OSTEOCHONDRAL GRAFTING

WHO,WHEN,WHERE,WHY,& HOW

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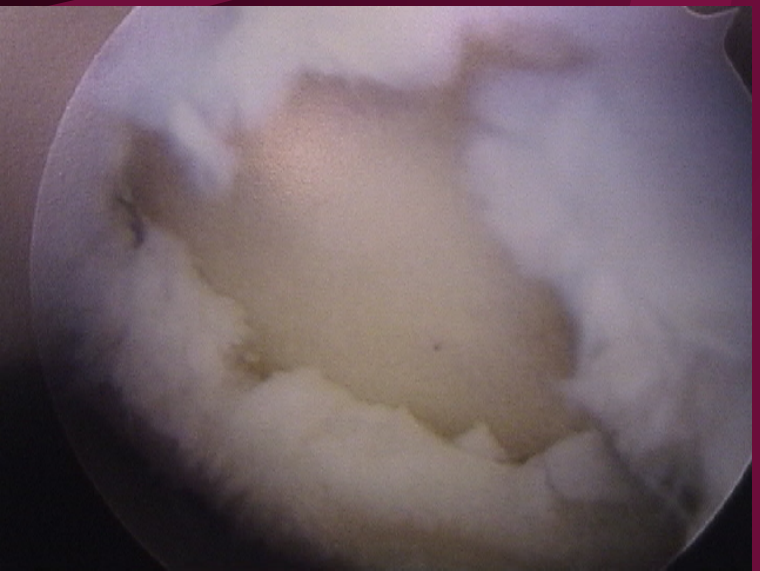
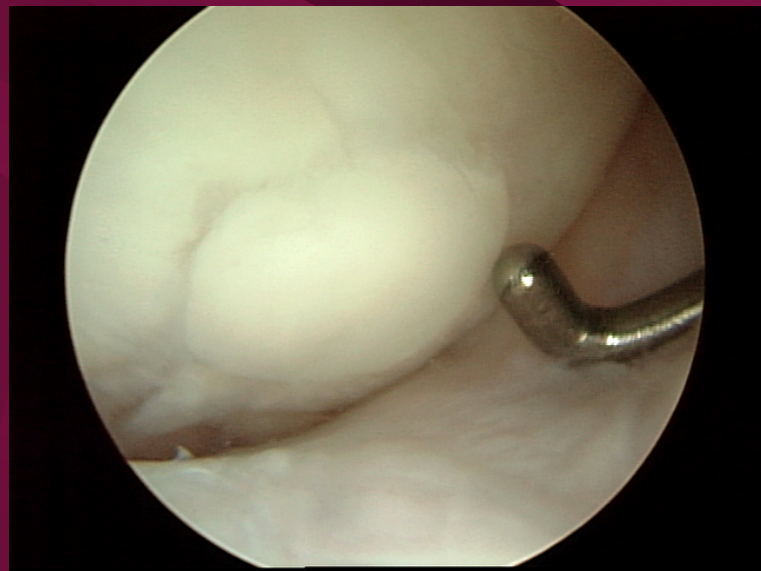
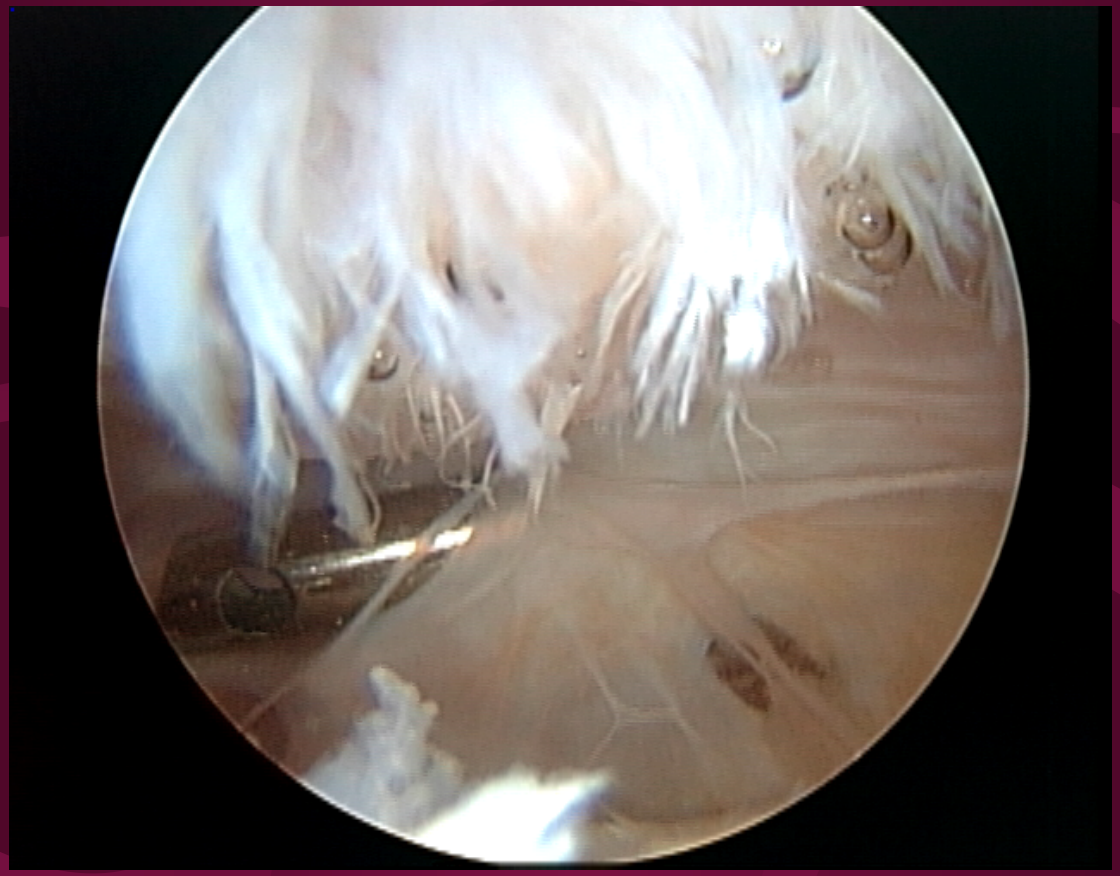
Presentation Goals

