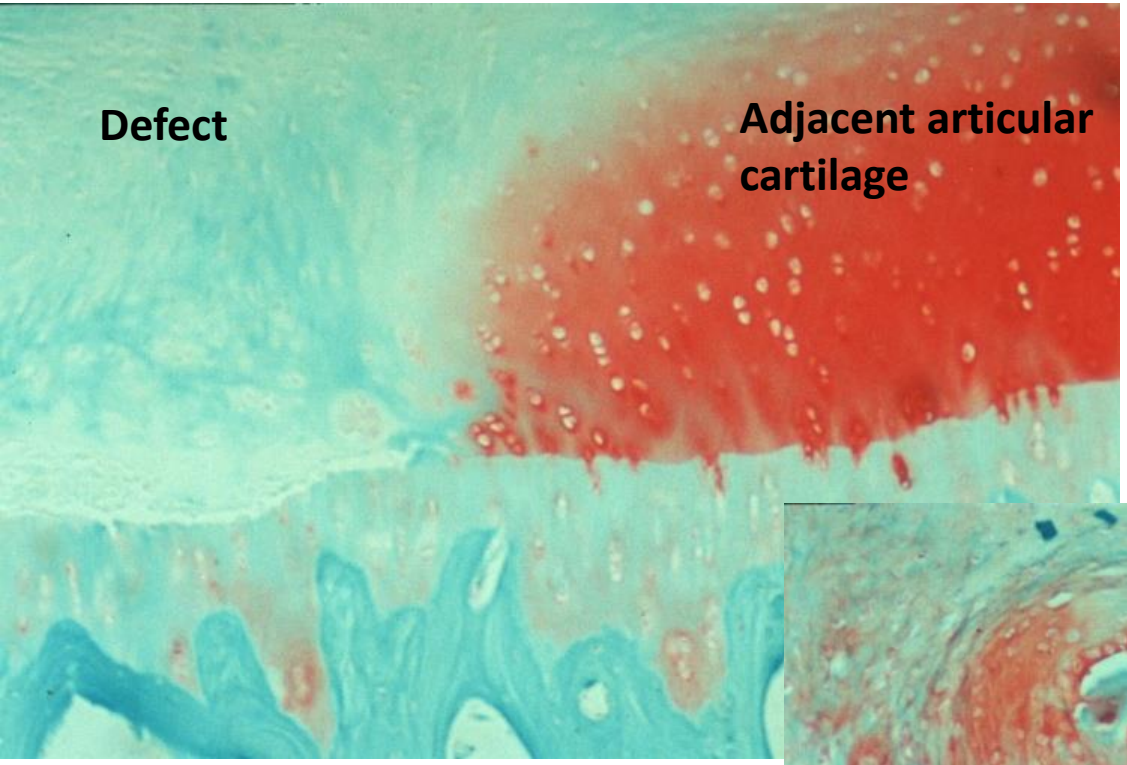
*†Howard A. Breinan, *Scott D. Martin, *Hu-Ping Hsu, and *†‡Myron Spector



