

Consequences of cartilage injuries related to the post playing years -
Osteoarthritis



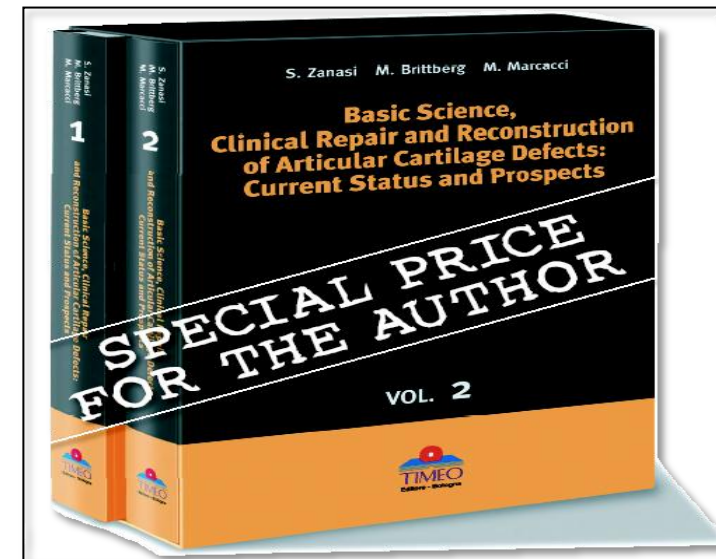
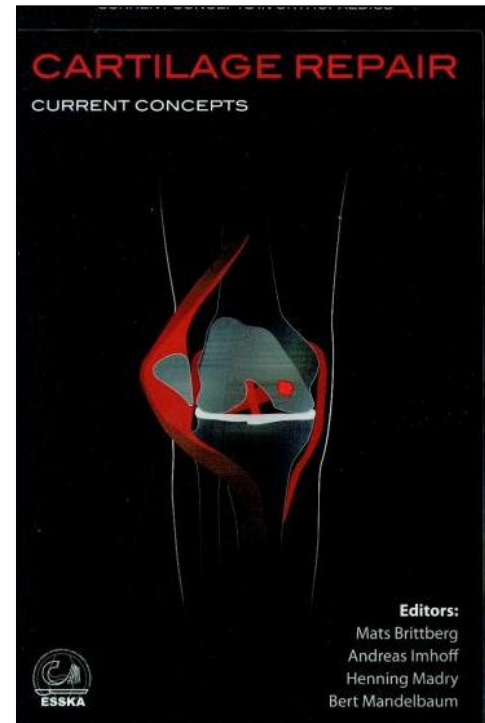
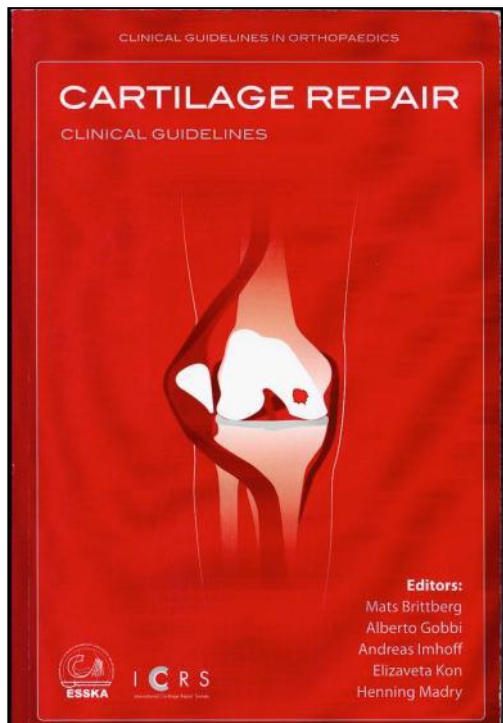
DIU 2016

Philippe Neyret – Adrien Peltier

Elvire Servien-

References

- EFORT Basel course 2013
- Bernhard Waibl, Cartilage Care; Bern Matthias Steinwachs, Schulthess Klinik Zurich



Natural History

Limited spontaneous repair

NO Vascularization ... no inflammatory process... no recruitment or **undifferentiated cells** + inability for replication and repair by mature chondrocytes (**similar to early OA**)

[Jackson D.](#)
JBJS am 2001

[Buckwalter J.](#)
JBJS am 1997



Natural History

Will limit their ability to play*

Predispose them to **joint deterioration and disability**. The natural course progression is that articular cartilage defects are to become **osteoarthritis** over time**

How to prevent this progression ?