- Review of Clinical History
- Review of Bioengineering History
- Review of Surgical Technique





Treatment Options

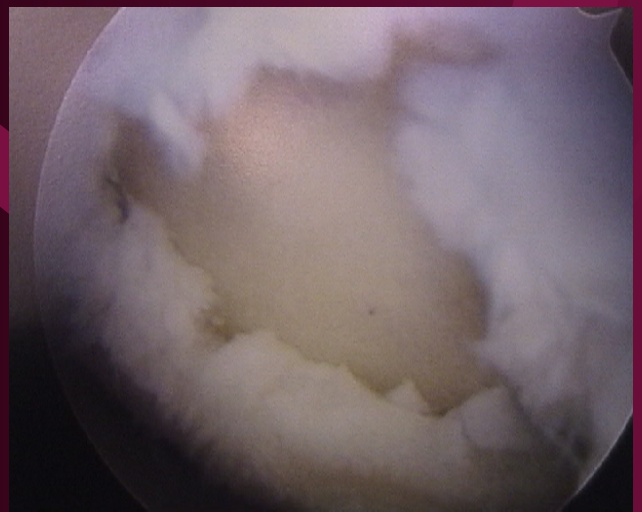


Surgical Options

- Lavage, debridement
- Drilling, abrasion, microfracture
- Osteochondral autograft
- Chondrocyte Implantation
- Osteochondral allograft

WHO ?

- NO age limit
- Generally under the age of 50 years
- Focal, full thickness articular cartilage defects



WHEN ?

- Most often after failed debridement and or microfracture
- Appropriate as the initial surgical treatment of focal full thickness lesions

WHEN ?

- Defect size variable in the literature
  - One cm
  - Five cm
- Literature supports best results in young
- Femoral Condyle> Trochlea> Patella

WHEN ?

- Osteochondritis Dissecans
- More Controversial
  - Osteonecrosis
  - Osteoarthritis

WHERE ?

ANYWHERE

WHERE ?

- Knee
- Ankle
- Shoulder
- Hip

WHY ?

Osteochondral Autografts

- Non-inflammatory healing response
- Fill defects with osteochondral bone graft
- Favorable results at 7-10 years
- Immediate access to graft
- Minimally-invasive procedure

WHY ?