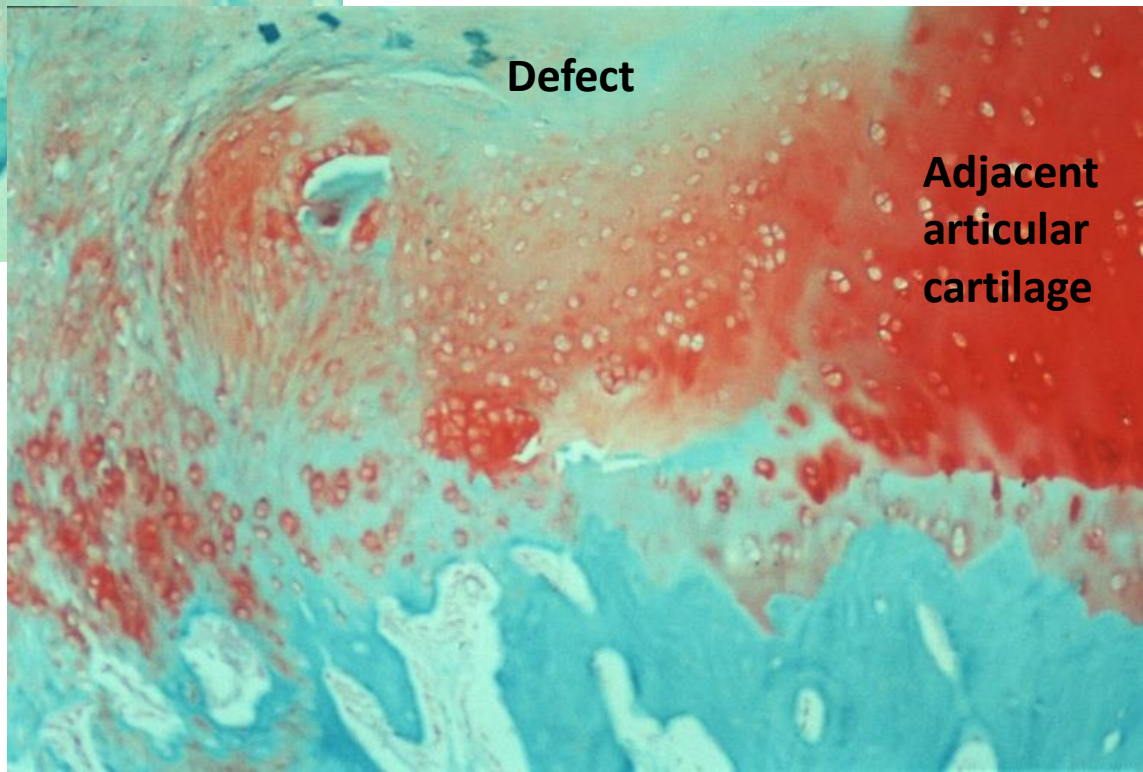
**15 Wks Post-op., n=8, Mean ± SEM**



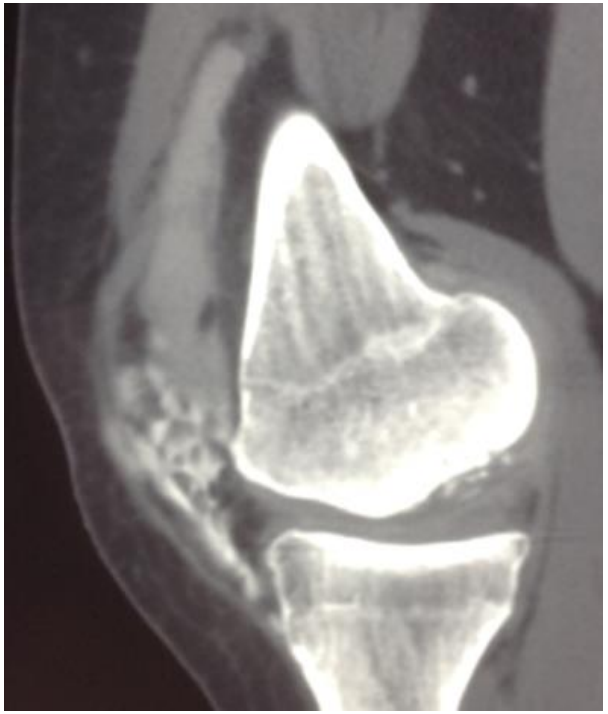
## Microfracture alone

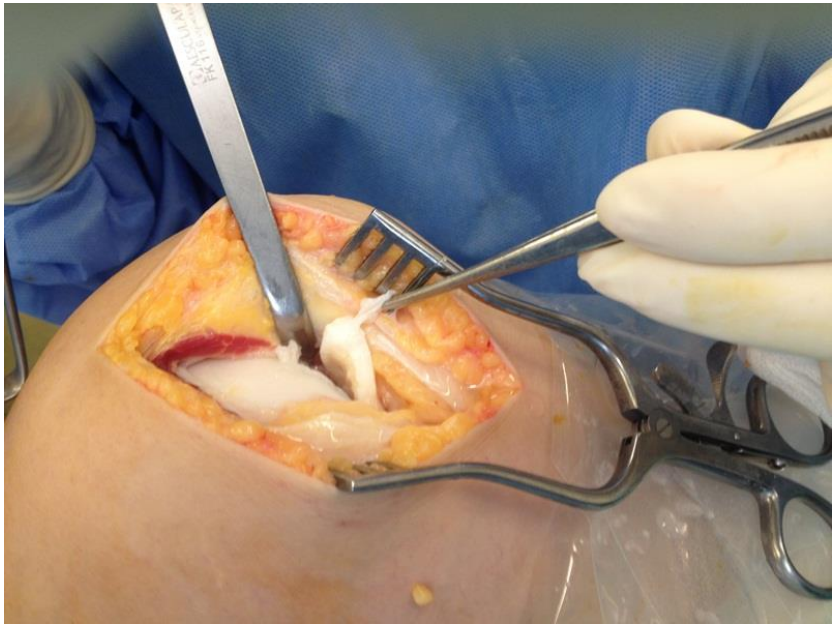


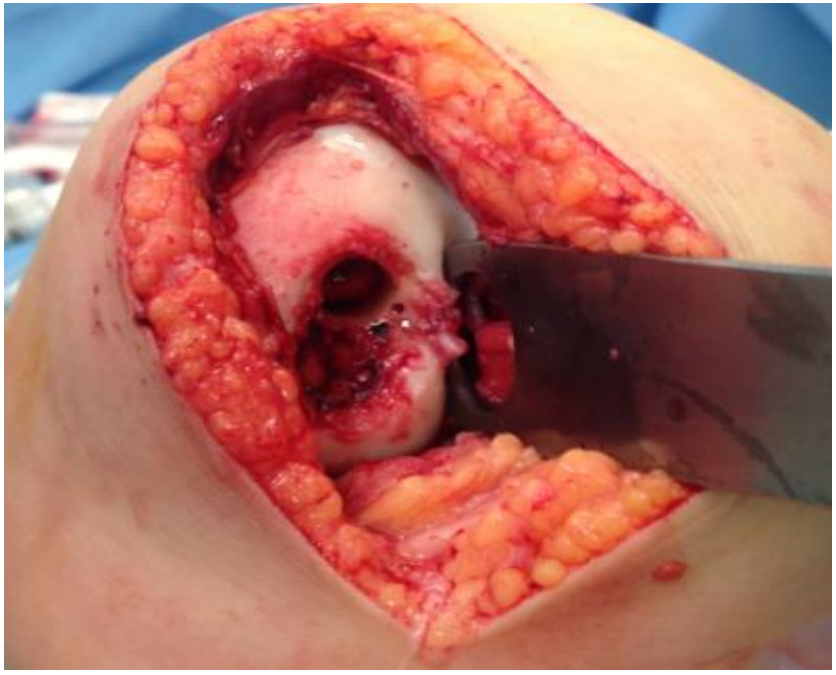

## Microfracture /collagen II



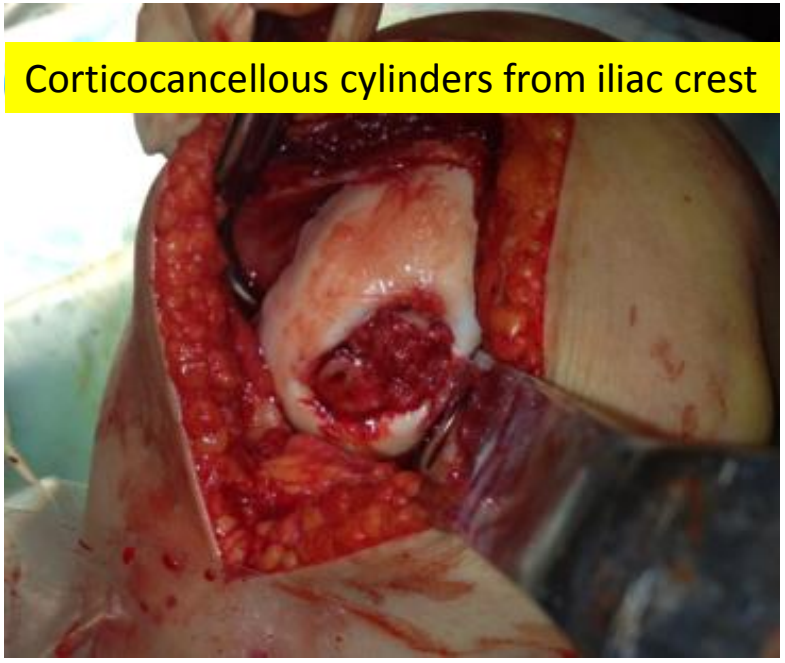
19 y old female, OCD MFC, symptomatic, Lyschom score 58