[Felson D](#)

*Ann Intert Med 2000**

[Kujala U](#)

*Ann Rheum 1995**

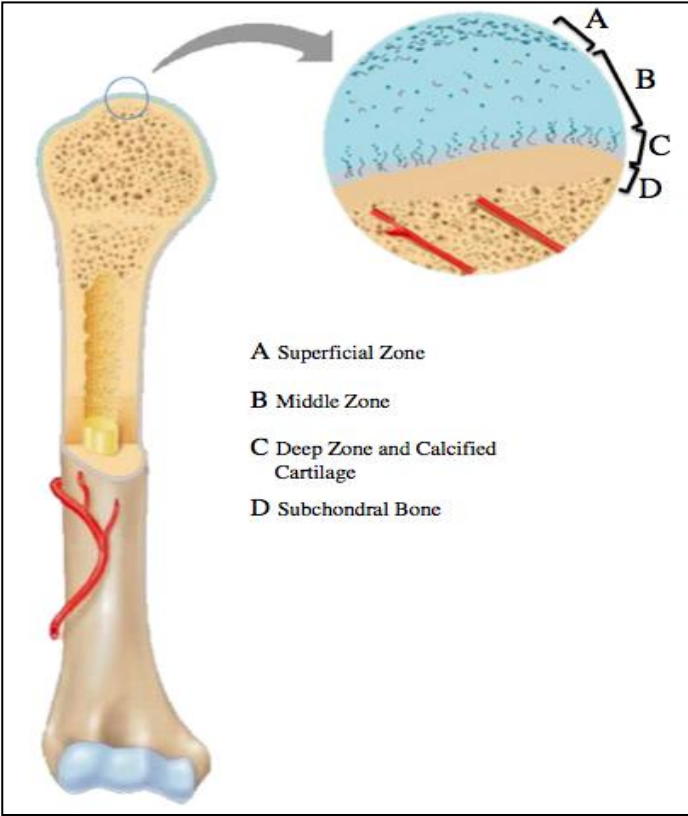
[Zaslav K., Gobbi A.](#)

New frontiers for cartilage repair and protection.

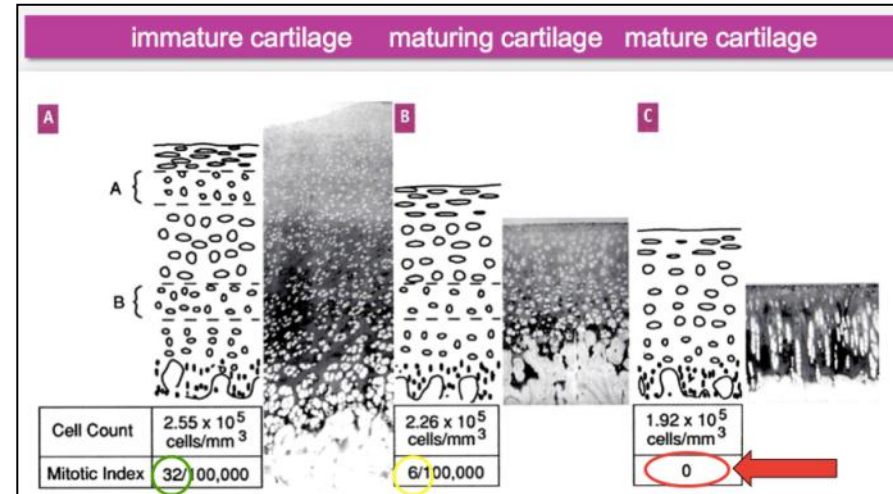
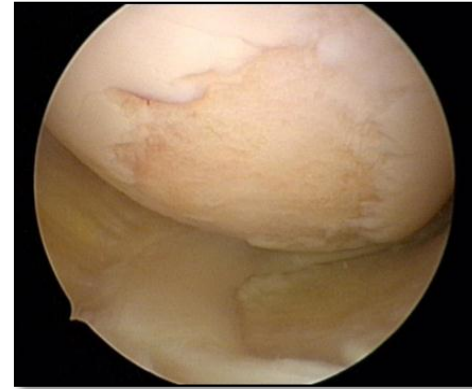
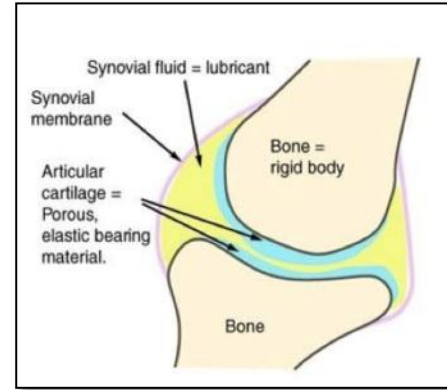
*Cartilage. 2012.***



