GELENKPUNKT
SPORTS AND JOINT SURGERY INNSBRUCK

Enhanced Microfracture

Christian Fink and Miguel Rivera

FIFA MEDICAL CENTRE OF EXCELLENCE

ESSKA Teaching Center

MOTUM HUMAN·PERFORMANCE·INSTITUTE

isag institut für sport-, alpinmedizin und gesundheitstourismus

UMIT the health & life sciences university

Disclosures

- Consultat/Product Royalties from

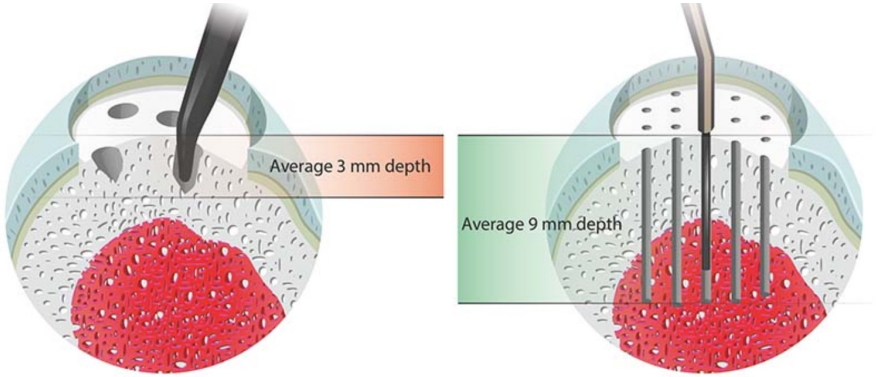
Karl Storz, Medacta

- Fellowship/Research support from

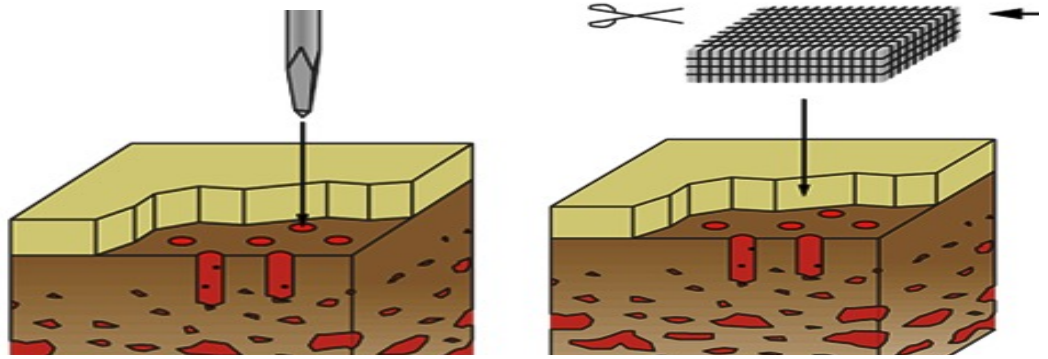
Arthrex, Medacta, ZimmerBiomet

BONE MARROW STIMULATION TECHNIQUES

- Micro (nano) fracture



- mBMS



Microfracture for the Treatment of Symptomatic Cartilage Lesions of the Knee: A Survey of International Cartilage Regeneration & Joint Preservation Society

Cartilage | SAGE

Jesus Medina[1], Ignacio Garcia-Mansilla[2], Peter D. Fabricant[3], Thomas J. Kremen[4], Seth L. Sherman[5], and Kristofer Jones[4]

385 surgeons

42-item questionnaire

70% use Microfracture Awl
17% Kirschner wire

47% use biologic agents (most common were scaffolds and injectable agents)

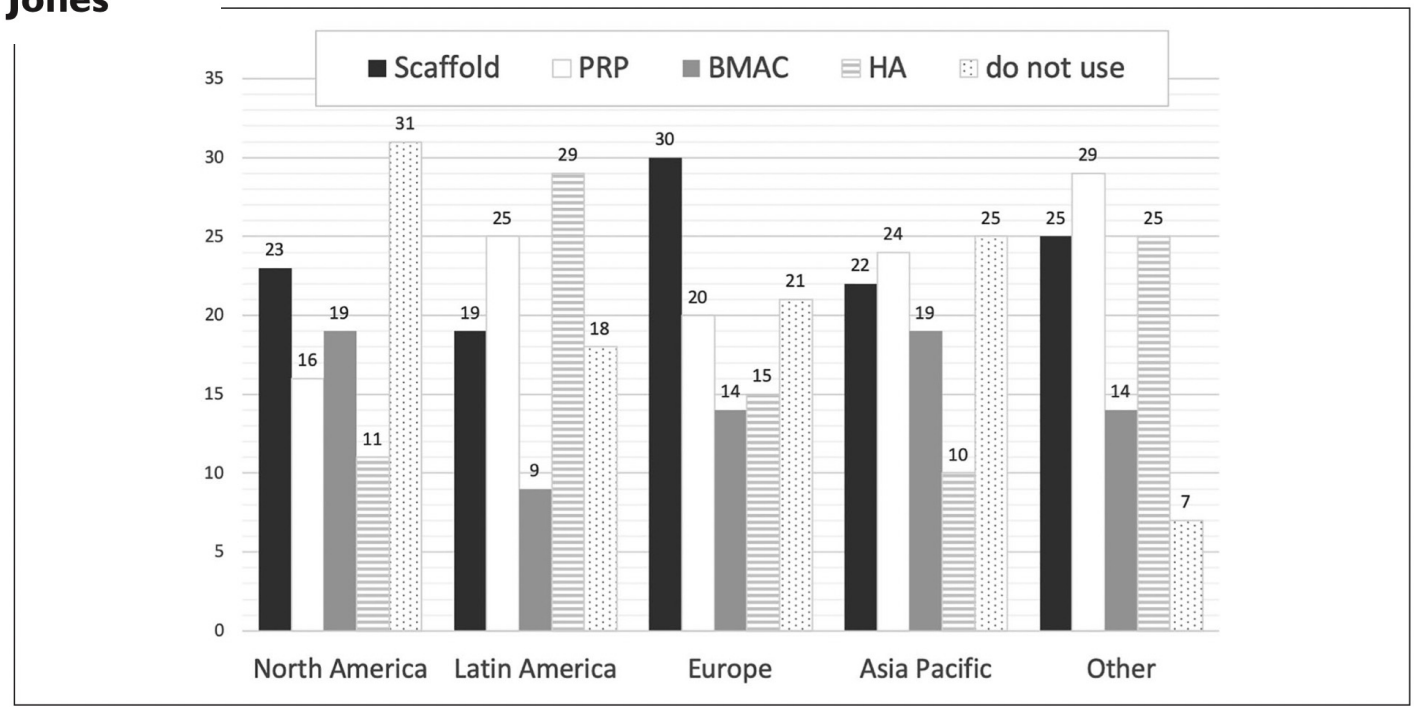
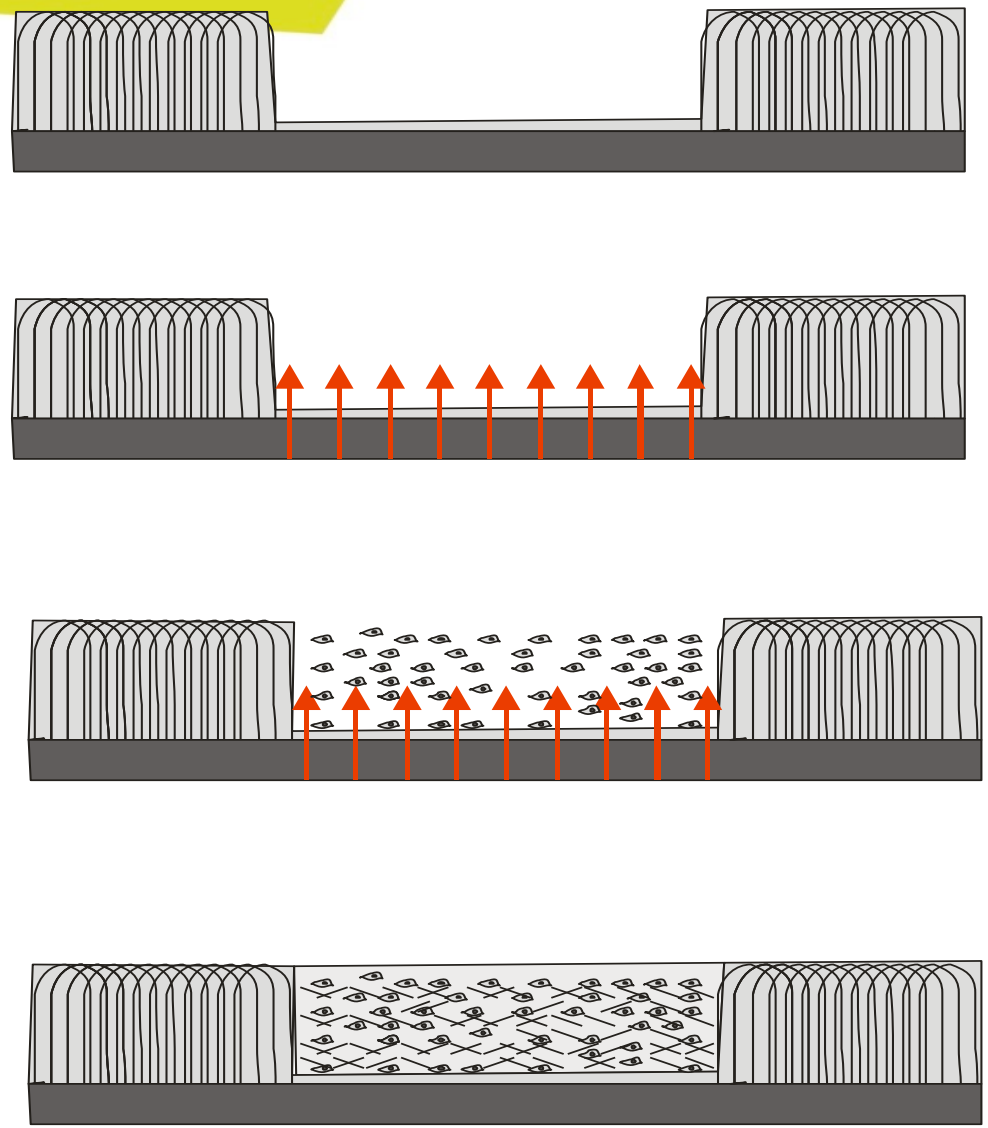
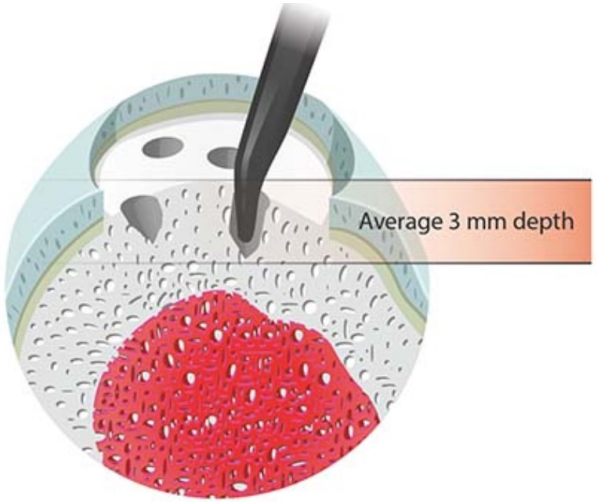
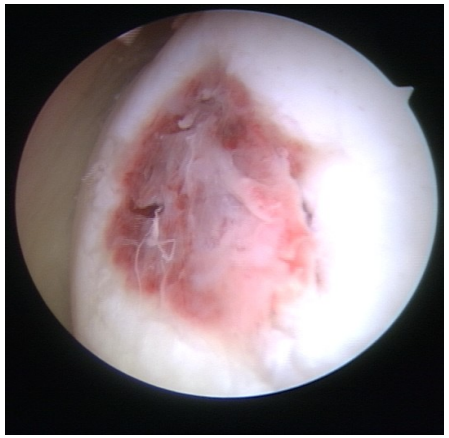