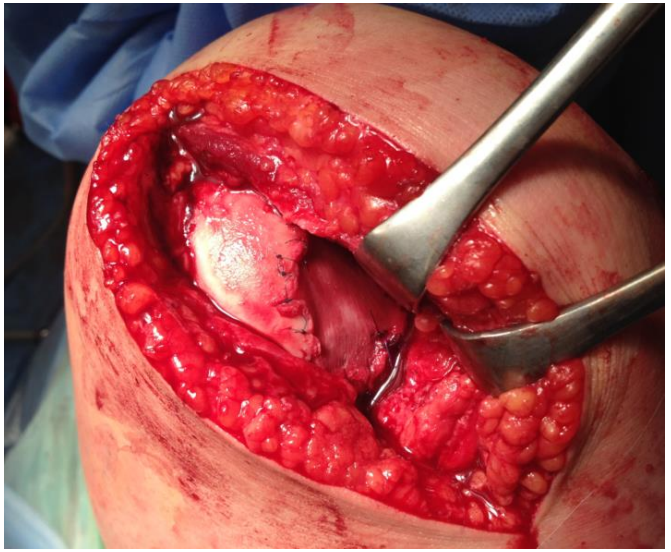


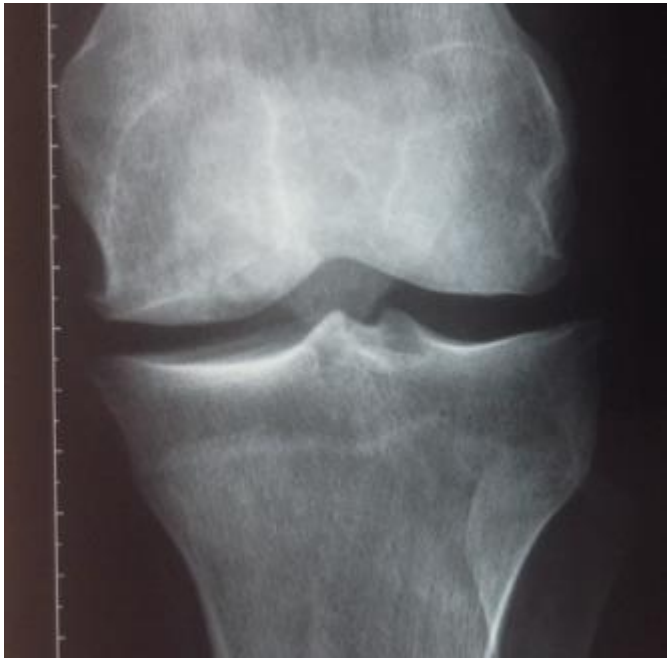



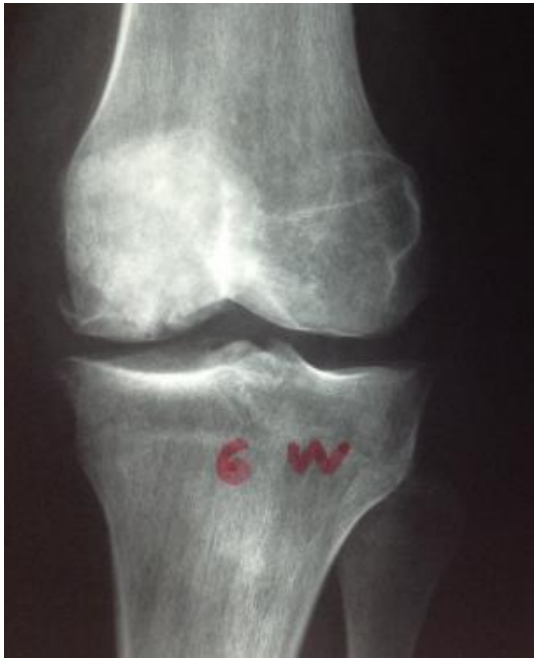
Corticocancellous cylinders from iliac crest