CLINICAL STUDIES

Autograft Development

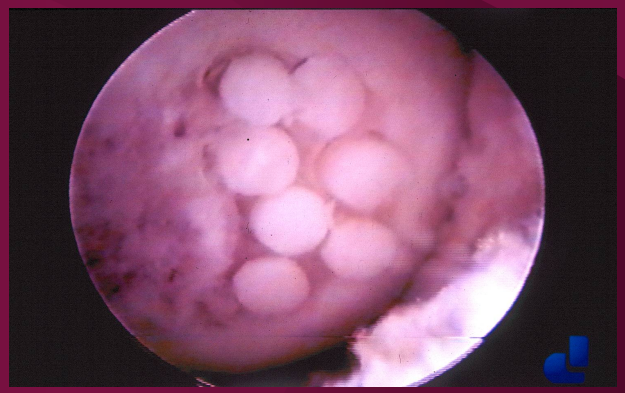
- Open mosaicplasty
  - Hangody
- Open/arthroscopic OATS
  - Bobic
- Open/arthroscopic COR
  - Barber-Chow

Bobic (1995)

- Condyle lesion with ACL injury
- Arthroscopic technique with ACL reconstruction
- 29 patients with >1cm lesion
- 19/22 excellent results @ 2-3 year follow-up
- Hyaline cartilage biopsy specimens

Hangody (1997)

- Preliminary report
- 44 patients
- Open technique with autograft
- HSS score
  - Pre: 62
  - Post: 94



Hangody Results

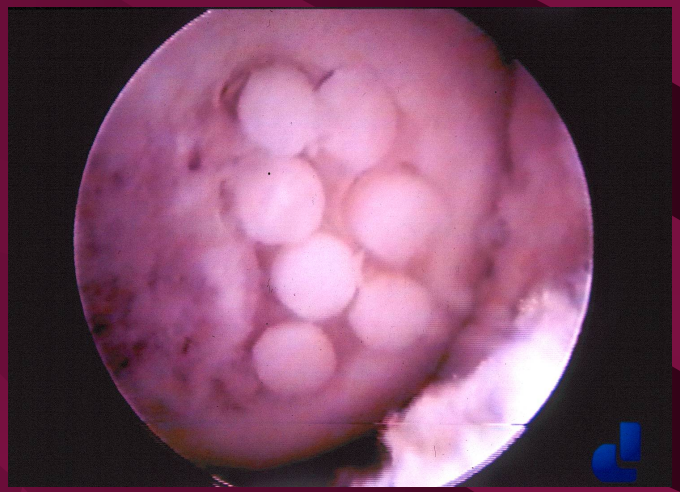
- Multicenter prospective study
- 417 patients
- 1992 to 1996
- Arthroscopic technique
- Femoral condyle lesions

Post-op Improvement
Modified Cincinnati Knee Score

	1 year	3 year	5 year
Abrasion	58 %	28 %	0 %
Microfracture	57 %	33 %	34 %
Drilling	21 %	33 %	34 %
Mosaicplasty	89 %	88 %	87 %

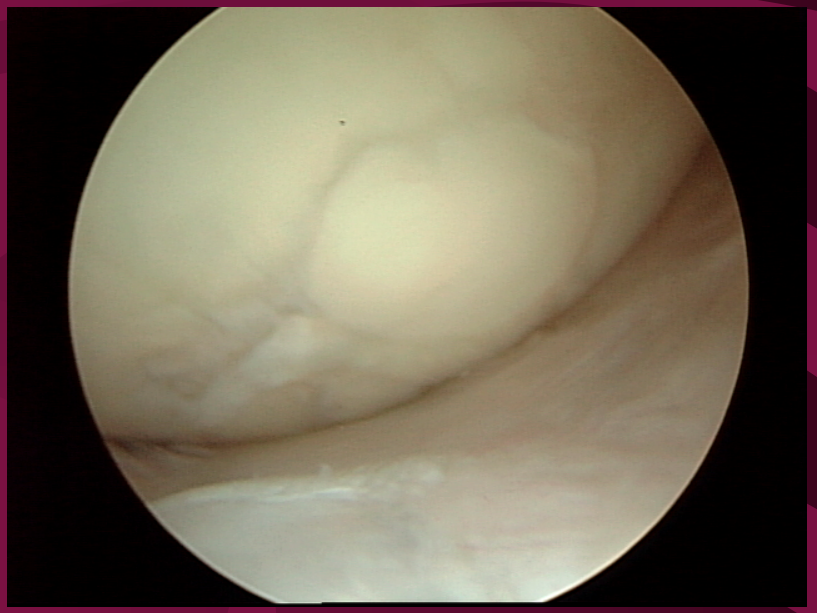
Hangody 2004 JBJS

- 831 Patients
- Up to 10 year follow-up
- Good to excellent results:
  - 92% Femoral
  - 87% Tibial
  - 79% Trochlear and Patellar
  - 94% Talar Dome