Figure 4. Utilization of biological agents among different regions. Results are shown as mean percentage of responses. PRP, platelet-rich plasma; BMAC, bone marrow aspirate concentrate; HA, hyaluronic acid.

Micro fracture







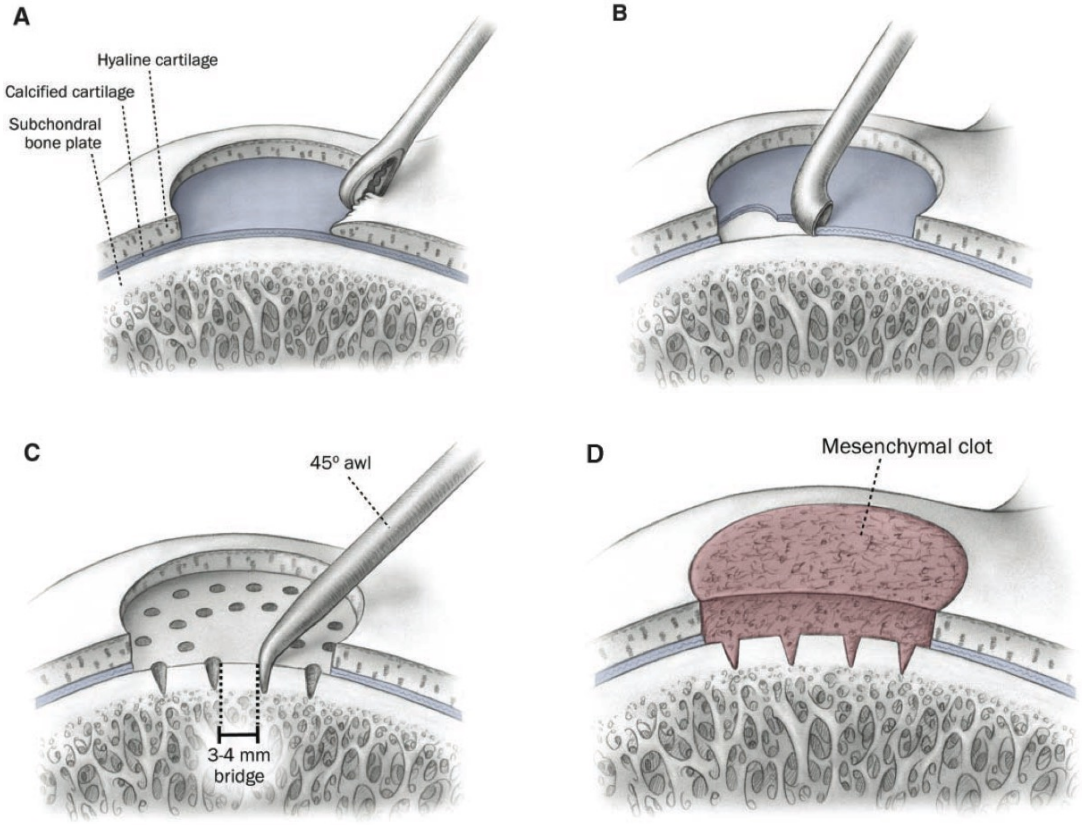
Steadman et al, 1987

Microfracture

Am J Sports Med. 2009 Oct;37(10):2053-63. doi: 10.1177/0363546508328414. Epub 2009 Feb 26.

Clinical efficacy of the microfracture technique for articular cartilage repair in the knee: an evidence-based systematic analysis.

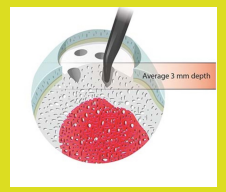
Mithoefer K[1], McAdams T, Williams RJ, Kreuz PC, Mandelbaum BR.



- **Conclusion:**
  - 28 Studies (3122 Patienten)
  - Short to mid-time results: good
  - **Long time results are demending or inconsistent**

Factors Affecting Outcome After Microfracture

Factors	Better Results With
Age	<40 years
Duration of symptoms	<12 months
Lesion size	<4 cm^2
Body mass index	<30 kg/m^2
Preoperative activity level	Tegner score >4
Previous surgery	Primary microfracture
Repair cartilage volume	Good defect fill (>66%)



Microfracture in Football (Soccer) Players: A Case Series of Professional Athletes and Systematic Review

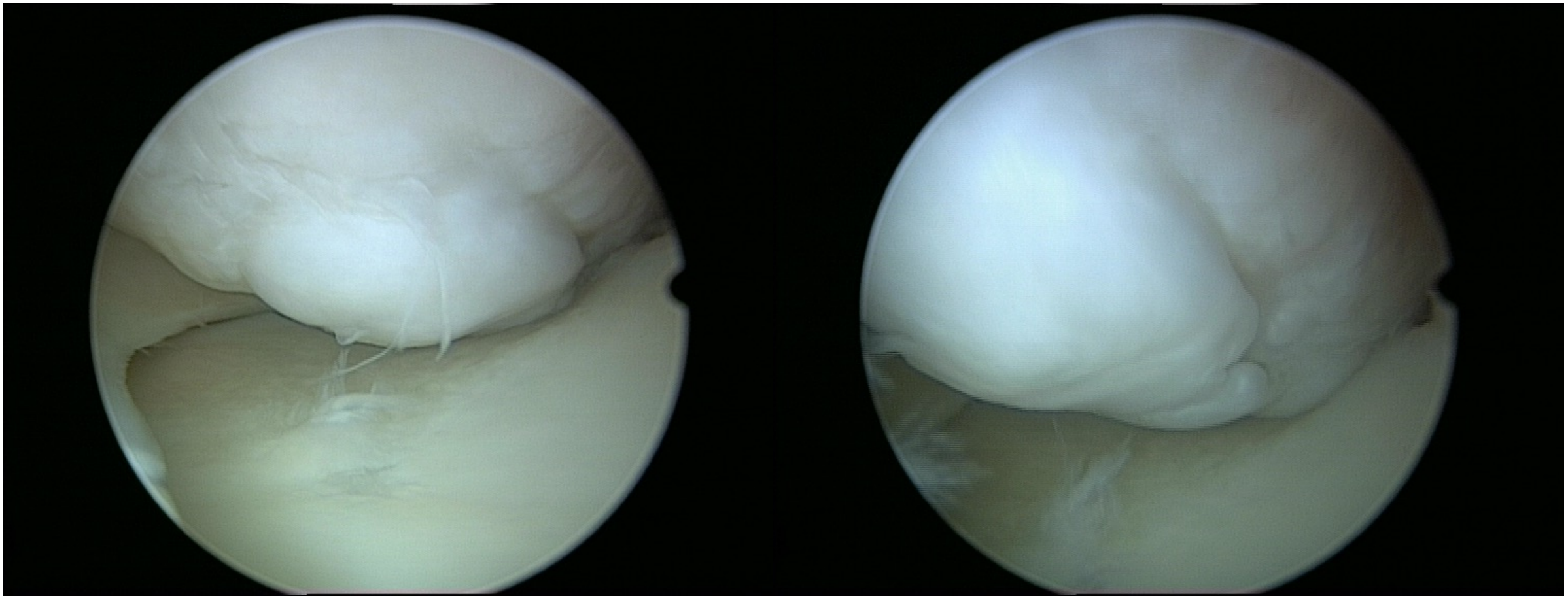
Cartilage
3(Suppl. 1) 18S–24S

DOI: 10.1177/1947603511418960
http://cart.sagepub.com
SAGE

Kai Mithoefer[1] and Richard J. Steadman[2]

- Systematic review of 11 level III and IV studies with average f/up 46 months
- Average RTS after microfx – 67% at mean of 8 ±1 month
- 67% returned to pre-injury level
- However, 36% of the studies included reported decreased level of activity in majority of patients between 2-5 years postoperatively