Stem cells







# AMIC technique for cartilage regeneration

44 year old male, Large Osteochondral Defect on MFC

Jacobi M, Jakob R.P

Fribourg, Switzerland

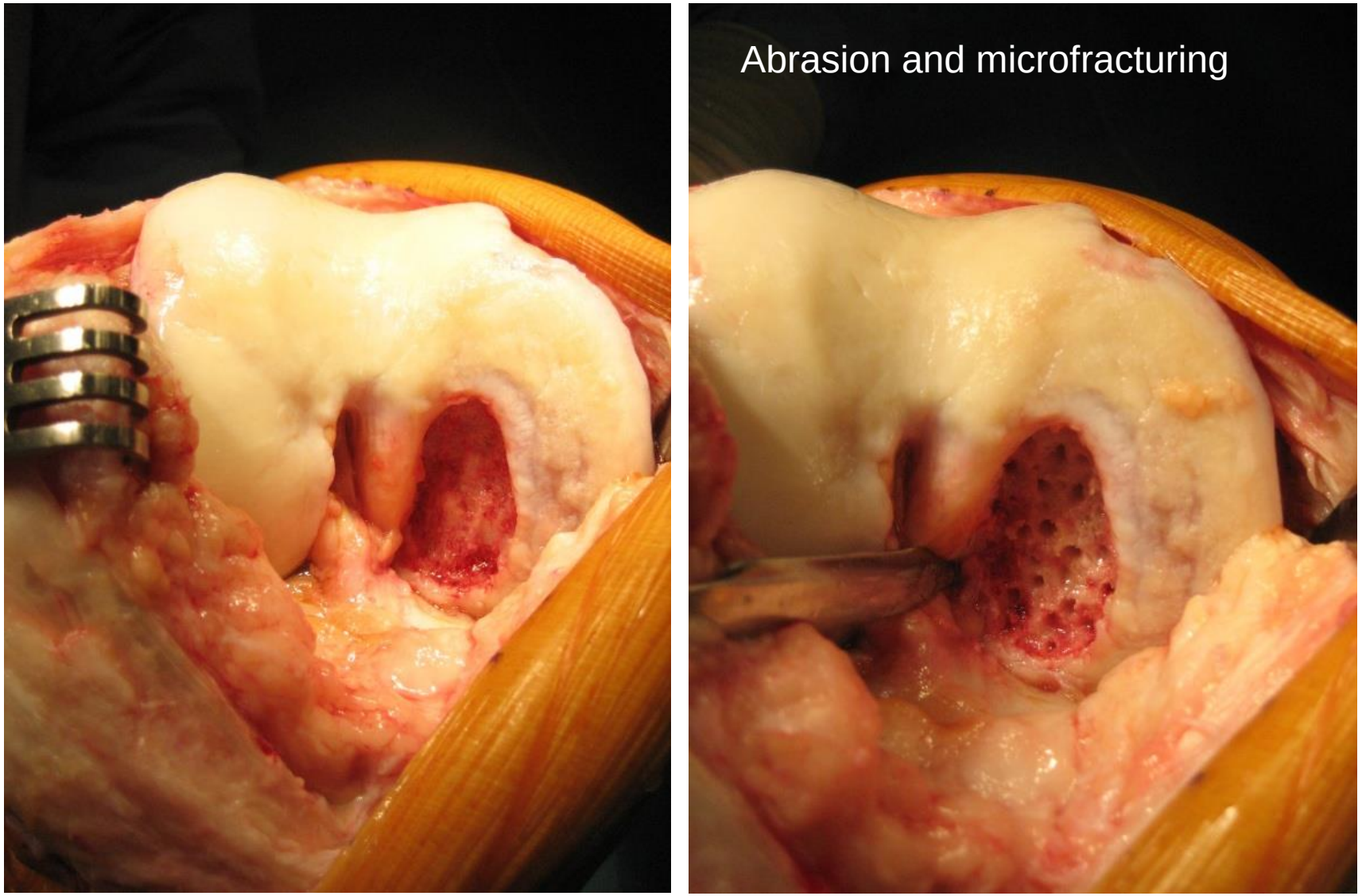

D


D
45°

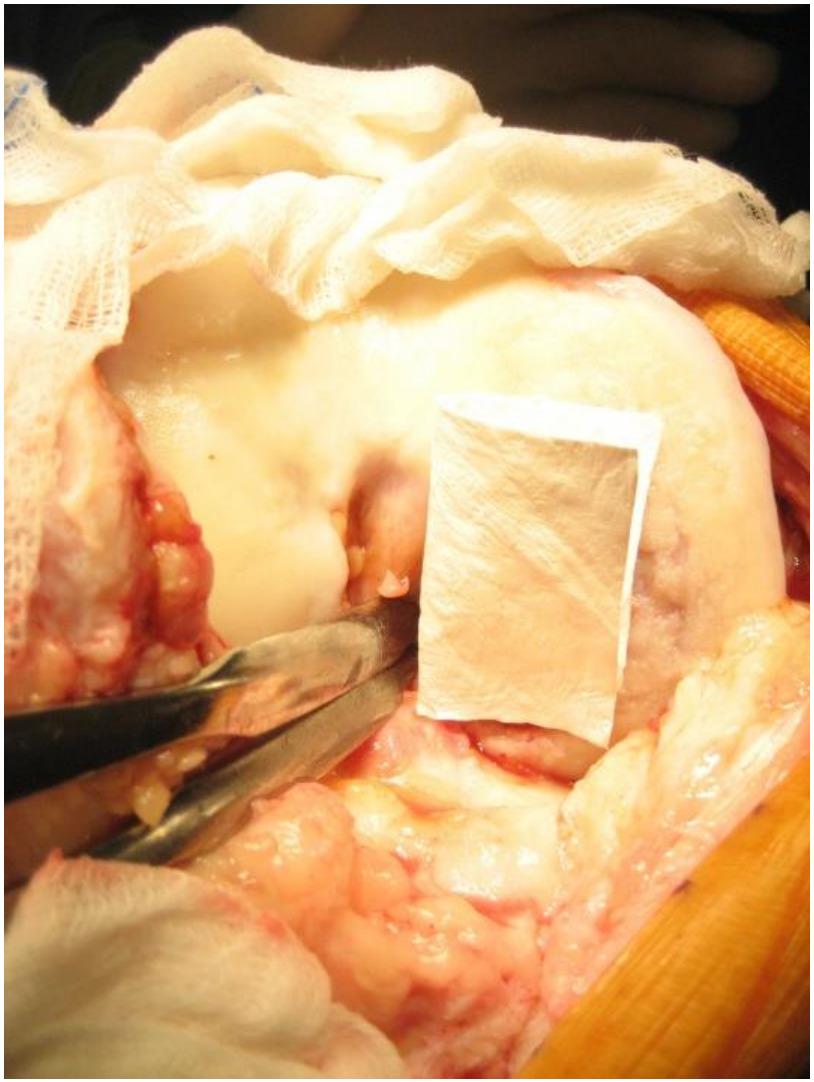

tilt -5

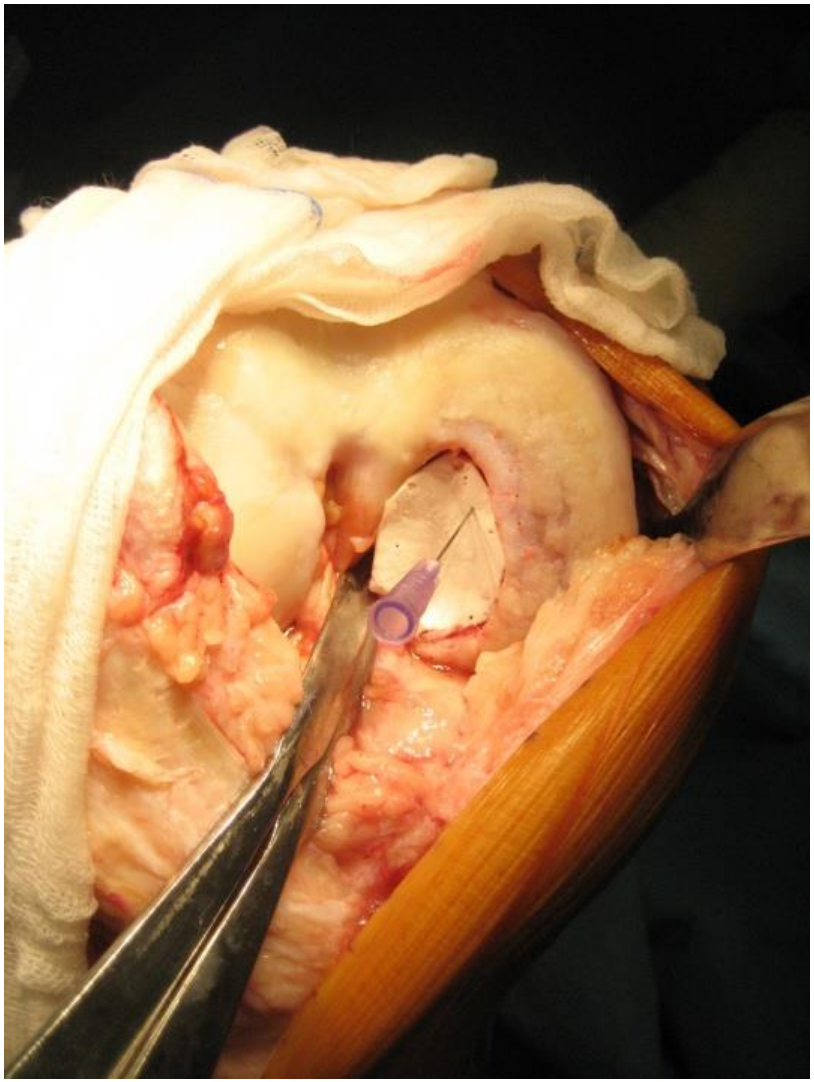
# First step: Unloading Osteotomy

# 4 weeks later



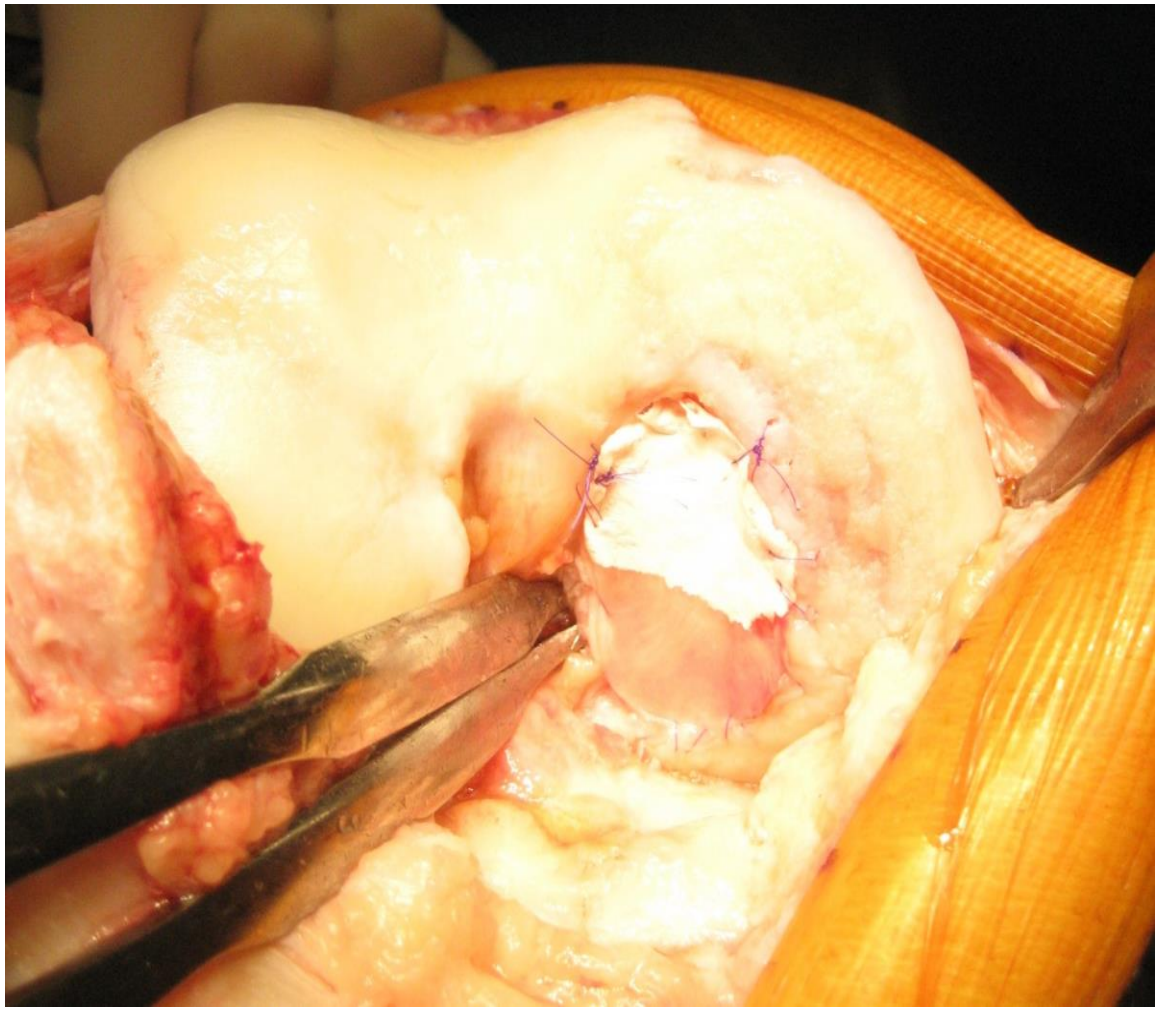
# Preparation of Chondro-Gide Matrix



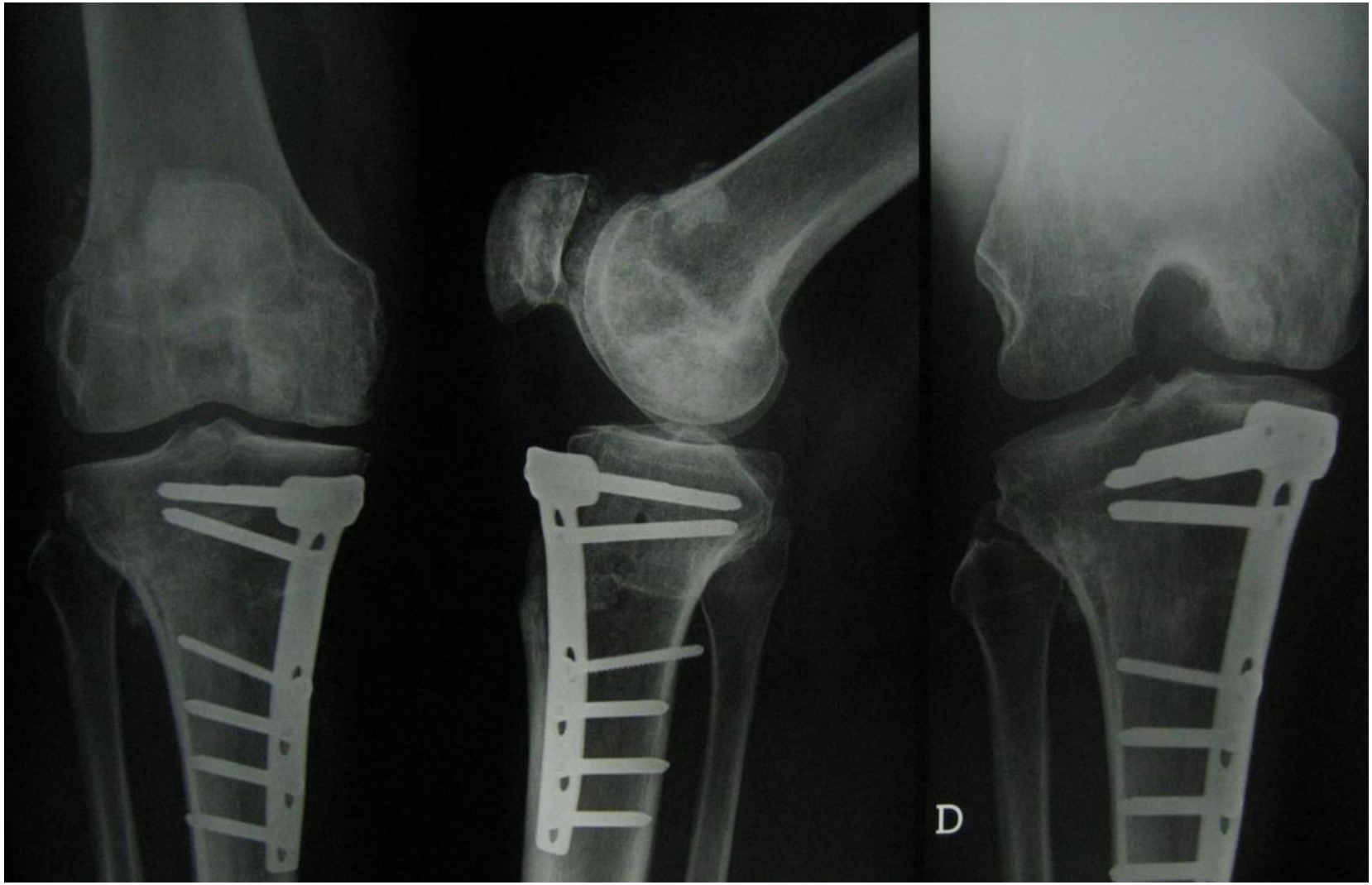