Cartilage structure



To produce hyaline cartilage with a well-integrated and flexible subchondral base and the normal zonal variability
Tidemark



**Osteochondral
defects**

Etiology

Contents

Cartilage repair

Palliative
Reparative
Restorative

NEW FRONTIERS

Prevention

G, CS, ASU
Visco S
PRP
PEMFs

Tissue engineering

Scaffolds
Growth factors
Cells
Bioreactors

Joint injuries, including **ligament, meniscal, and cartilage** injuries, **are common** in sport, especially in soccer most often involving **knee, hip, and ankle**.

Subsequent cartilage damage of the affected joints is due to primary **joint impact** frequently observed in hip and knee whilst secondary to the extra-cartilage soft tissue injuries injury occurs most often in the ankle and knee.

**Clinical and Basic Science of Cartilage
Injury and Arthritis in the Football
(Soccer) Athlete**

Hannah H. Lee^{1,2} and Constance R. Chu^{1,2}

Cartilage
3(Suppl. 1) 63S-68S
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<http://cart.sagepub.com>


Treatment options for cartilage injury in the football player

Surgical techniques can generally be categorized into three groups

1. Growth marrow stimulation based-techniques,
2. Osteochondral transplantation techniques
3. Cell based repair techniques

Prospective randomized studies on these three techniques are **still limited** and each of the repair technique is associated with unique **advantages** and **limitation** in soccer players

Palliative	Cartilage repair Reparative	Restorative
Microfractures	Osteochondral Autologous Transplantation	Autologous Chondrocytes Implantation
MTx	OATS	ACI

Cartilage repair

Palliative*

Reparative

Restorative

Palliative

Arthroscopic debridement

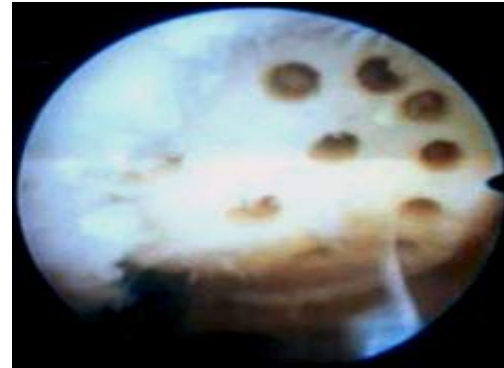
Abrasion arthroplasty

Abrasion chondroplasty

85% worldwide

Cartilage repair

Palliative
Reparative*
Restorative



Reparative

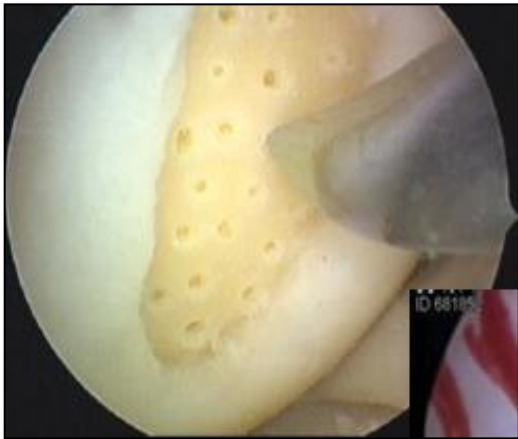
Perforations (Pridie)
Microfractures* (Steadman)
Osteochondral graft