Problem – Hypertrophic Ossification



Technical Modifications

Microfracture versus Nanofracture

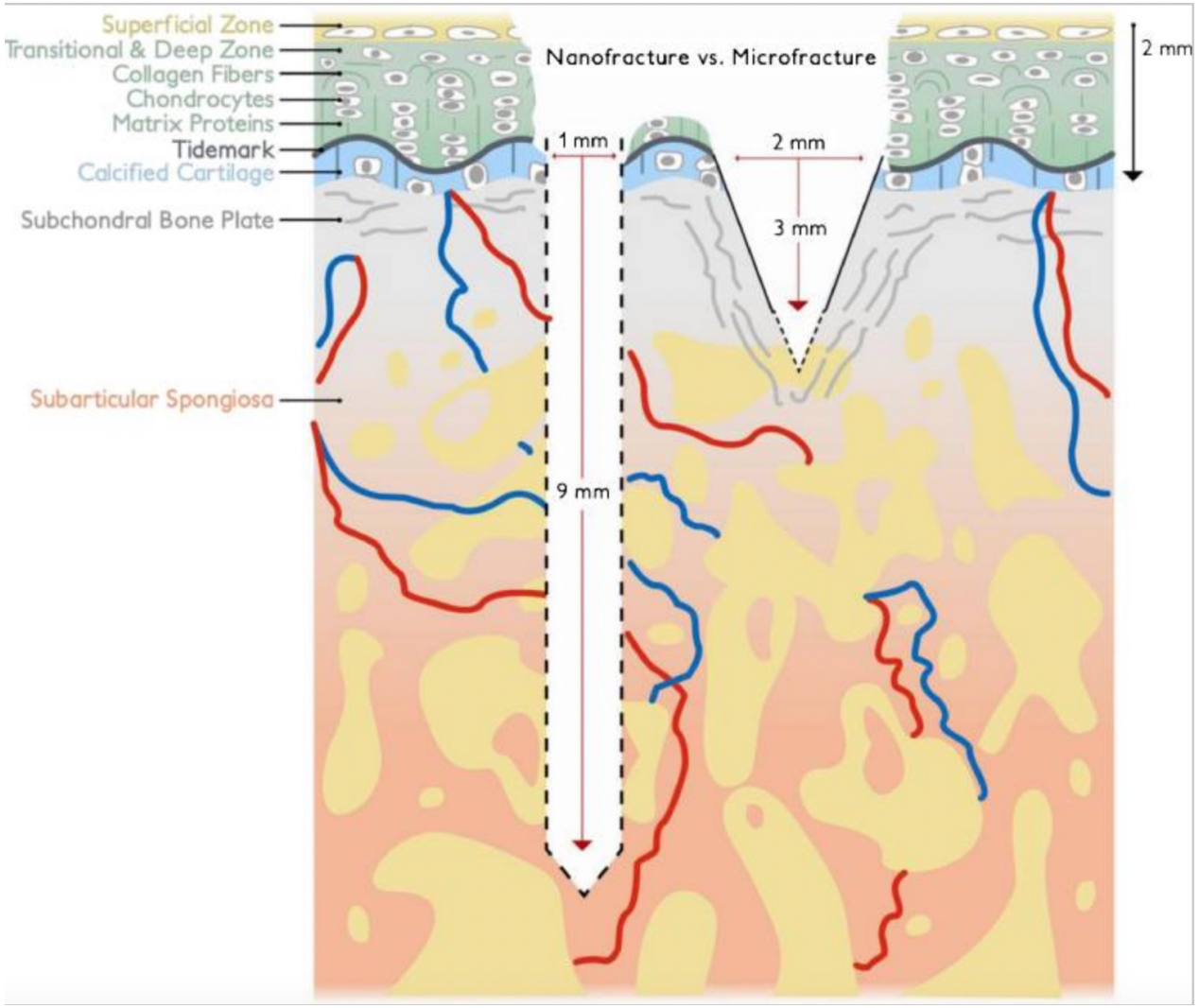
Reviewing subchondral cartilage surgery: considerations for standardised and outcome predictable cartilage remodelling

A technical note

Jan P. Benthien · Peter Behrens

Microfracture possible shortcomings:

- Shallow marrow access
- Inconsistent depth
- Large diameter perforation
- Intra-channel bone compaction



Subchondral drilling for articular cartilage repair: a systematic review of translational research

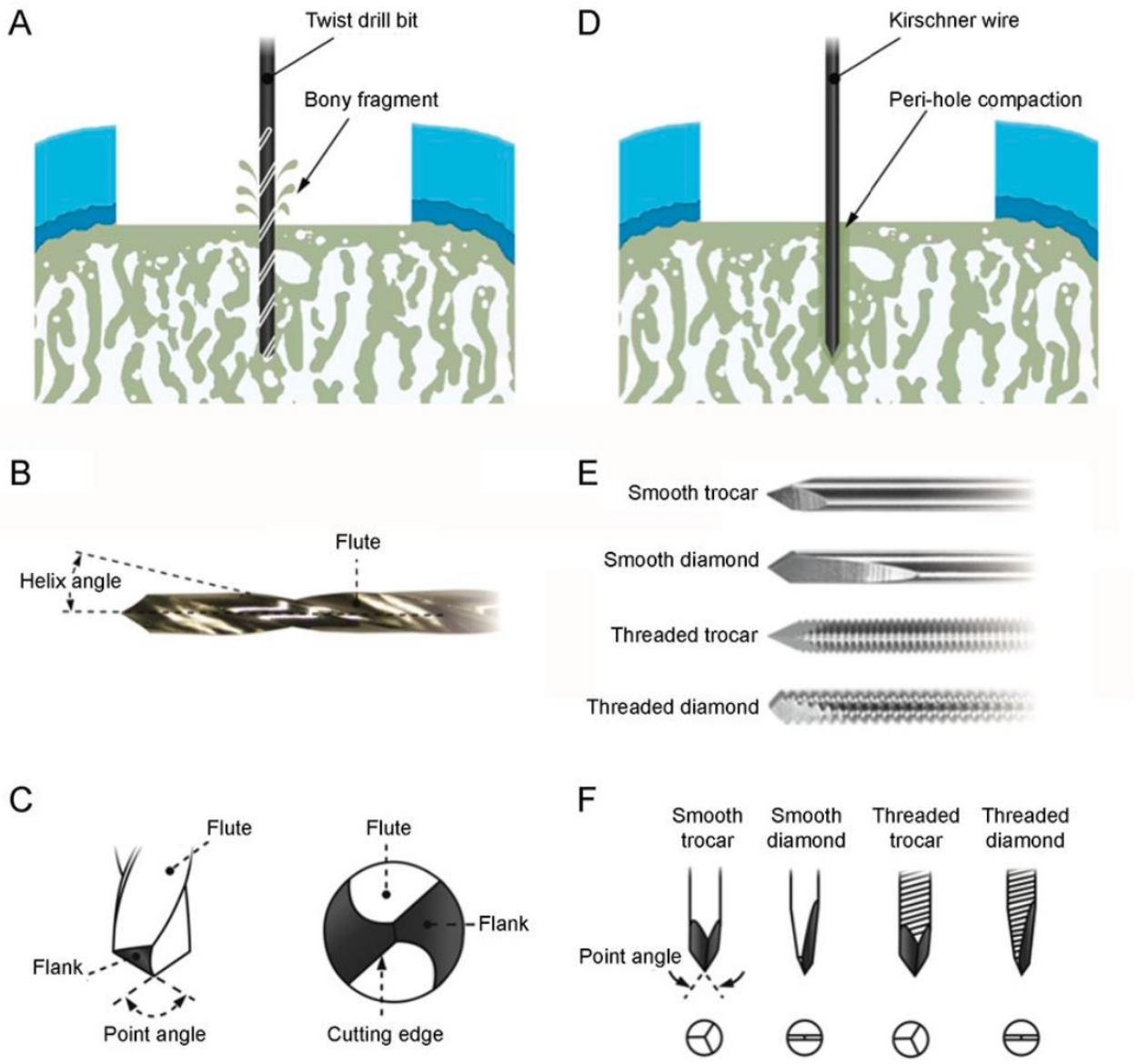
Liang Gao[1], Lars K. H. Goebel[1, 2], Patrick Orth[1, 2], Magali Cucchiarini[1], Henning Madry[1, 2, *]

[1]Center of Experimental Orthopedics, Saarland University, Homburg, Germany

[2]Department of Orthopaedic Surgery, Saarland University Medical Center, Homburg, Germany

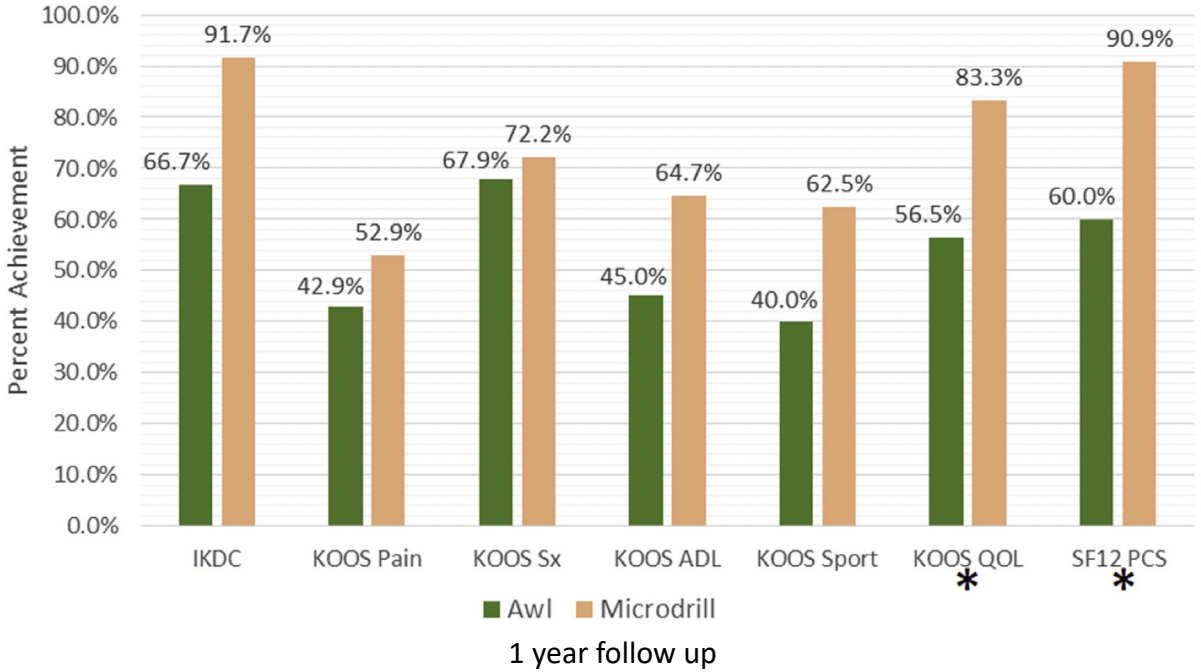
12 animal studies

- Subchondral drilling led to improved repair outcome compared with defects that were untreated or treated with abrasion arthroplasty for cartilage repair
- Subchondral drilling yields improved short-term structural articular cartilage repair compared with spontaneous repair



Microdrilling Demonstrates Superior Patient-Reported Outcomes and Lower Revision Rates Than Traditional Microfracture: A Matched Cohort Analysis

Alexander Beletsky, M.D., Neal B. Naveen, B.S., Tracy Tauro, B.A., Taylor M. Southworth, B.S., Jorge Chahla, M.D., Ph.D., Nikhil N. Verma, M.D., Adam B. Yanke, M.D., and Brian J. Cole, M.D.