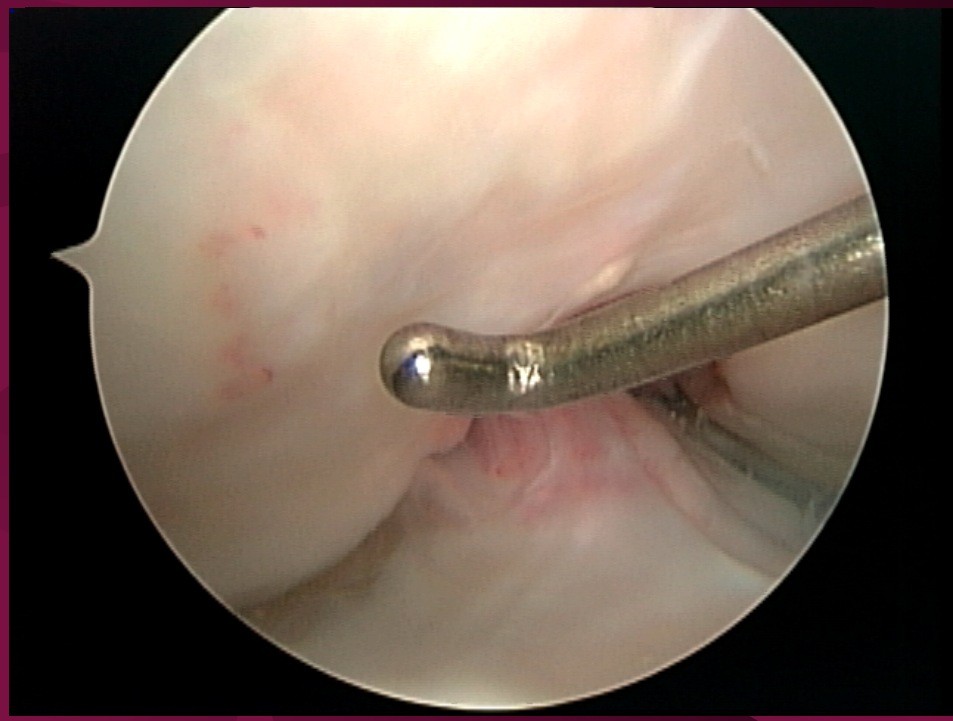
Hangody 2004 JBJS

- 3% morbidity
- 69 of 83 second look arthroscopy with congruent surface and viable chondrocytes with histology



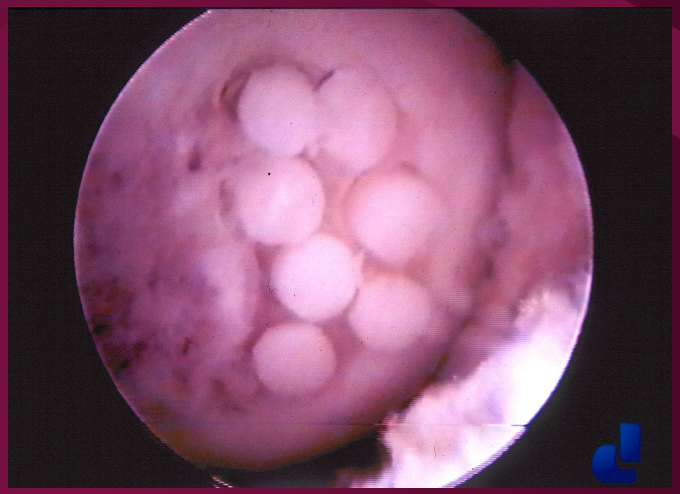
Hangody 2004 JBJS

- Histologic evidence of long term graft survival
- Fibrocartilage filling of donor sites



Hangody 2004 JBJS

- Recommendations
  - Defects 1-4 square cms. in size
  - Attention to detail in technique
  - Upper limit age of 50 yrs