MFx: Principles

Create access to the **subchondral bone marrow**

Inflow of bone marrow **stem cells** into the prepared cartilage defect

Transformation into predominantly **hyaline like cartilage** tissue



MFx

Pros



- Easy and fast to accomplish
- Strictly arthroscopic technique
- Cheap

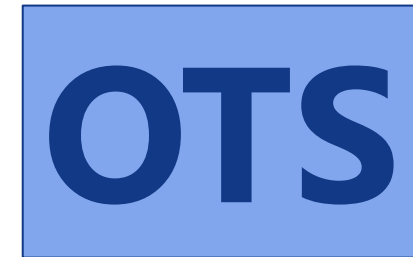
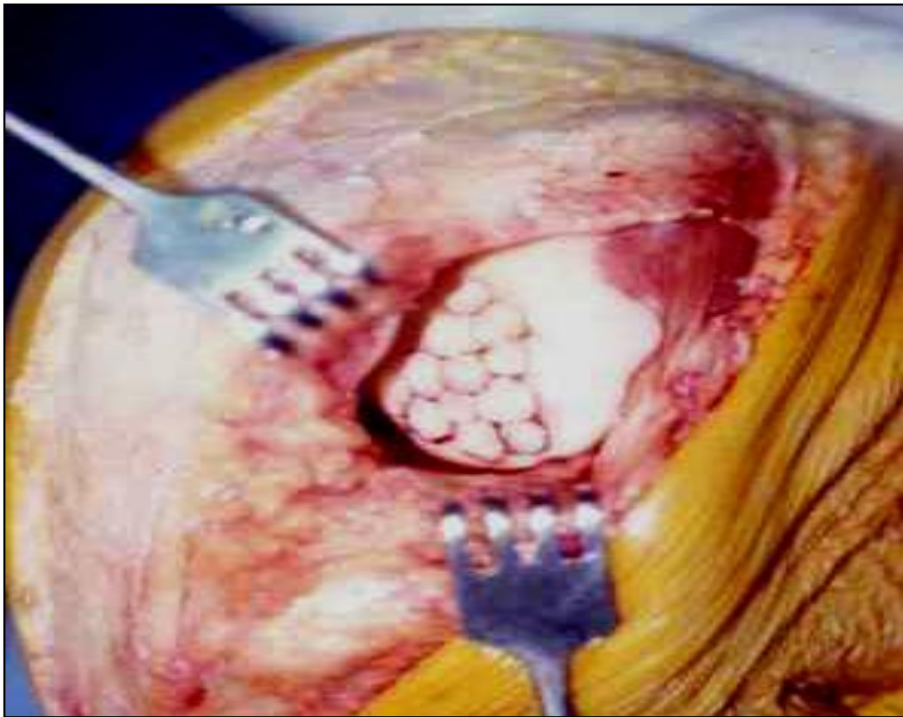
Cons



- Inferior tissue quality
 - Intra-lesional ossification, osteophytes
 - Limited durability
-

Osteochondral Grafts

- Osteochondral allografts and autografts
- Mosaicplasty



Hangody, L. (2010). Clinical experiences with autologous osteochondral mosaicplasty in an athletic population: a 17-year prospective multicenter study. *AJSM*, 38(6), 1125–1133.

Pros



- Cheap
- **Good** /predictable carilage and bone **quality**
- Potentially **minimally invasive tech**

Cons



- Surface congruency ?
- Horizontal integration?
- **Donor site** morbidity

Cartilage repair

Palliative
Reparative
Restorative



Restorative

ACI
MACI

Autologous Chondrocytes Implantation

Autologous chondrocytes are **isolated**, expanded, seeded onto the affected area and localized by covering with a **periosteal flap** (Ex: CarticelR)



ACI

[Brittberg M](#)
New Eng J Med 1994

[Minas, T....](#)
(2013)CORR



Autologous Chondrocytes Implantation

- Cartilage cultivation



➔ cartilage biopsy ($0,05 \times 10^6$ million cells)



➔ mechanical and enzymatic digestion (≤ 16 h)



➔ ex vivo expansion of chondrocytes (~ 21 days)



➔ transplantation of min. 10^6 cells/cm²
cartilage defect ($3-10 \times 10^6$ cells)



Pros



- Superior **quality**
- Solid long term outcome available

Cons



- Two interventions
- **Arthrotomy** requested
- **Demanding** surgical technique **and logistics**
- **Cost** intensive

Characterized Chondrocytes Implantation

- ACI can result in dedifferentiation of the cultured cells with a possible shift to a fibrocartilage-like 1 rich repair cartilage.
- To address this aspect CCI has been developed to improve hyaline articular cartilage regeneration through the identification and selective expansion of specific chondrocytes subpopulations capable of producing **more hyaline-like repair cartilage tissue**. The subgroup of chondrocytes is characterized by expression of a **gene marker** profile and phenotypic cells characteristics that have been associated with formation of hyaline cartilage in vivo