1 year follow up

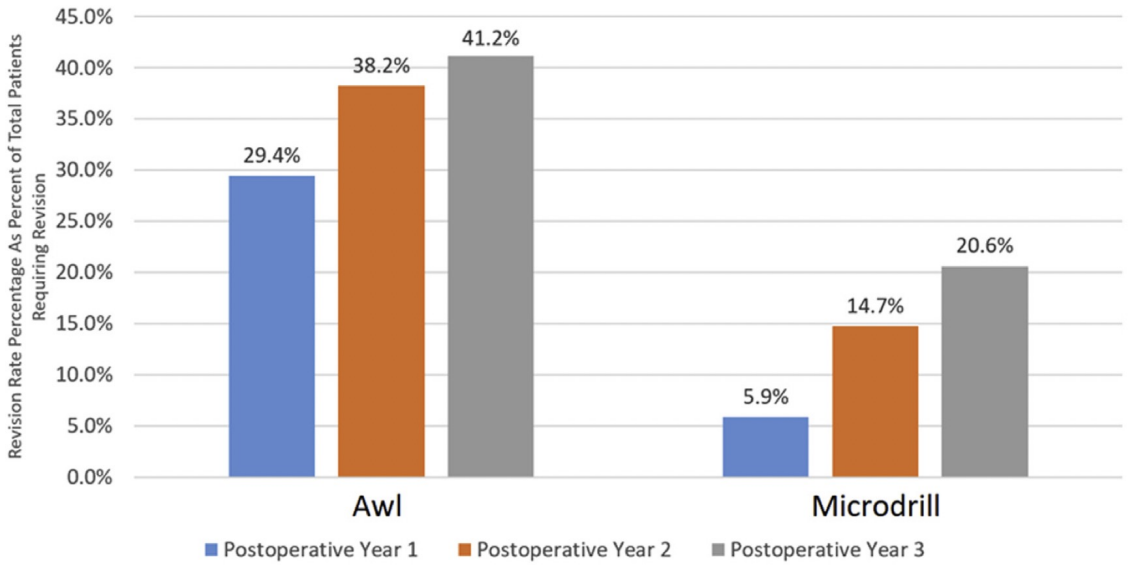
Level 2 Prospective Study

1.5 mm Drill versus Conventional Microfracture awl

34 patients each group

Improved IKDC, SF12 PCS, and KOOS Pain, Symptom, Sport, and Quality of Life ($P < .04$) at 6 months

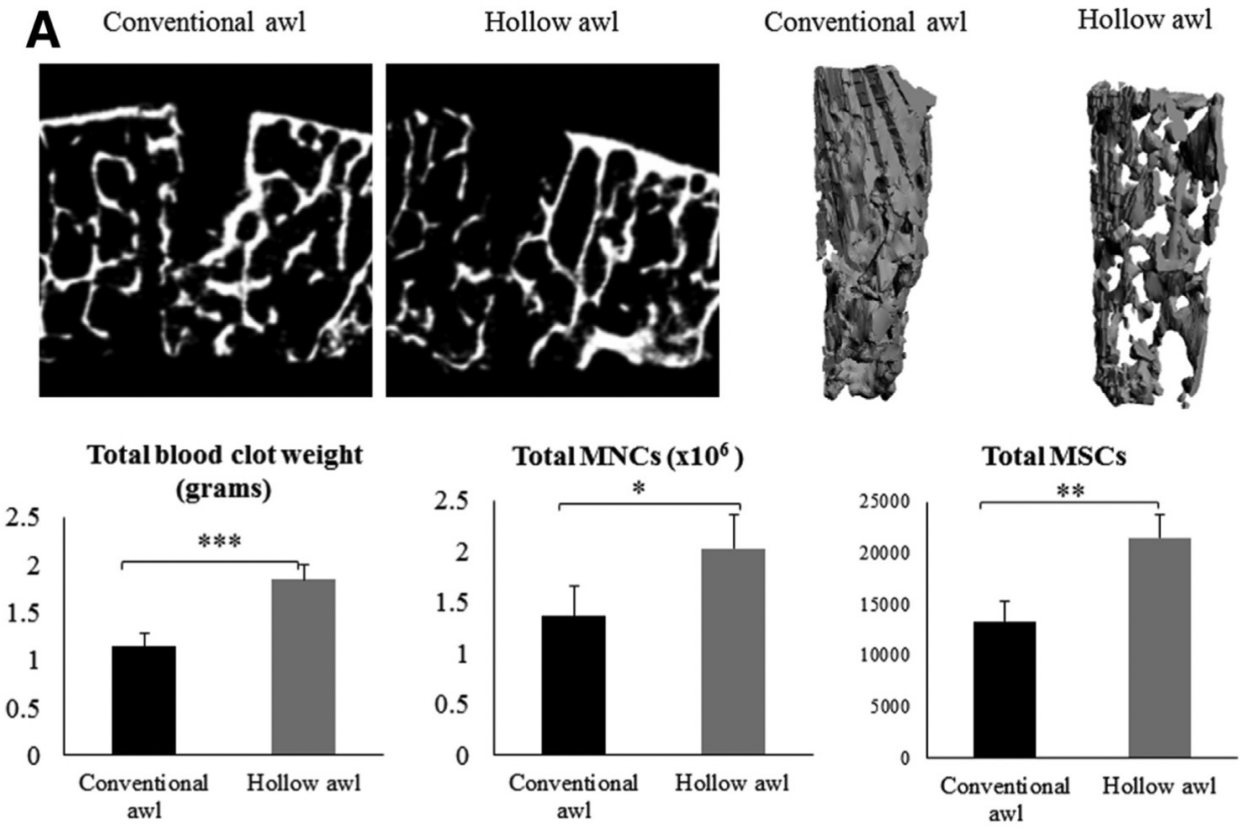
Lower revision rate at 3 years post-op



Revision Rate

Development and Efficacy Testing of a "Hollow Awl" That Leads to Patent Bone Marrow Channels and Greater Mesenchymal Stem Cell Mobilization During Bone Marrow Stimulation Cartilage Repair Surgery

Byoung-Hyun Min, M.D., Ph.D., Minh-Dung Truong, Ph.D., Hyung Keun Song, M.D., Jae Ho Cho, M.D., Ph.D., Do Young Park, M.D., Heon Ju Kweon, M.D., and Jun Young Chung, M.D.



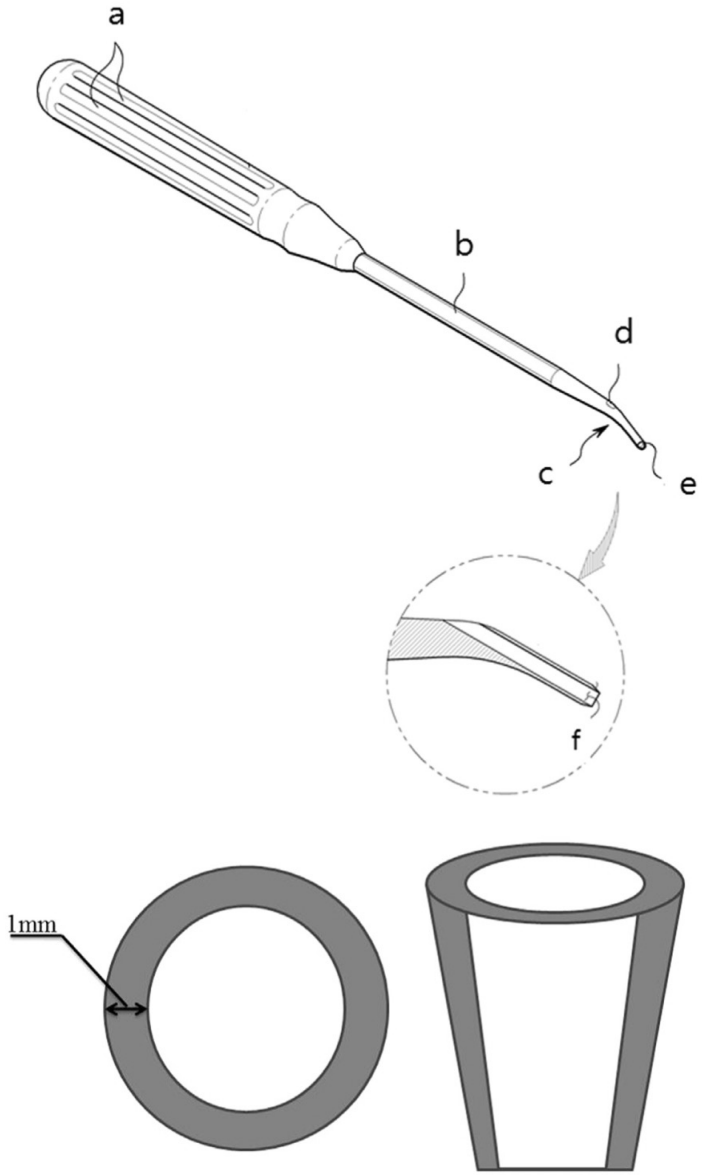
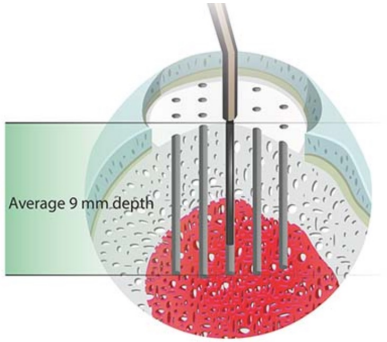
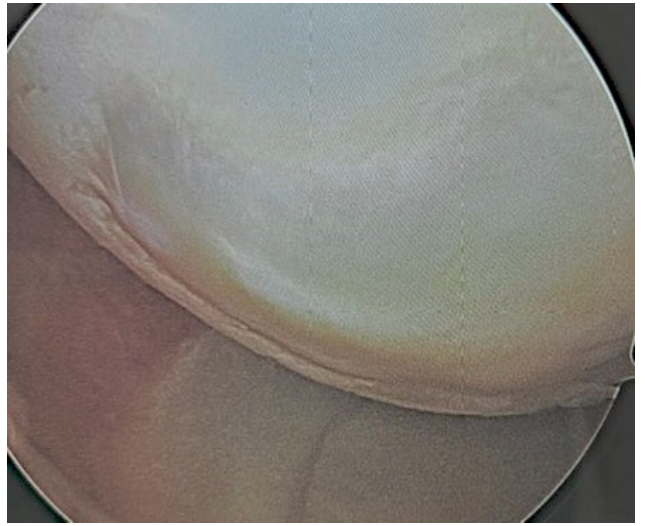


Fig 4. A 3-dimensional polygonal region of interest for analysis of subchondral bone microarchitecture at the circumference of the microfracture hole in 1 mm thickness.