# Spongiosa + Hydroxyappatite + Serum + Fibringlue

# Filling of the defect and membrane suture



# 3 months later

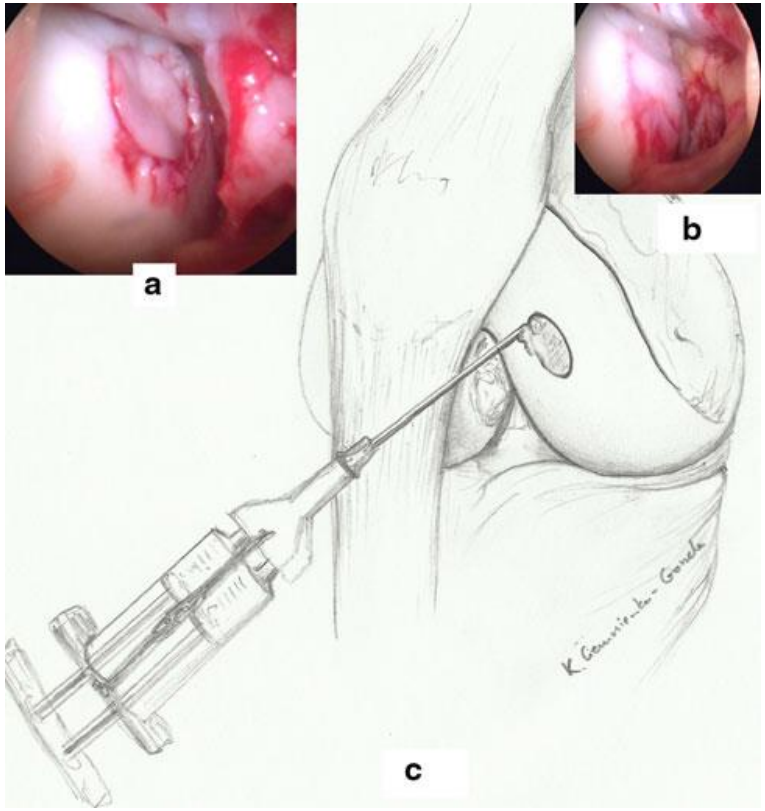


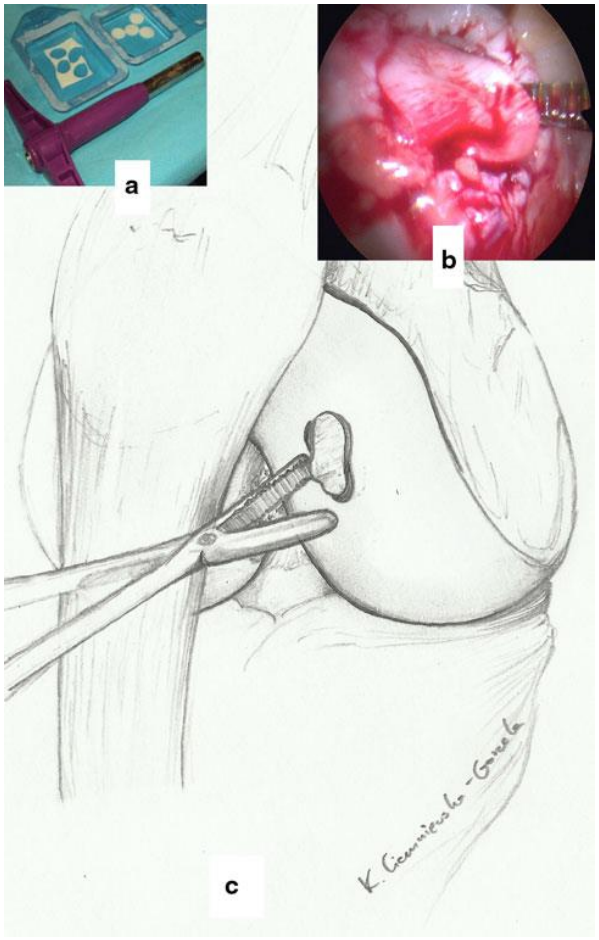
Knee Surg Sports Traumatol Arthrosc (2012) 20:922–925
DOI 10.1007/s00167-011-1657-z

KNEE

# All-arthroscopic AMIC procedure for repair of cartilage defects of the knee

Tomasz Piontek · Kinga Ciemniewska-Gorzela · Andrzej Szulc · Jakub Naczk · Michał Słomczykowski



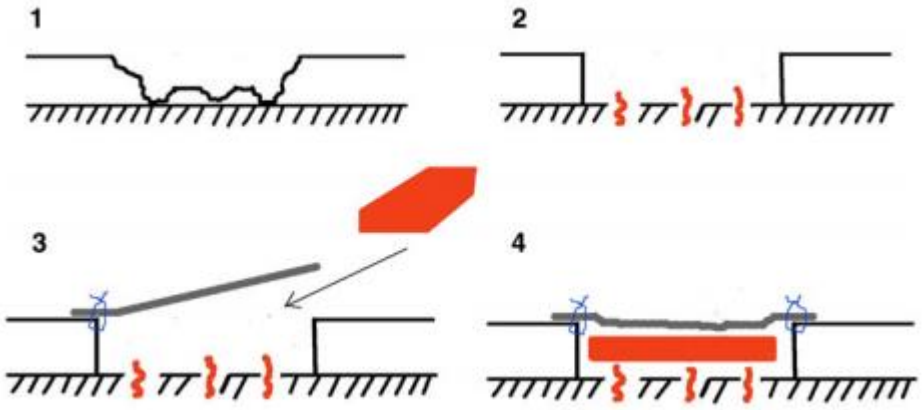



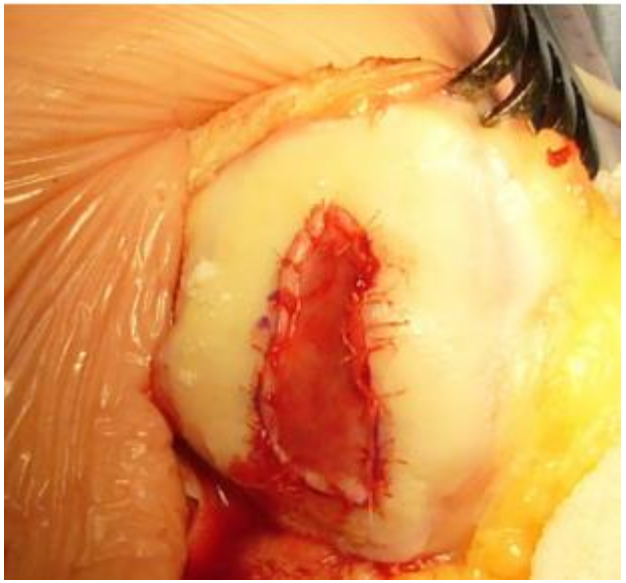
Knee Surg Sports Traumatol Arthrosc (2011) 19:536–542