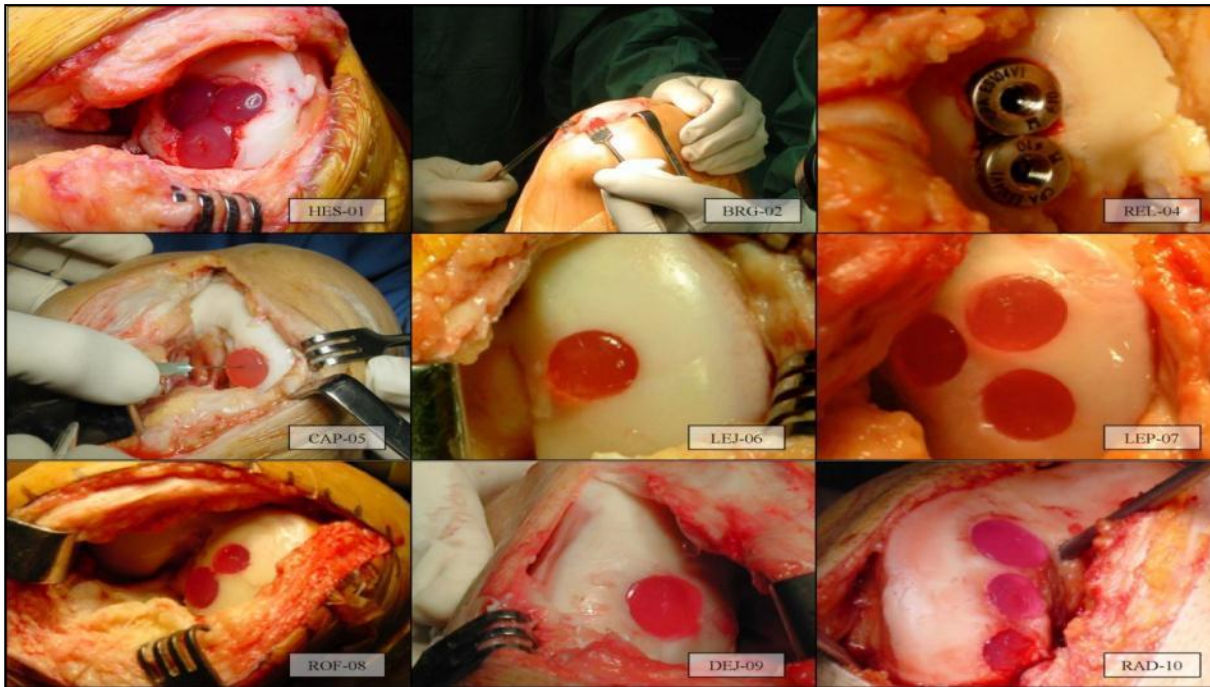


[Saris DB](#)
AJSM 2009

[Dell'Accio F](#)
Athritis Rheum 2001

Matrix Autologous Chondrocyte Implantation

Autologously isolated and enriched chondrocytes are combined with a synthetic matrix (Ex: HyalograftR, CartipatchR)



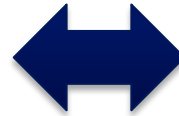
MACI

[Selmi, T., Neyret, P. \(2008\)](#)
"Autologous chondrocyte implantation in a novel alginate-agarose hydrogel: Outcome at two year".
JBJS Br May 90-B:597-604

General population

Surgical treatment is effective

Treatment Algorithm are available



Recreational players

Different expectations
Pain relief
Return of functionality
Some sports participation



The dilemma
for responsible physician

Professional players

Different expectations
Fast return to high level
No real concern of joint damage
Particularly if **short career**



MTx

OATS

ACI

Football players who **successfully returned to competition**

- Chronicity **<12 months**
- **<25 years** old (vs >30Y)
- Short duration of symptoms: **Early surgery**

Microfractures

MTx

8 +/-1 **months**

range, 2-16

Osteochondral
Autologous
Transplantation
OATS

7 +/- 2 **months**

range, 4-11

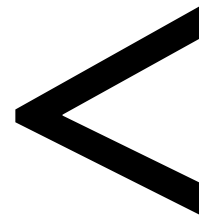
Autologous
Chondrocytes
Implantation
ACI