Nano -fracture



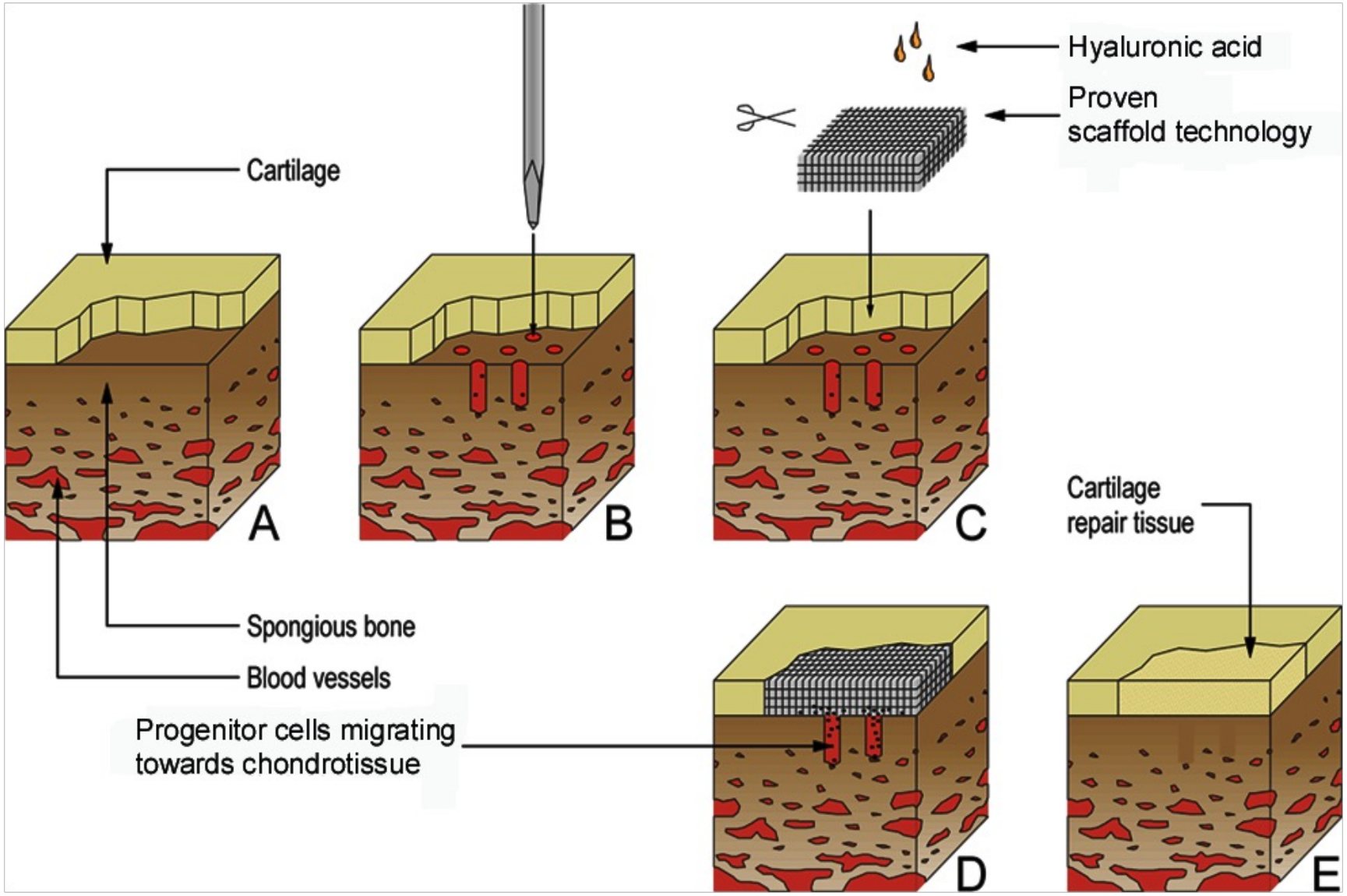


professional Soccer Player, male 31y

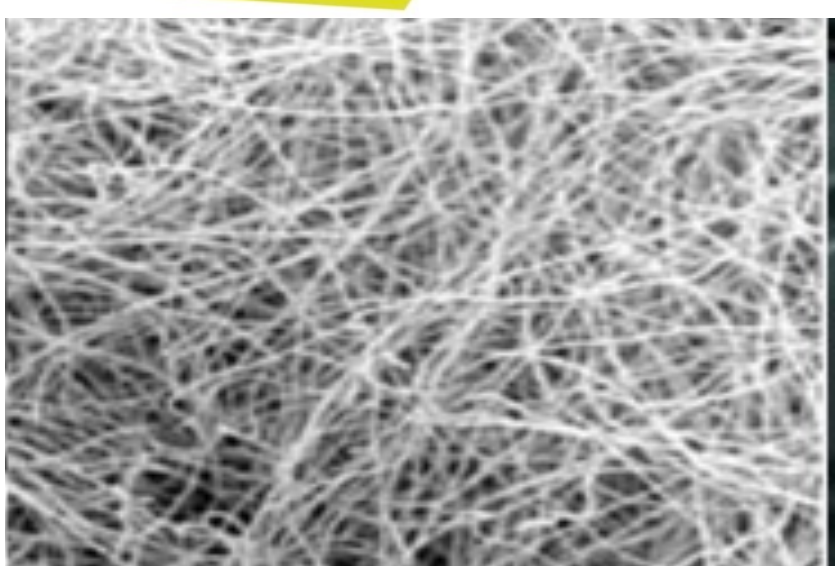
5.5 months post op

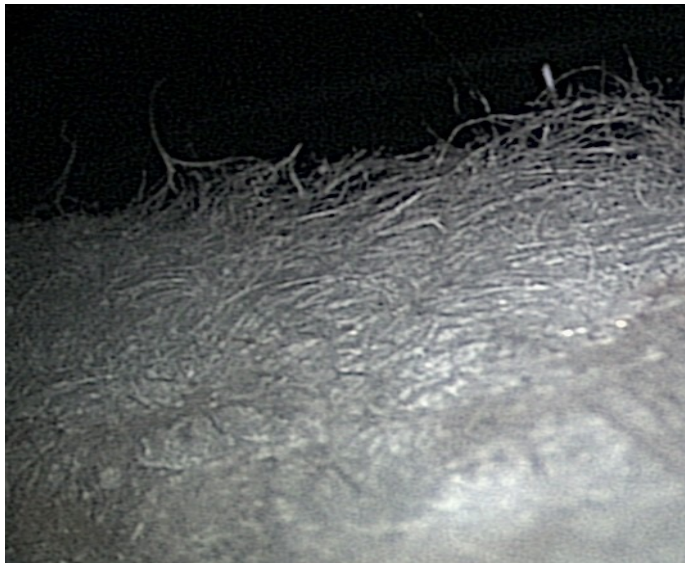
Matrix associated BMS

mBMS


Hyaluronic acid
Proven
scaffold technology
Cartilage
A
B
C
Cartilage
repair tissue
Spongious bone
Blood vessels
Progenitor cells migrating
towards chondrotissue
D
E

Matrices

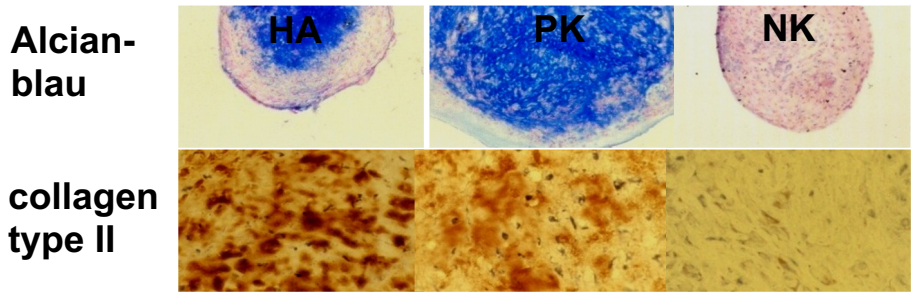




- HA, 2x2cm²
- gel-like consistency

- self adhearend, beidseitig einsetzbar
- no need for additional fixation

More specific cartilage formation of stem cells due to HA



ELSEVIER

Tissue and Cell 36 (2004) 431–438

Tissue&Cell

www.elsevier.com/locate/tice

Hyaluronic acid and autologous synovial fluid induce chondrogenic differentiation of equine mesenchymal stem cells: a preliminary study

A.A. Hegewald[a], J. Ringe[a,b,*], J. Bartel[a], I. Krüger[b], M. Notter[c], D. Barnewitz[d], C. Kaps[a,b], M. Sittinger[a]

[a] *Tissue Engineering Laboratory, Department of Rheumatology, Charité—University Medicine Berlin, Campus Mitte, Berlin, Germany*
[b] *TransTissue Technologies GmbH, Berlin, Germany*
[c] *Molecular and Cellular Immunology, Department of Transfusion Medicine, Charité—University Medicine Berlin, Campus Benjamin Franklin, Berlin, Germany*
[d] *Research Center of Medical Technology and Biotechnology, Bad Langensalza, Germany*

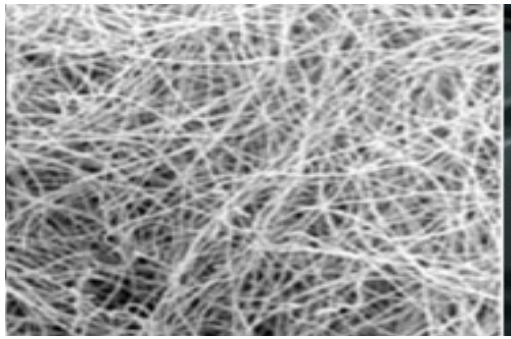
Received 24 February 2004; received in revised form 21 July 2004; accepted 27 July 2004