Horas et al 2003 JBJS Autograft vs. ACI

- Prospective, randomized
- 40 pts
- Mean 3.75cm
- Both groups improved at 2 yrs
- ACI progress was slower

Bentley et al 2003 JBJS Autograft vs. ACI

- Prospective, randomized
- 100 pts
- Mean 4.66 cm
- Mean f/u 19 months
- ACI superior outcomes 88% vs 66%

Marcacci 2005 Arthoscopy

- 37 patients in a prospective study
- 2 year f/u
- 78 % good to excellent using ICRS Score
- Young patients and LFC lesions did the best

Gudas et al 2006

Knee Surg Sports

Autograft vs Microfracture vs Debridement

- A series of elite athletes
- 82% return to same level sport
- With ACL autograft showed quickest return
- 10 yr f/u:
  - 75% with autograft still active
  - 37% with microfracture still active

Krych et al
JBJS 2012
Activity Level vs. Microfracture

- 96 patients: 48 osteochondral/48 microfracture
- 5 year f/u
- 2.65cm square defect size
- Equal outcomes scores: SF 36, IKDC
- Improved acivity level with osteochondral grafting using Marx activity scoring system

Patel and Tapasvi
2015
Current Review Musculoskelet Med

- 20 patients
- Defect 5-12 mm, 17/20 were condylar
- Mean f/u 42 months
- IKDC subjective score 81.6
- 1 yr f/u MOCART all had bone healing

WHY ?

BASIC SCIENCE STUDIES

Bioengineering Concerns

- Proud Plug
  - Sees increased joint load
  - Progressive loss of surface
  - Damage to opposing surface
- Recessed Plug
  - Sees decreased joint load
  - Integration of soft fibrous tissue
  - Decreased nutrition (fluid – bone)

Topographic Matching for Osteochondral Grafting
Bartz et al AOSSM March 2001

- Loadbearing condylar recipient sites
  - Most medial or lateral patellar groove donors are best
  - Most inferior groove donor site provides best match
- Intercondylar notch donor sites
  - Accurate surface restoration for 4-6mm defects
  - Inadequate surface restoration for >8mm defects

Topographic Considerations Osteochondral Grafting

Ahmad et al AOSSM March 2001

- Donor Sites
  - Medial trochlea, lateral trochlea, intercondylar notch
    - Small nonloading region
    - Similar cartilage thickness (2.1mm ave.)
- Recipient Sites
  - Lateral and medial trochlea curvature best match for femoral condyles
  - Intercondylar notch curvature best match for central trochlea
  - Cartilage thickness (2.5mm ave.)

Cole 2002 AOSSM

- Contact pressure at donor site of patellofemoral joint
- Pressure is not uniform
- Pressure is higher on the lateral condyle
- Harvest grafts from medial condyle

Koh 2002 AOSSM

- Graft height mismatch
- Small incongruities lead to significantly elevated contact pressures
  - 0.5mm proud worse than 0.5mm sunk

Burks 2002 AOSSM

- Pressure changes from defects in femoral condyle
- 15mm diameter leads to 150% increase in pressure transference to normal cartilage

Bioengineering Concerns Evans 2004 Arthroscopy

- Manual versus Power Punch for Harvest
- Chondrocyte viability better with the use of a manual punch

Bioengineering Concerns Lane 2004 AJSM

- Goat 6 Month Study
- Cleft between host and transferred region remains

Bioengineering Concerns Huntley 2005 JBJS

- Chondrocyte Death From Graft Harvesting
  - Fresh human tissue
  - Confocal microscopy
    - Central 99 % viable
    - 382 micron margin of cell death
    - No change in 2 hours

Bioengineering Concerns Epstein et al Arthroscopy 2012

- Cadaveric study of harvesting grafts
- Mini-open vs. arthroscopic
- MSR best harvested open to obtain a perpendicular graft for implantation
- LSR mini vs arthroscopic no difference in graft perpendicularity

Patil et al 2008 AJSM
Insertion Force and Chondrocyte Viability

- 8mm diameter autografts
- Force < 400N
- Good cell viability
- Several low impact blows lesss damaging by a few higher impact blows

HOW ?