18 +/- 4 **months**

range, 12-36

Microfractures

MTx



ACI

Characterized

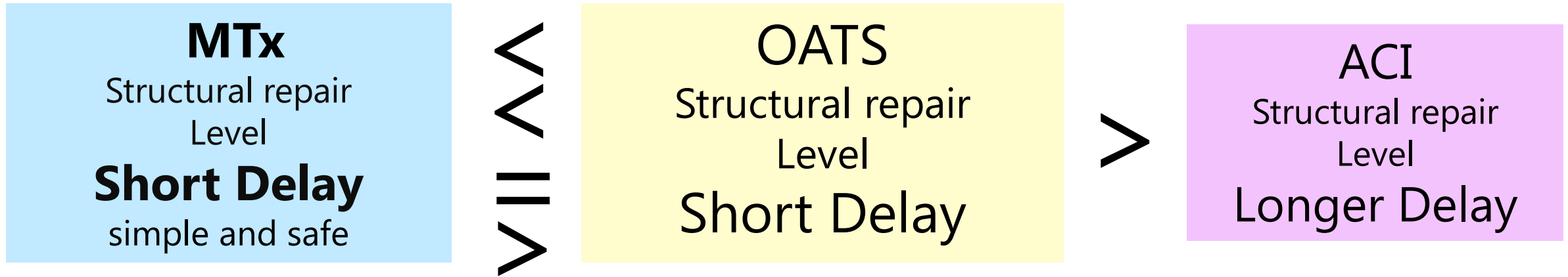
At least 3years

**Better structural
repair**

Better KOOS score

(Sports / QOL)

Histological and morphological scores in general population



The timing of return to the preinjury level is at least as important as the remaining period to be played at the preinjury level.

- In professional footballers who wants to continue their career for at least a couple of years



MTX is mainly considered the **first treatment option among professional football players**

Cartilage repair

Palliative
Reparative
Restorative

NEW FRONTIERS

Prevention

G, CS, ASU
Visco S
PRP
PEMFs

Tissue engeneering

Scaffolds
Cells
Growth factors
Bioreactors

Viscosupplementation

Findings suggest the use of viscosupplementation (hyaluronic acid) for **small defects** in articular cartilage in the athlete and perhaps **as a post-injury treatment**, in season, for patients with bone bruises on MRI.

Although further study is needed to validate efficacy for these uses, the low morbidity supports its use for these potential indications.

[Waddell DD, Bert JM. Arthroscopy. 2010.](#)

[Greenberg DD. Osteoarthritis Cartilage. 2006](#)



Role of Platelet-Rich Plasma (PRP)

...can be defined as the volume of the plasma fraction from autologous blood with platelet concentration above baseline (200,000 platelets/ μ L). PRP contains different **growth factors**, which regulate key processes involved in tissue repair. The rationale for topical use of PRP is to stimulate the natural healing cascade and tissue regeneration by a “supraphysiological” release of platelet derived factors directly at the site of treatment. PRP has been successfully used in surgical and outpatient procedures in the treatment of several musculoskeletal problems

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Vox Sang. 2009;

[Bennett NT](#)

Am J Surg. 1993

[Molloy T](#)

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[Anitua E.](#)

Biomaterials. 2007.

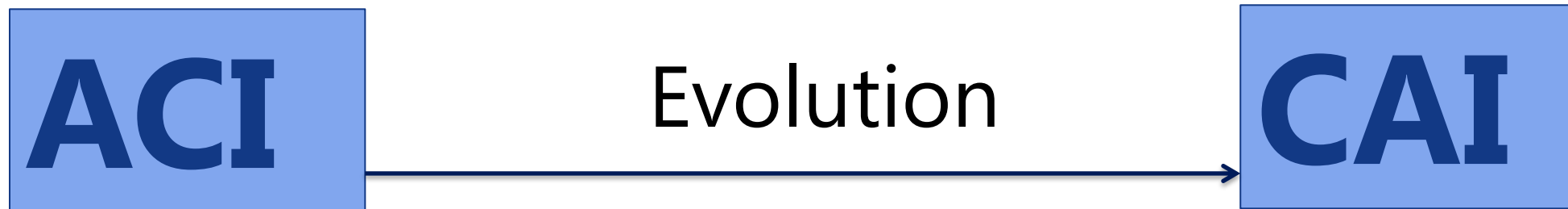
[Mishra A, Pavelko T.](#)

Am J Sports Med. 2006.