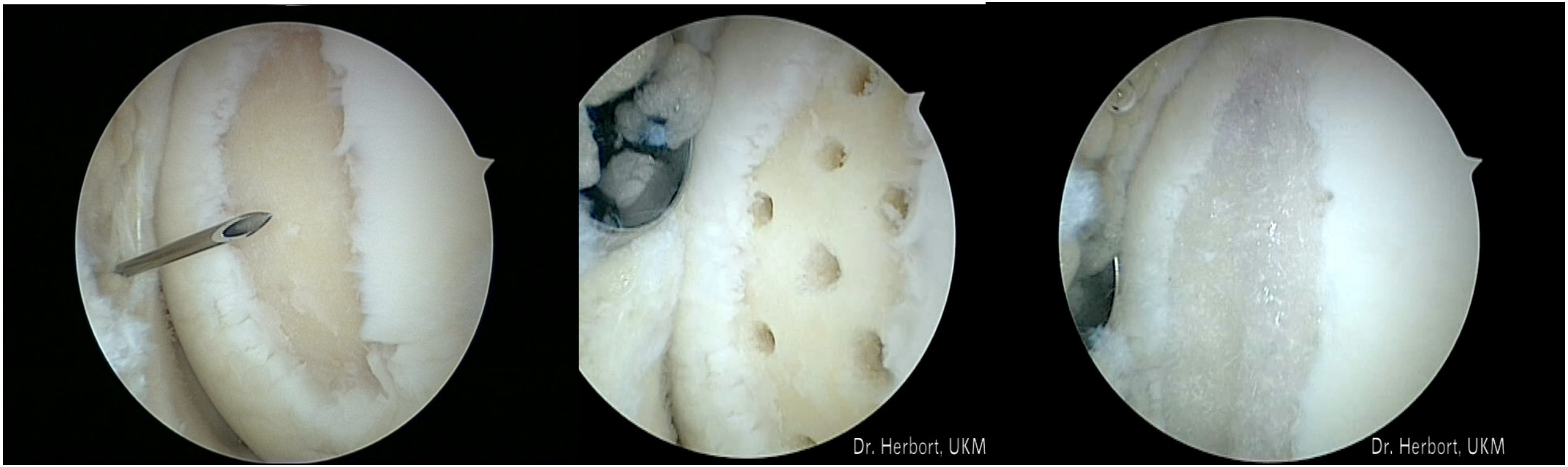
real-time RT-PCR detection of

induced chondrogenic marker genes

- **collagen type IIα1**
- **COMP**
- **aggrecan**

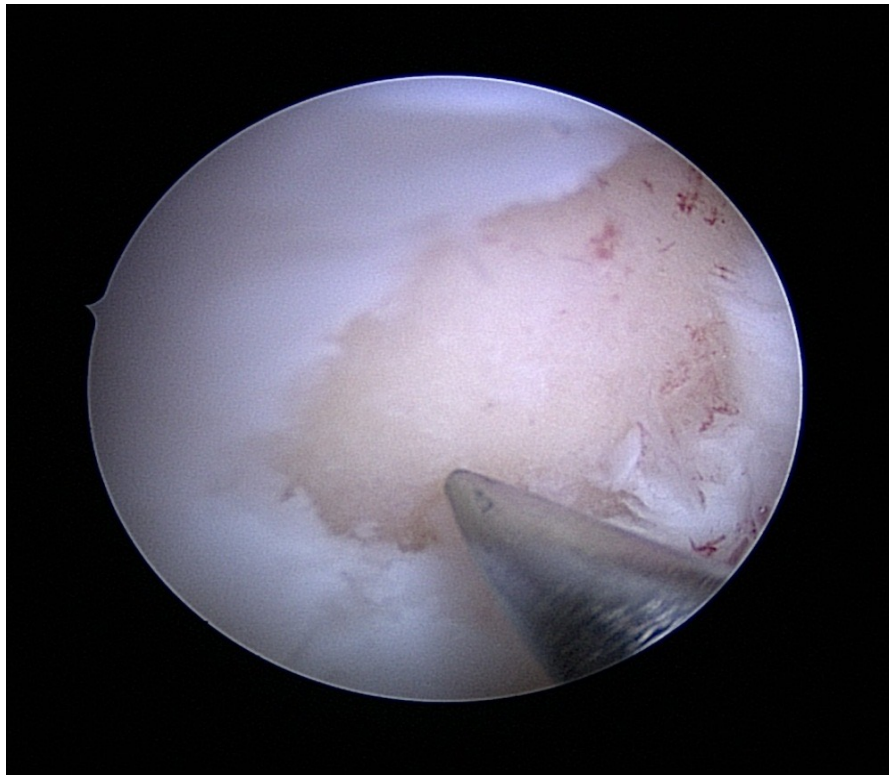
mBMS





Implantation - med. femural condyle

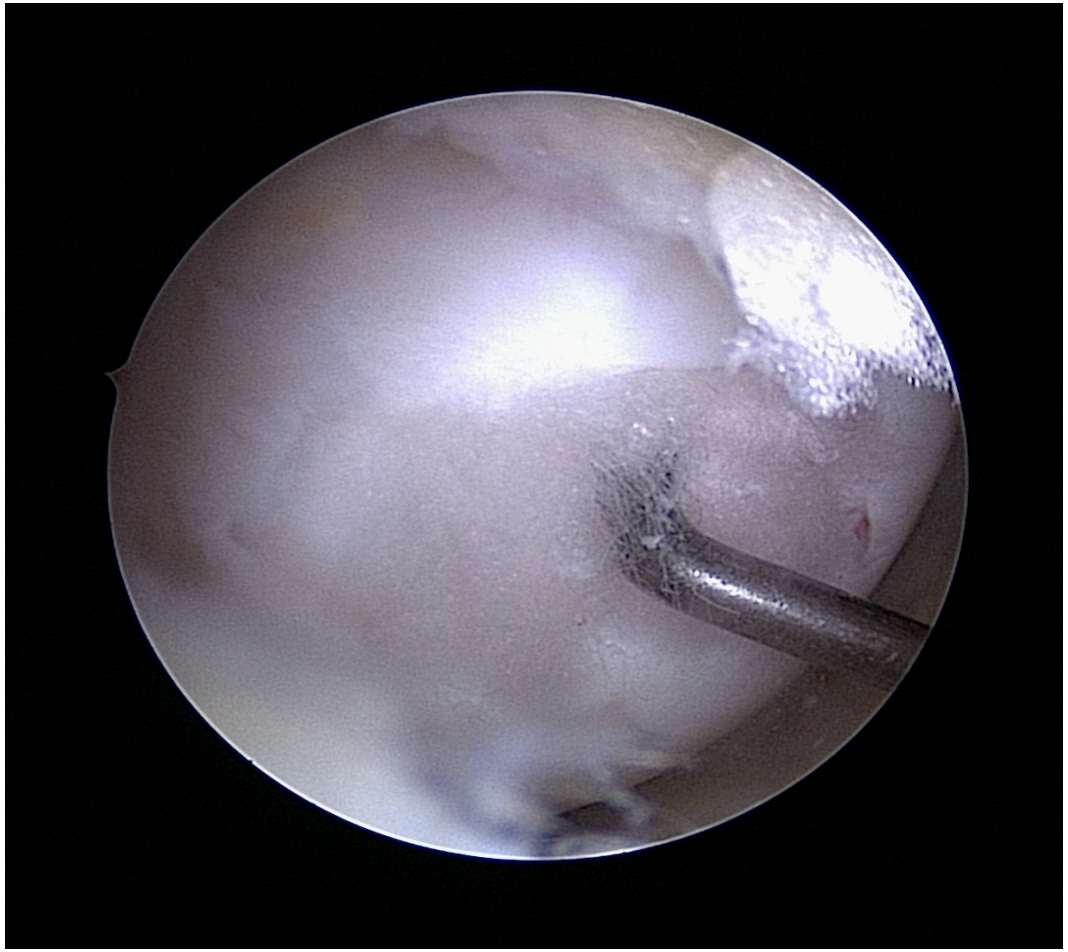
SIZING

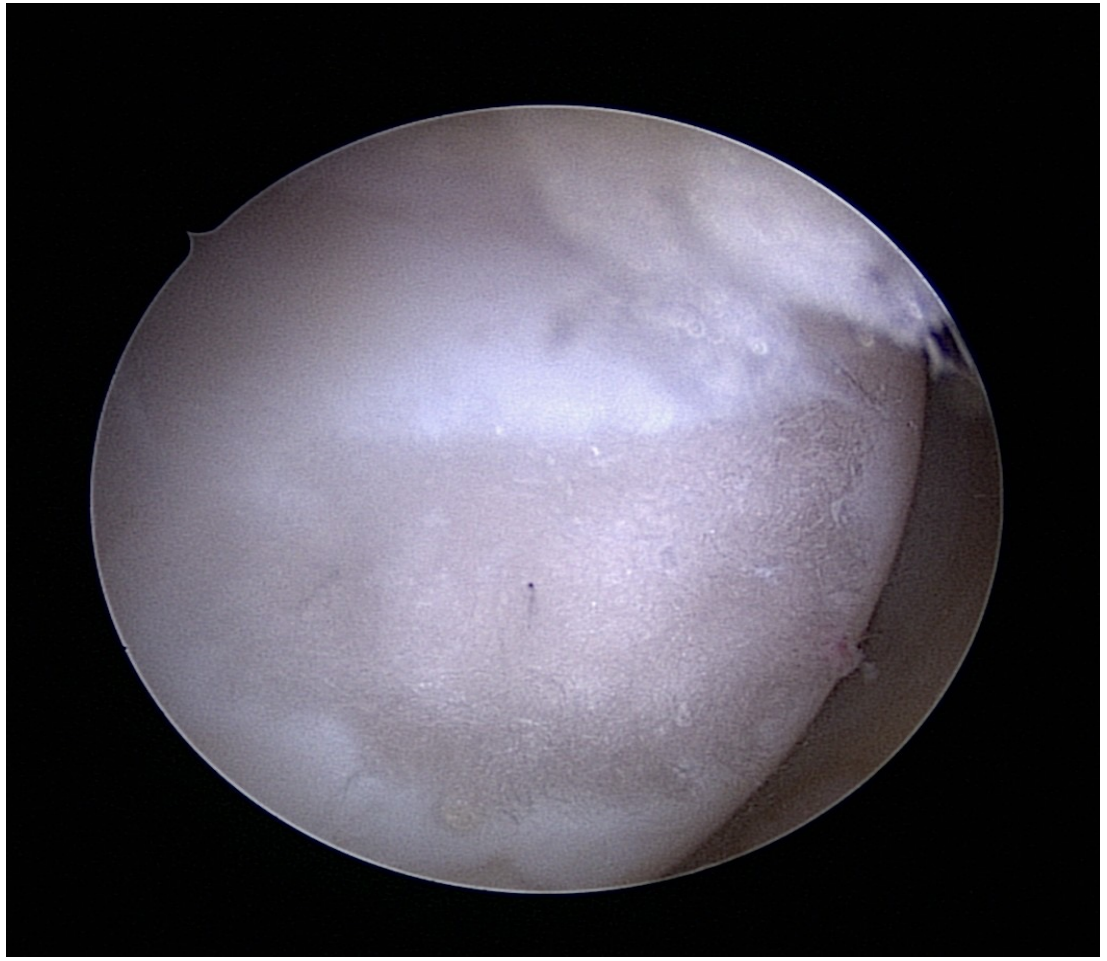


1,5 cm²

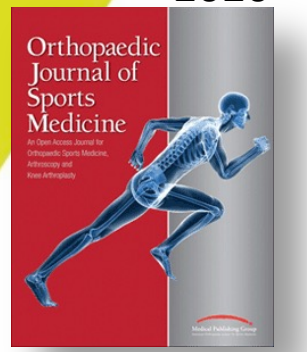
Microfx

Implantation - med. femural condyle





2020

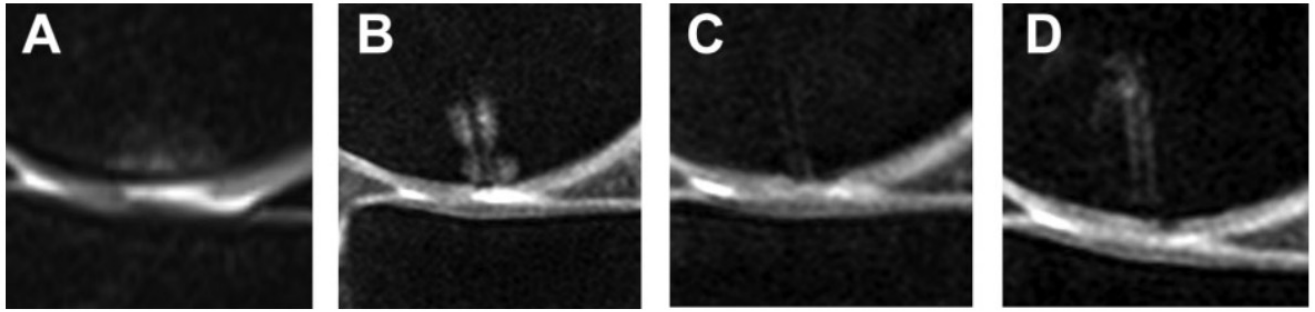


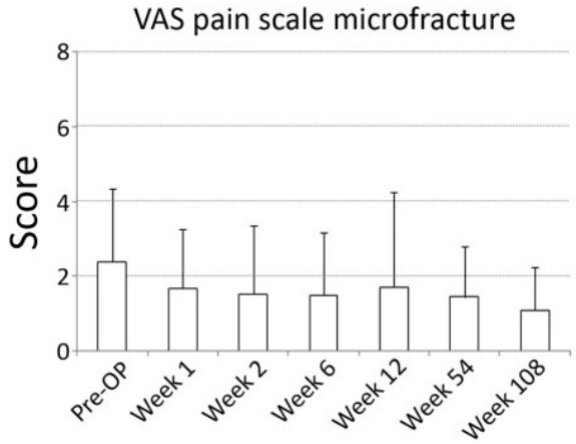
Matrix-Augmented Bone Marrow Stimulation With a Polyglycolic Acid Membrane With Hyaluronan vs Microfracture in Local Cartilage Defects of the Femoral Condyles

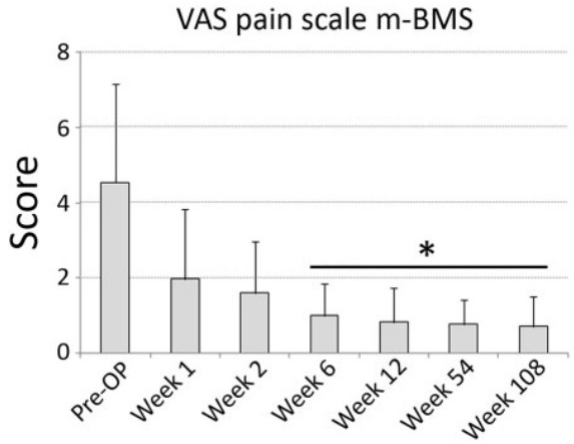
A Multicenter Randomized Controlled Trial

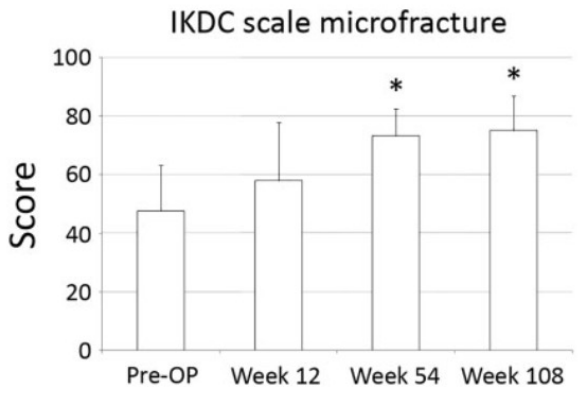
Johannes Glasbrenner,*† MD, Wolf Petersen,‡ MD, Michael J. Raschke,† MD, Matthias Steiger,§ MD, René Verdonk,‖ MD, PhD, Claudio C. Castelli,¶ MD, Giorgio Zappalà,¶ MD, Daniel Fritschy,# MD, and Mirco Herbort,** MD

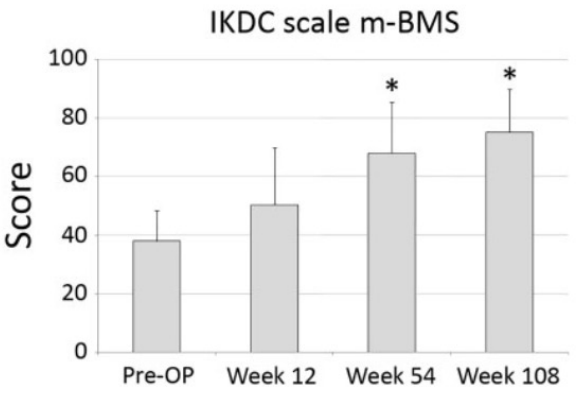
- Level 1 Study
- FU: 2 years

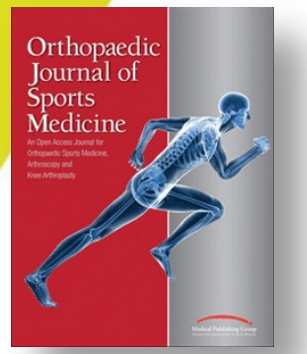












Matrix-Augmented Bone Marrow Stimulation With a Polyglycolic Acid Membrane With Hyaluronan vs Microfracture in Local Cartilage Defects of the Femoral Condyles

A Multicenter Randomized Controlled Trial

Johannes Glasbrenner,*† MD, Wolf Petersen,‡ MD, Michael J. Raschke,† MD, Matthias Steiger,§ MD, René Verdonk,‖ MD, PhD, Claudio C. Castelli,¶ MD, Giorgio Zappalà,¶ MD, Daniel Fritschy,# MD, and Mirco Herbort,** MD

Conclusion:

This is the first randomized controlled trial comparing m-BMS with a polyglycolic acid matrix with hyaluronan with MF. The use of the Chondrotissue implant in m-BMS has been proven to be a safe procedure. No difference was found between m-BMS and MF in terms of patient-reported outcome scores and MRI assessment until postoperative 2 years. Long-term follow-up studies including histological assessment are desirable for further investigation.