DOI 10.1007/s00167-010-1337-4

KNEE

# Autologous matrix-induced chondrogenesis combined with platelet-rich plasma gel: technical description and a five pilot patients report

A. A. M. Dhollander · F. De Neve · K. F. Almqvist · R. Verdonk · S. Lambrecht · D. Elewaut · G. Verbruggen · P. C. M. Verdonk

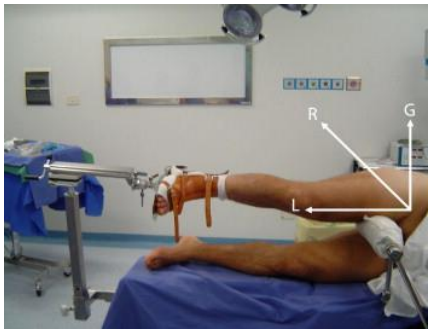


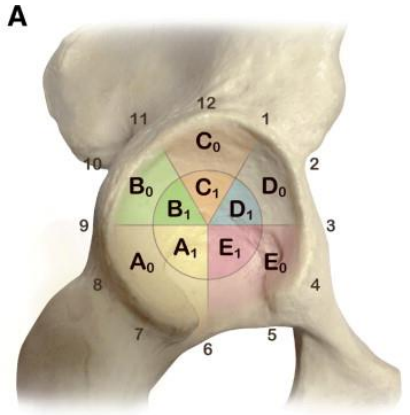
# A Novel Technique for Treating Cartilage Defects in the Hip: A Fully Arthroscopic Approach to Using Autologous Matrix-Induced Chondrogenesis