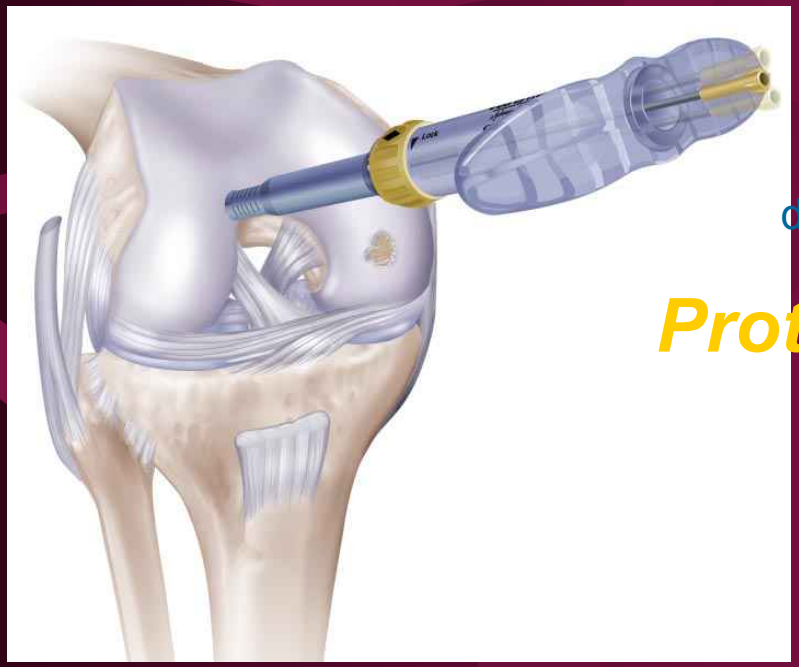
Autograft Systems

- COR
- OATS
- Mosaicplasty

Cartilage Repair System

NEW GENERATION IN OSTEOCHONDRAL TRANSPLANTATION

COR™
precision targeting



Improved Accuracy

Reproducible and focused graft harvest and drilling with a first-of-kind perpendicularity device

Protecting Chondrocyte Viability

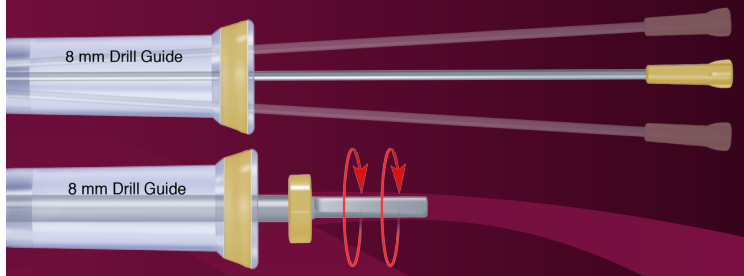
"No impact transfer" & *"Low impact delivery"*

Ease of Use

Intuitive handling and efficiency combined in a completely disposable system

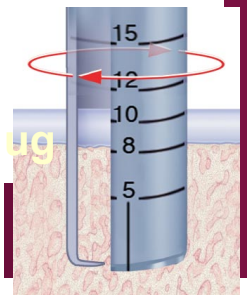
Improved Accuracy

Harvester and Drill Guide w/ Perpendicularity

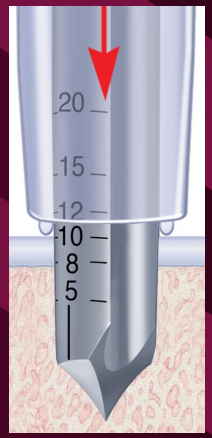


Cutting Tooth

Underscores
Graft



Improved Drill Bits 5mm-20mm depth



Spade Cutting Tip

- Single Use guarantees sharp tip
- Minimizes tip wandering and cartilage damage

Fluted Channels

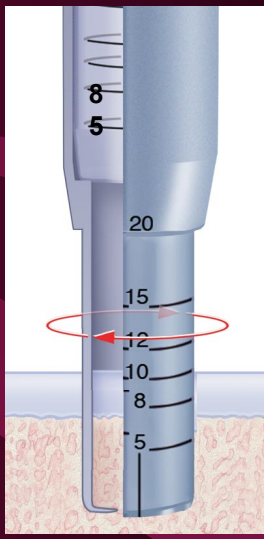
- Reduces drilling force by removing bone
- Reduces friction and heat that may cause cell damage