Acellular scaffolds

	Chondux	BST CarGEL	GelrinC
Material	Chondroitin-sulfate and Polyethylene glycol (PEG) hydrogel	Chitosan-glycerol phosphate	Synthetic Polyethylene gycol di-acrylate (PEG-DA) and denatured fibrinogen
Year	2009	2010	2013
Specifics	Polymerized intraoperatively with UV light	Mixed with patient's whole blood; Implantation in liquid form	Implantation in liquid form; Set in place with 90-second exposure to UV light
Outcome	Level 1 study [1] P: 18 to 65 y/o with full thickness femoral condyle defect 2 to 4 cm^2 O: Improvement in pain 6 months post op; Improvement in IKDC scores at 18 and 24 months	Level 1 Study [2] P: 18 to 55 y/o with full thickness femoral condyle defect O: Improvement in radiographic outcomes at 5 years; No difference WOMAC scores versus microfx alone	Level 2 study [3] P: 18 to 65 y/o with full thickness femoral condyle defect 1 to 6 cm^2 O: Improvement in radiologic outcome (Magnetic Resonance Observation of Cartilage Repair Tissue; MOCART) at 2 years follow-up

[1] Wolf MT, Zhang H, Sharma B, et al. Two-Year Follow-Up and Remodeling Kinetics of ChonDux Hydrogel for Full-Thickness Cartilage Defect Repair in the Knee. CARTILAGE. 2020;11(4):447-457
[2]] Shive MS, Stanish WD, McCormack R, Forriol F, Mohtadi N, Pelet S, Desnoyers J, Méthot S, Vehik K, Restrepo A. BST-CarGel® Treatment Maintains Cartilage Repair Superiority over Microfracture at 5 Years in a Multicenter Randomized Controlled Trial. Cartilage. 2015 Apr;6(2):62-72
[3]Schreiner MM, Raudner M, Szomolanyi P, Ohel K, Ben-Zur L, Juras V, Mlynarik V, Windhager R, Trattnig S. Chondral and Osteochondral Femoral Cartilage Lesions Treated with GelrinC: Significant Improvement of Radiological Outcome Over Time and Zonal Variation of the Repair Tissue Based on T_2 Mapping at 24 Months. Cartilage. 2021 Dec;13(1_suppl):604S-616S.