[Sampson S, Mandelbaum B.](#) *Curr Rev Musculoskelet Med.* 2008

Future of Cartilage Reconstruction: Cartilage Auto Implantation

- Single stage procedure without chondrocyte culture and expansion
- Mechanically fragmented
- Cartilage fragments are embedded in a 3D polymeric resorbable scaffold



Cells : Mesenchymal Stem Cells

Role of Bone Marrow Aspirate Concentrate (BMAC)

MSCs

Single-step surgery

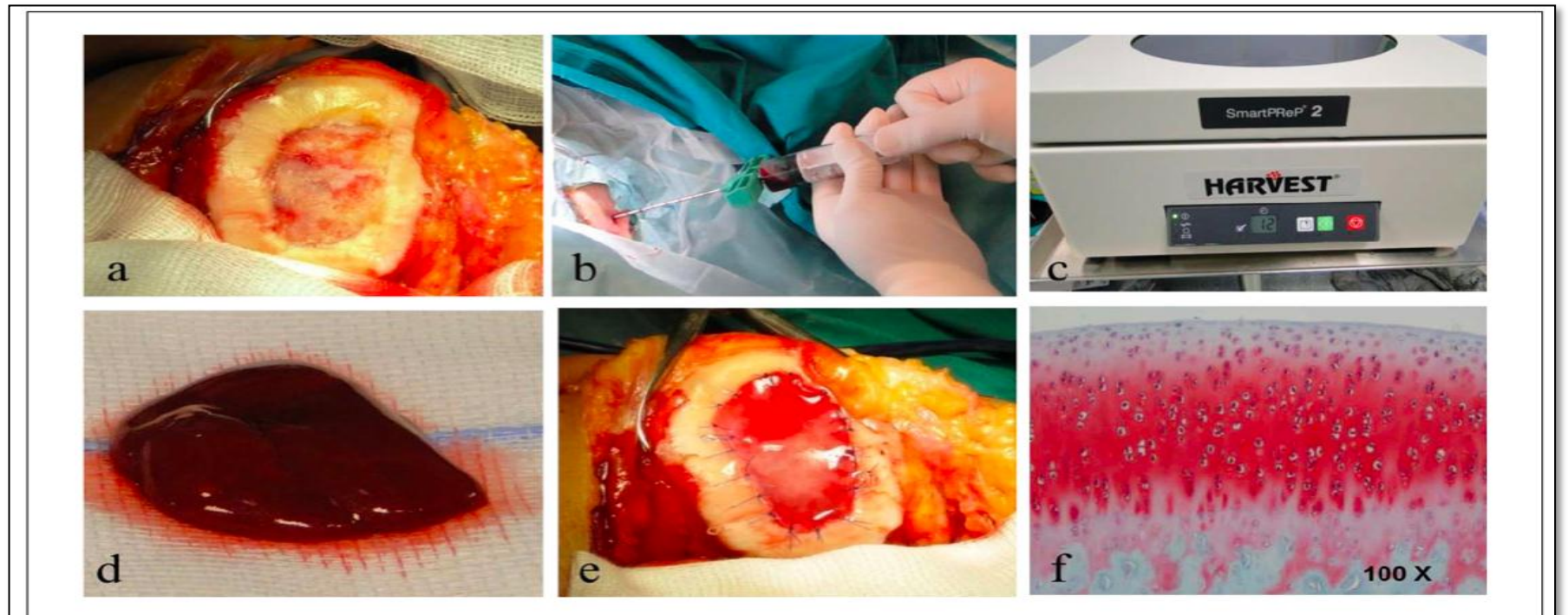
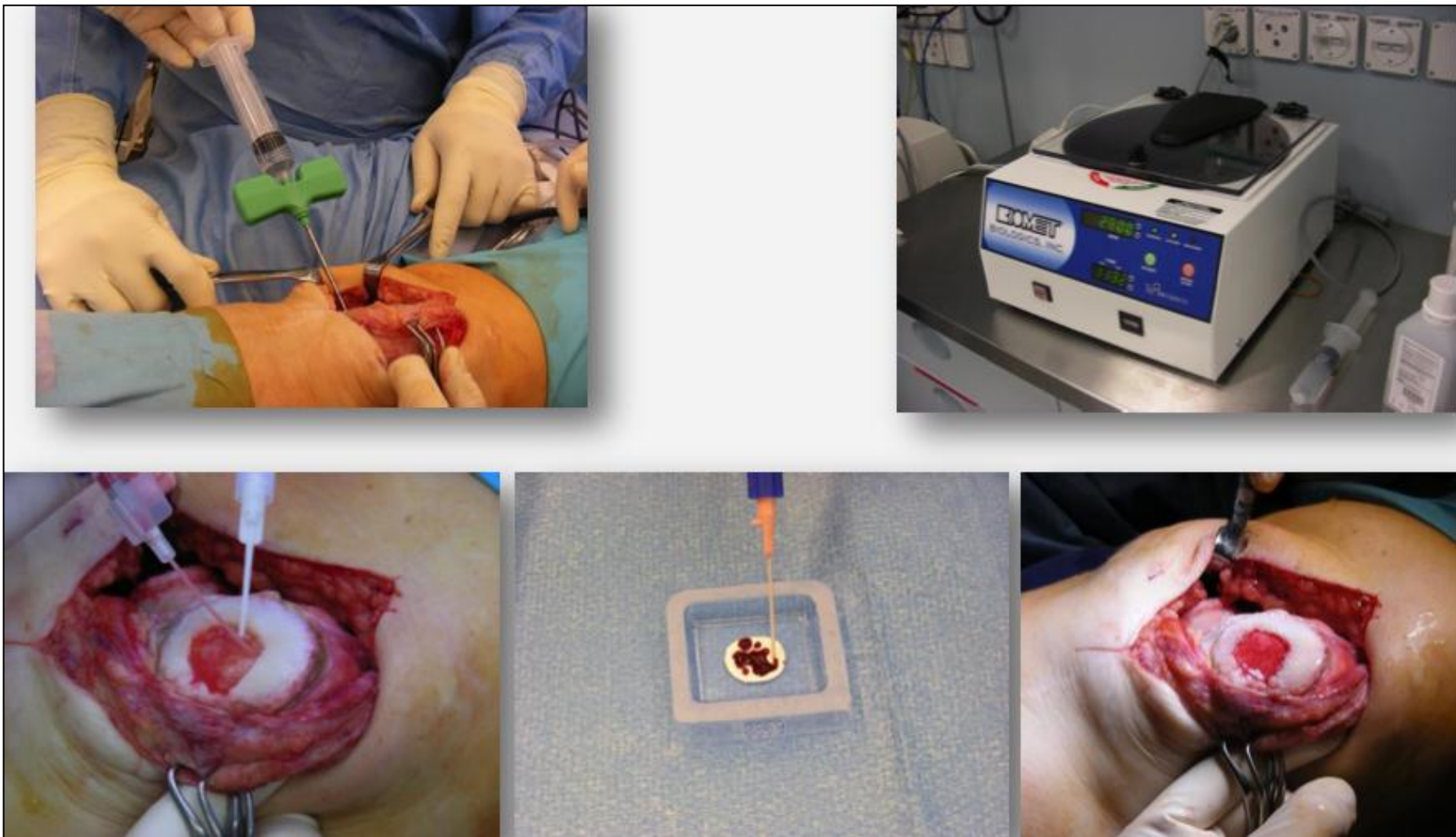


Figure 3. (A) Grade IV chondral lesion of patella, (B) bone marrow aspiration, (C) centrifugation, (D) BMAC clot after activation, (E) implantation and coverage with collagen scaffold, and (F) biopsy at 2-year follow-up.

Future:PRP-MSC augmented AMIC



Emerging Technologies: Gene Therapy

Genes can be transferred either into mature chondrocytes or into chondroprogenitor cells used for cartilage repair. **Pluripotent progenitor cells** seem to be **more receptive to transduction with recombinant adenoviral vectors** and may provide the preferred platform for delivery of genes to enhance cartilage repair



Take-home message

The choice of repair technique must be **tailored to the individual** athlete's situation

Further studies are needed to determine if the cartilage repair in footballers can **reduce the potential for cartilage deterioration**





AMMFL

ACADÉMIE MÉDICALE DE FOOTBALL DE LYON



Thank you!