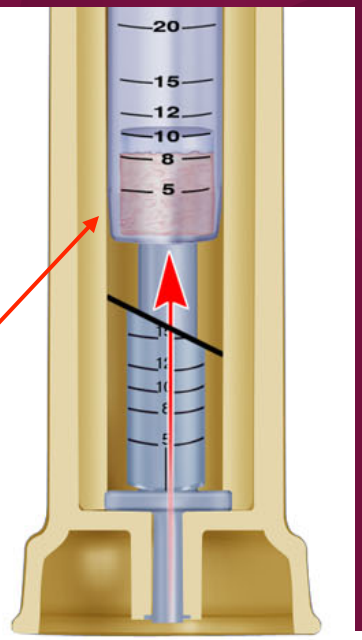
Protects Chondrocyte Viability

Protecting Chondrocyte Viability with *"No Impact Transfer"*

Harvester/Delivery Guide Cutter Interface

- Preloaded System
- Cutter protects and stores plug outside the guide tube until ready for transfer
- No contact with cartilage surface at any time





Graft Loader

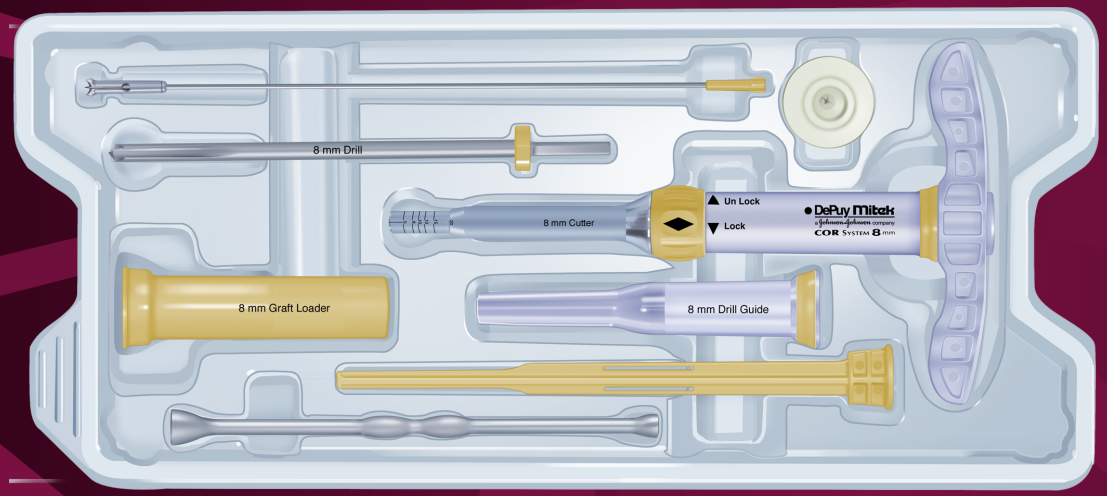
- No impact on cartilage surface
- Single step
- Loads plug with minimal force on cancellous bone

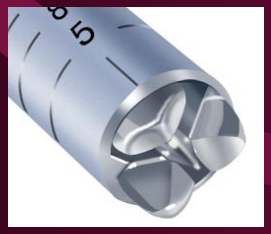
Ease of Use

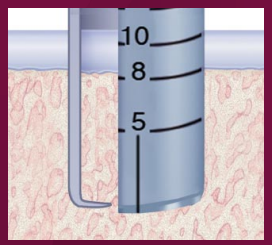
COR Precision Targeting… Easy to Use System

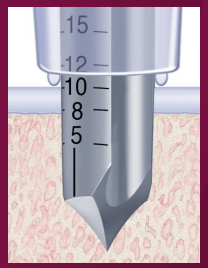
INTUITIVE HANDLING – Easily identified components – labeled and color coded

EFFICIENCY – Complete disposable system always available, no missing parts, no sterilization