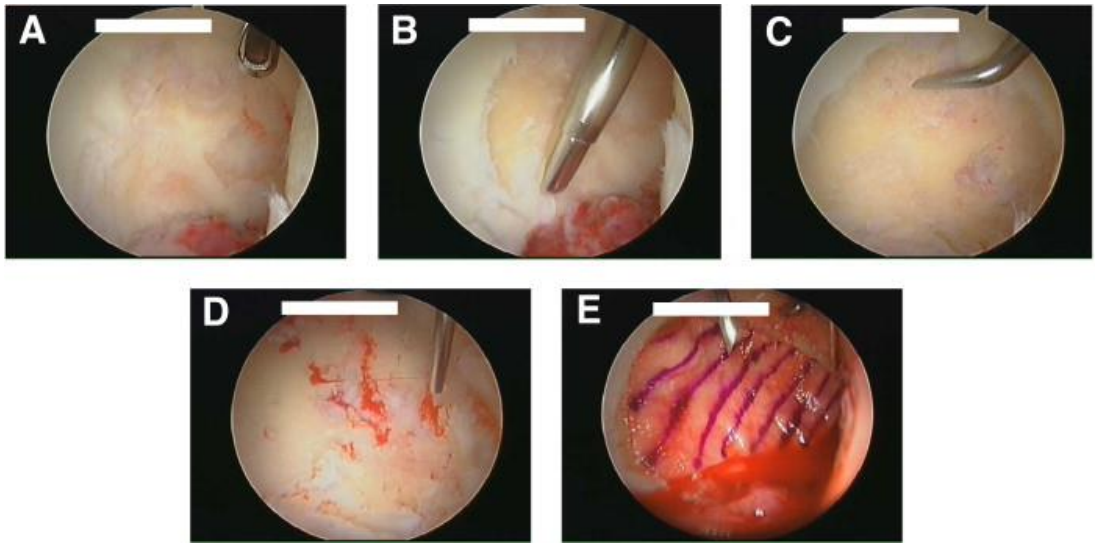
*Arthroscopy Techniques, Vol 1, No 1 (September), 2012: pp e63-e68*

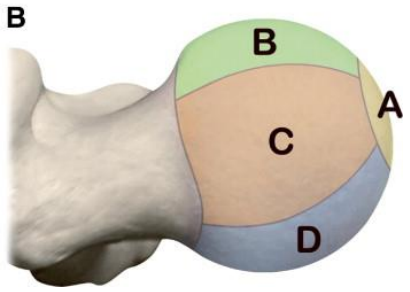
Andrea Fontana, M.D.







# Reconstruction of Osteochondral Lesions of the Talus With Autologous Spongiosa Grafts and Autologous Matrix-Induced Chondrogenesis

The American Journal of Sports Medicine, Vol. 41, No. 3
DOI: 10.1177/0363546513476671


Victor Valderrabano,* MD, PhD, Matthias Miska,*† MD, André Leumann,* MD, and Martin Wiewiorski,*‡§ MD

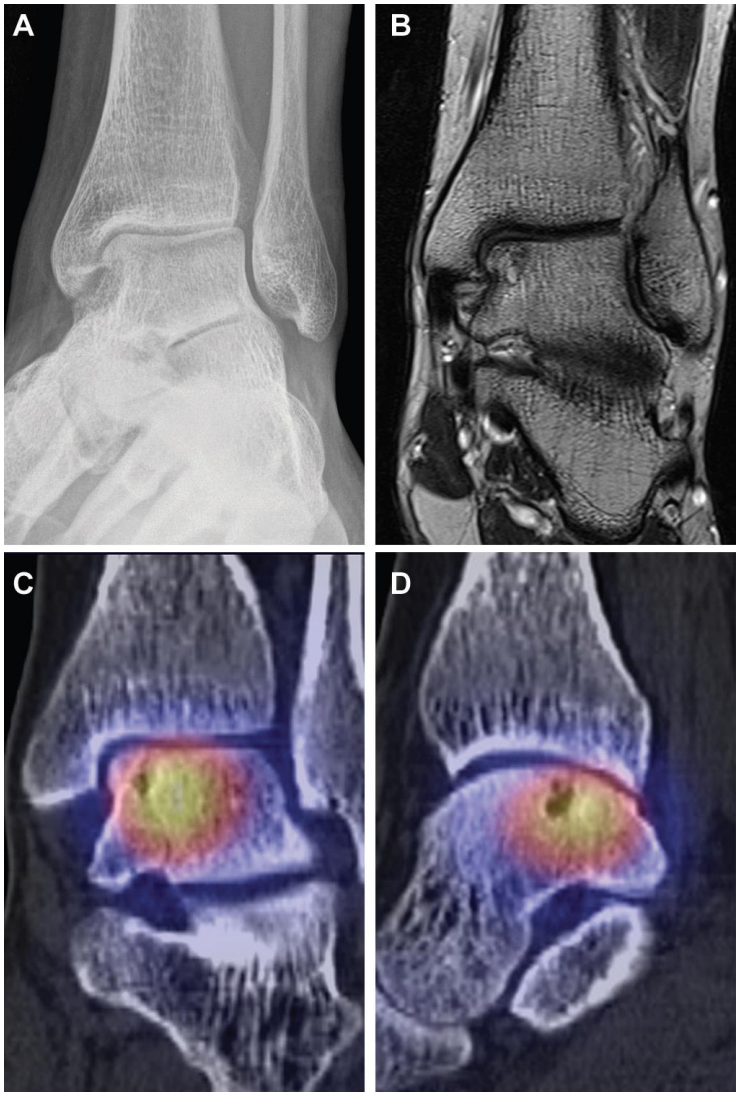
26 patients

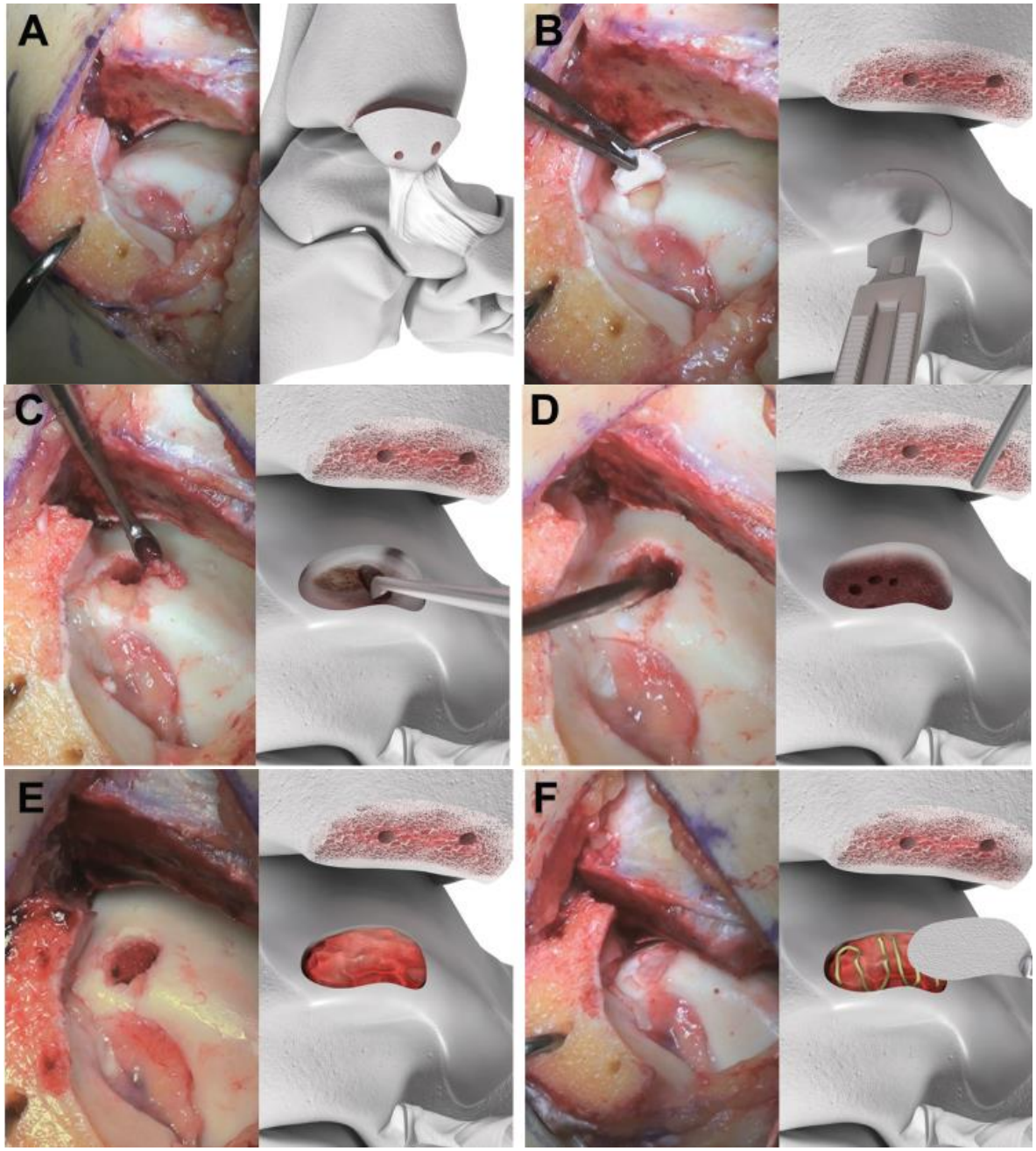
Ligament repair 17/26 cases.