Acellular scaffolds

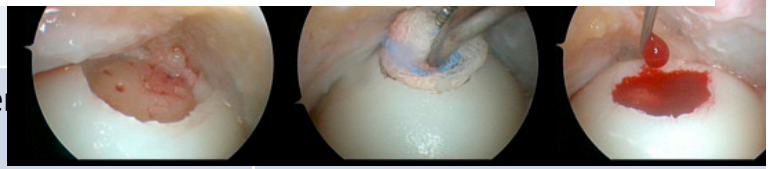
	GelrinC
Material	Synthetic Polyethylene gycol di-acrylate (PEG-DA) and denatured fibrinogen
Year	2013
Specifics	Implantation in liquid form; Set in place with 90-second exposure to UV light

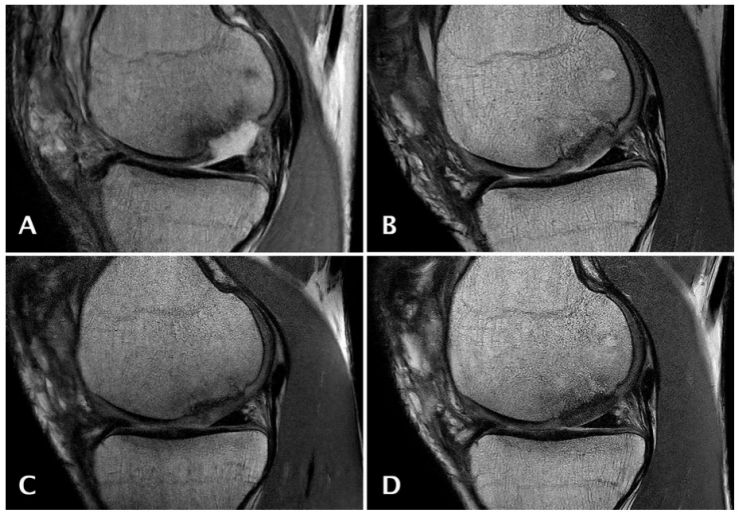
BST CarGEL [2]

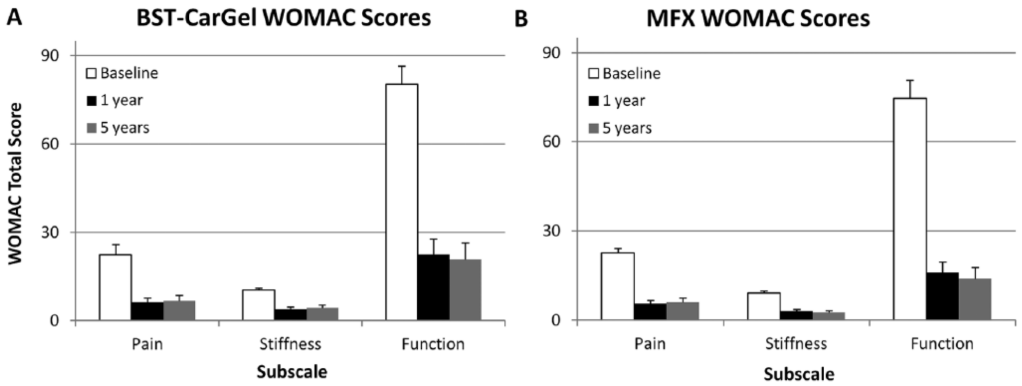
GelrinC [3]

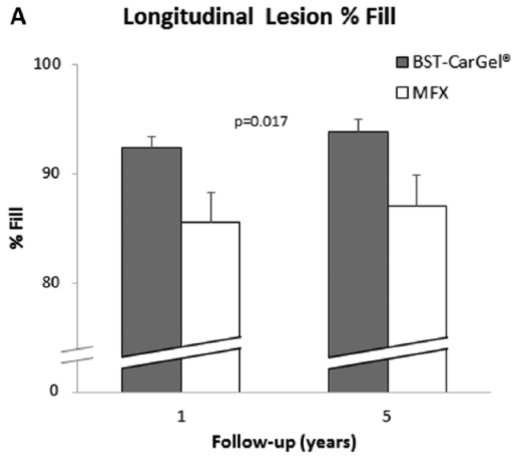
Chondral and Osteochondral Femoral Cartilage Lesions Treated with GelrinC: Significant Improvement of Radiological Outcome Over Time and Zonal Variation of the Repair Tissue Based on T_2 Mapping at 24 Months

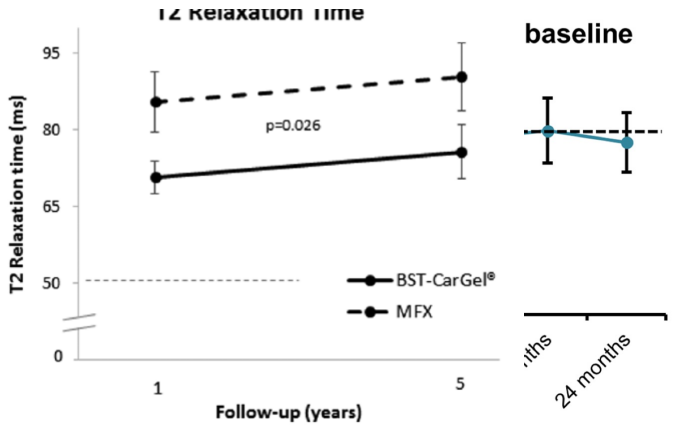
Markus M. Schreiner[1], Marcus Raudner[2], Pavol Szomolanyi[2], Kitty Ohel[3], Livnat Ben-Zur[3], Vladimir Juras[2], Vladimir Mlynarik[2], Reinhard Windhager[1], and Siegfried Trattnig[2]









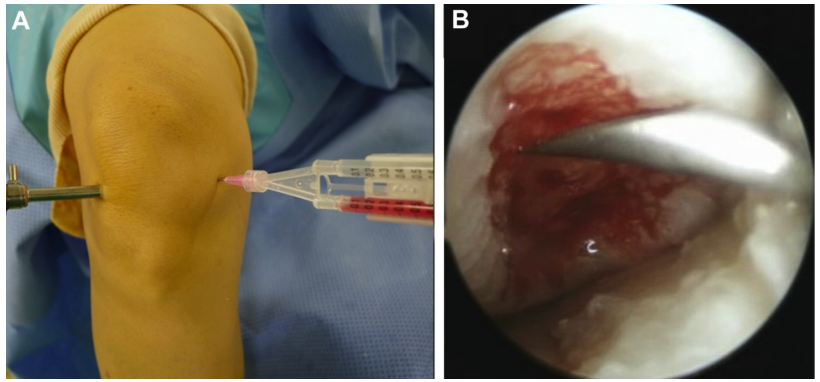


Biologic Augmentation

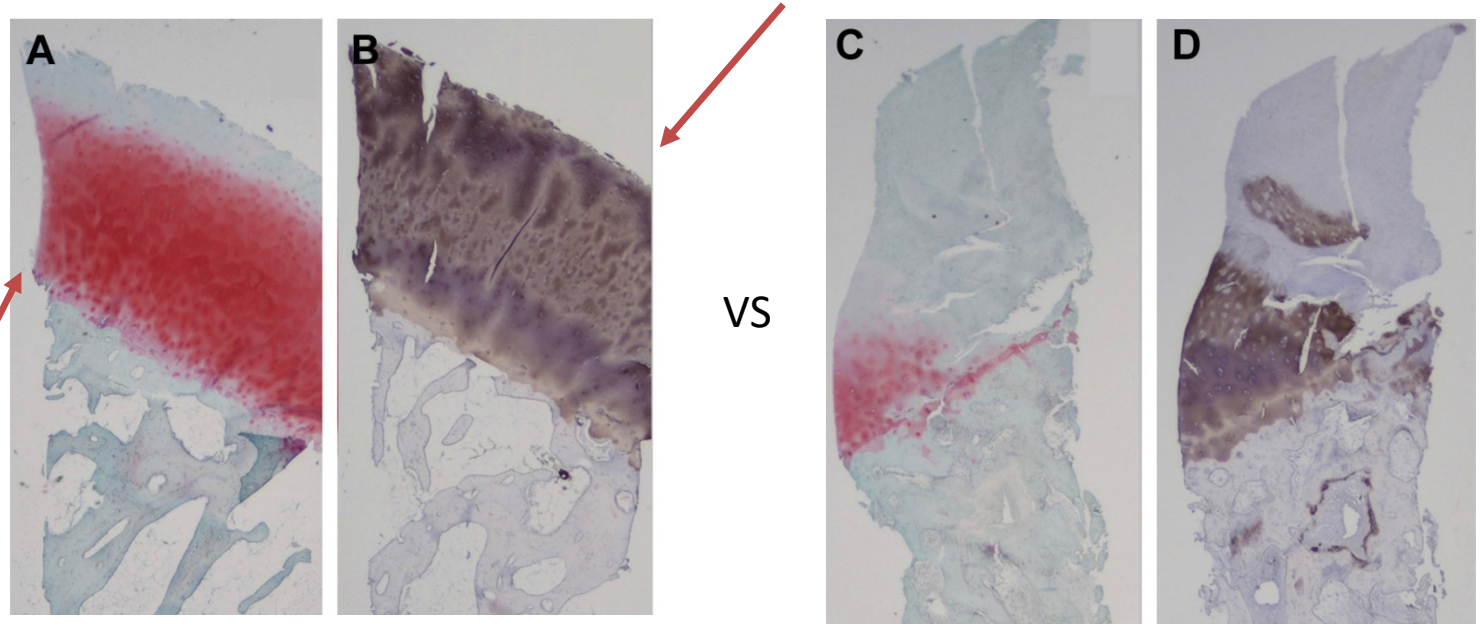
Adipose-Derived Mesenchymal Stem Cells With Microfracture Versus Microfracture Alone: 2-Year Follow-up of a Prospective Randomized Trial

Yong-Gon Koh, M.D., Oh-Ryong Kwon, M.D., Yong-Sang Kim, M.D., Yun-Jin Choi, M.D., and Dae-Hyun Tak, M.D.

Arthroscopy
The Journal of Arthroscopic and Related Surgery
2016



Extensive Collagen II Staining



VS

Extensive proteoglycan deposition

MFX + Adipose-derived MSC

MFX alone

Adipose-Derived Mesenchymal Stem Cells With Microfracture Versus Microfracture Alone: 2-Year Follow-up of a Prospective Randomized Trial

Yong-Gon Koh, M.D., Oh-Ryong Kwon, M.D., Yong-Sang Kim, M.D., Yun-Jin Choi, M.D., and Dae-Hyun Tak, M.D.

Arthroscopy
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40 patients each group

Conclusions: Compared with MFX alone, MFX and ADSCs with fibrin glue provided radiologic and KOOS pain and symptom subscore improvements, with no differences in activity, sports, or quality-of-life subscores, in symptomatic single cartilage defects of the knee that were 3 cm(2) or larger, with similar structural repair tissue.

Conclusions

Micro fracture – still a viable option for treatment of cartilage defects

Nanofractures/microdrilling – **improved results** **(mostly animal studies)**

Enhenced Microfracture – **improved results**

GELENKPUNKT
SPORTS AND JOINT SURGERY INNSBRUCK

FIFA MEDICAL CENTRE OF EXCELLENCE

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isag institut für sport-, alpinmedizin und gesundheitstourismus

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