Corrective calcaneal osteotomy 16/26

Minimum fup 24 months

AOFAS ankle score improved from a mean of 60 points preoperatively to 89 points




A
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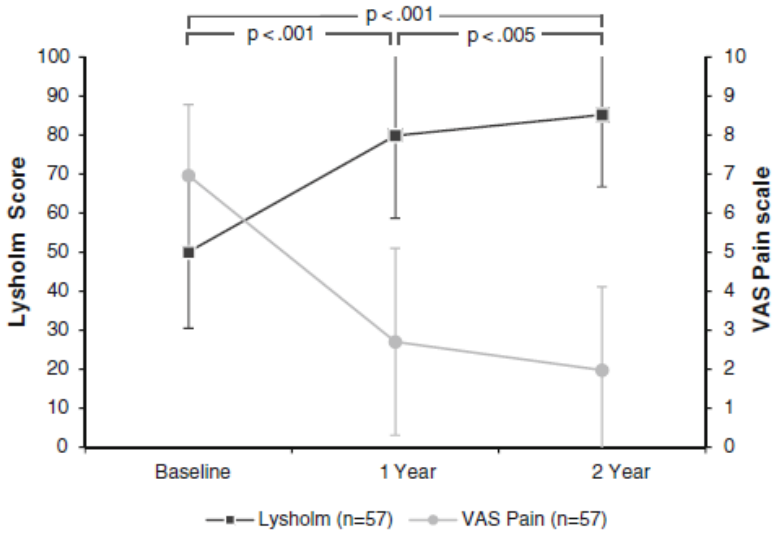
Arch Orthop Trauma Surg (2013) 133:87–93
DOI 10.1007/s00402-012-1621-5

ARTHROSCOPY AND SPORTS MEDICINE

# Outcome of Autologous Matrix Induced Chondrogenesis (AMIC) in cartilage knee surgery: data of the AMIC Registry

J. Gille · P. Behrens · P. Volpi · L. de Girolamo · E. Reiss · W. Zoch · S. Anders

Significant improvement of the mean Lysholm score was observed as early as 1 year after AMIC and further increased values were noted up to 2 years postoperatively

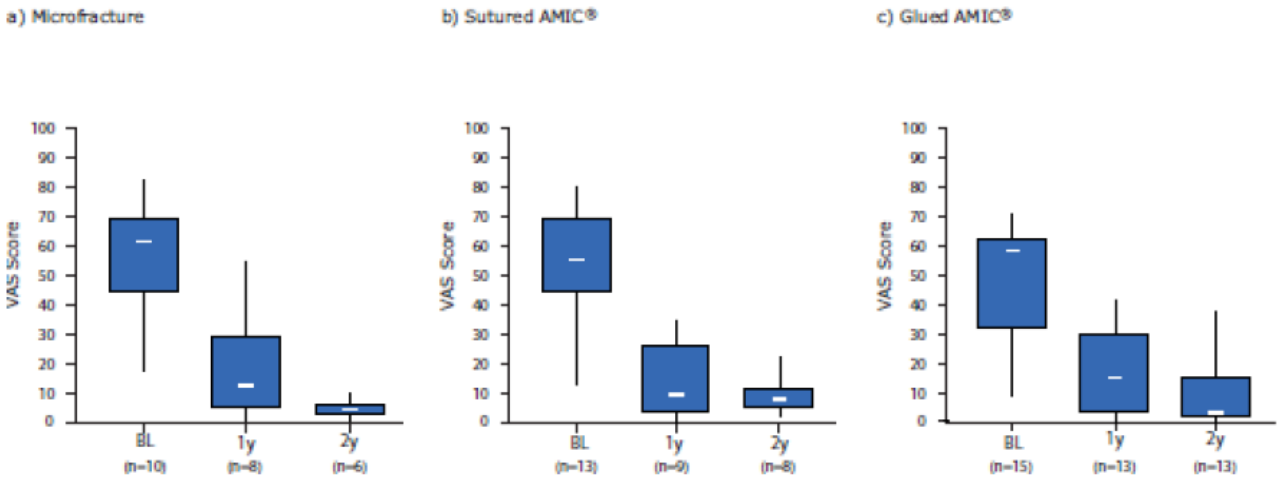


*The Open Orthopaedics Journal*, 2013, *7*, (Suppl 1: M4) 133-143




# A Randomized, Controlled Trial Comparing Autologous Matrix-Induced Chondrogenesis (AMIC®) to Microfracture: Analysis of 1- and 2-Year Follow-Up Data of 2 Centers

Sven Anders[*,1,†], Martin Volz[2,†], Hubert Frick[2] and Jörg Gellissen[3]




Improvements in ICRS score were seen at 1-and 2-years post-operation, irrespective of the technique used. MRI assessment revealed a satisfactory and homogenous defect filling in the majority of patients

WJO 5th Anniversary Special Issues (5): Knee

# Enhanced microfracture techniques in cartilage knee surgery: Fact or fiction?

*World J Orthop* 2014 September 18; 5(4): 444-449

Stefan Bark, Tomasz Piontek, Peter Behrens, Sabreen Mkalaluh, Deike Varoga, Justus Gille

Both techniques (microfracture and AMIC®) present an effective and safe method of treating full thickness chondral defects of the knee.

While results after microfractures deteriorate with time, clinical outcome after AMIC® seems to be more enduring