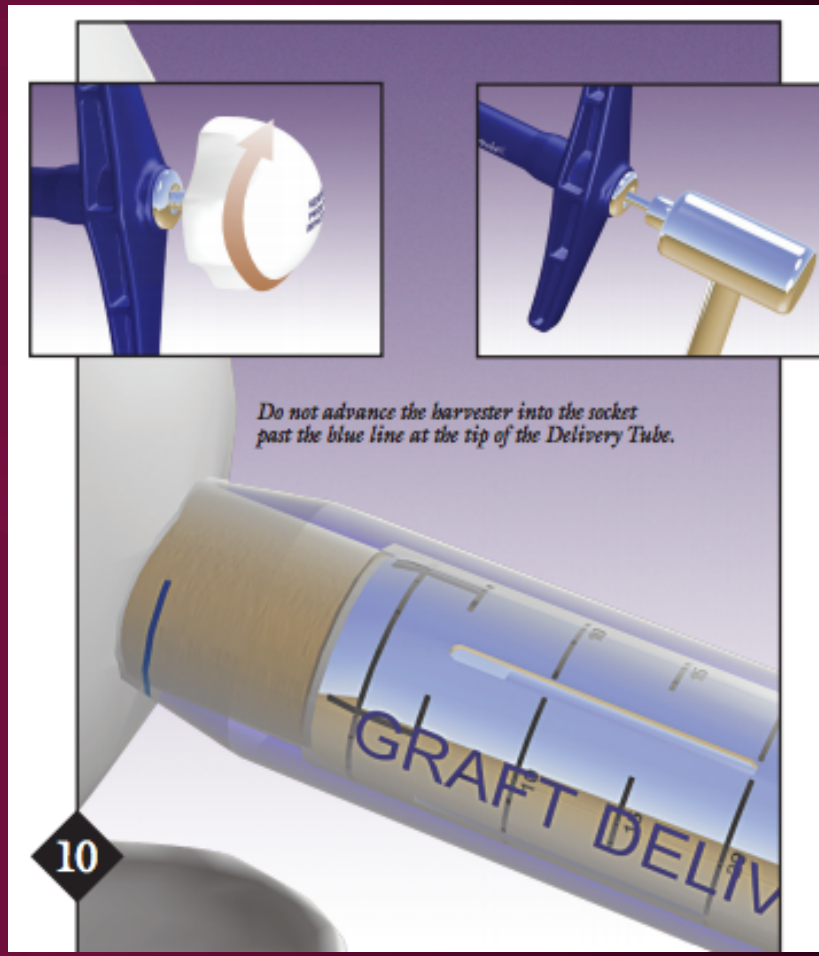






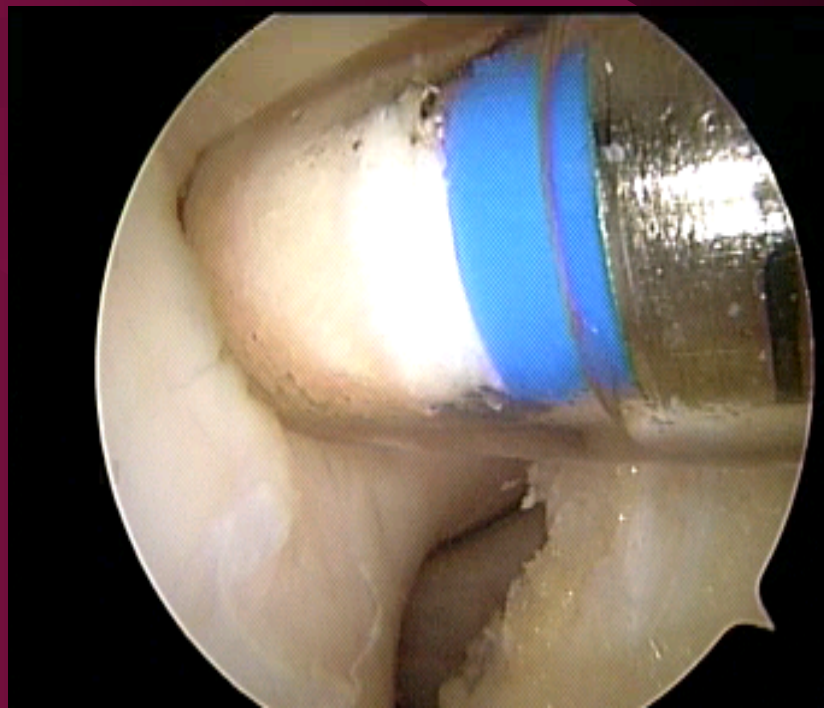
ARTHREX OATS SYSTEM


10mm DONOR
10mm RECIPIENT


Do not advance the harvester into the socket past the blue line at the tip of the Delivery Tube.
GRAFT DELIV
10

Technique Keys

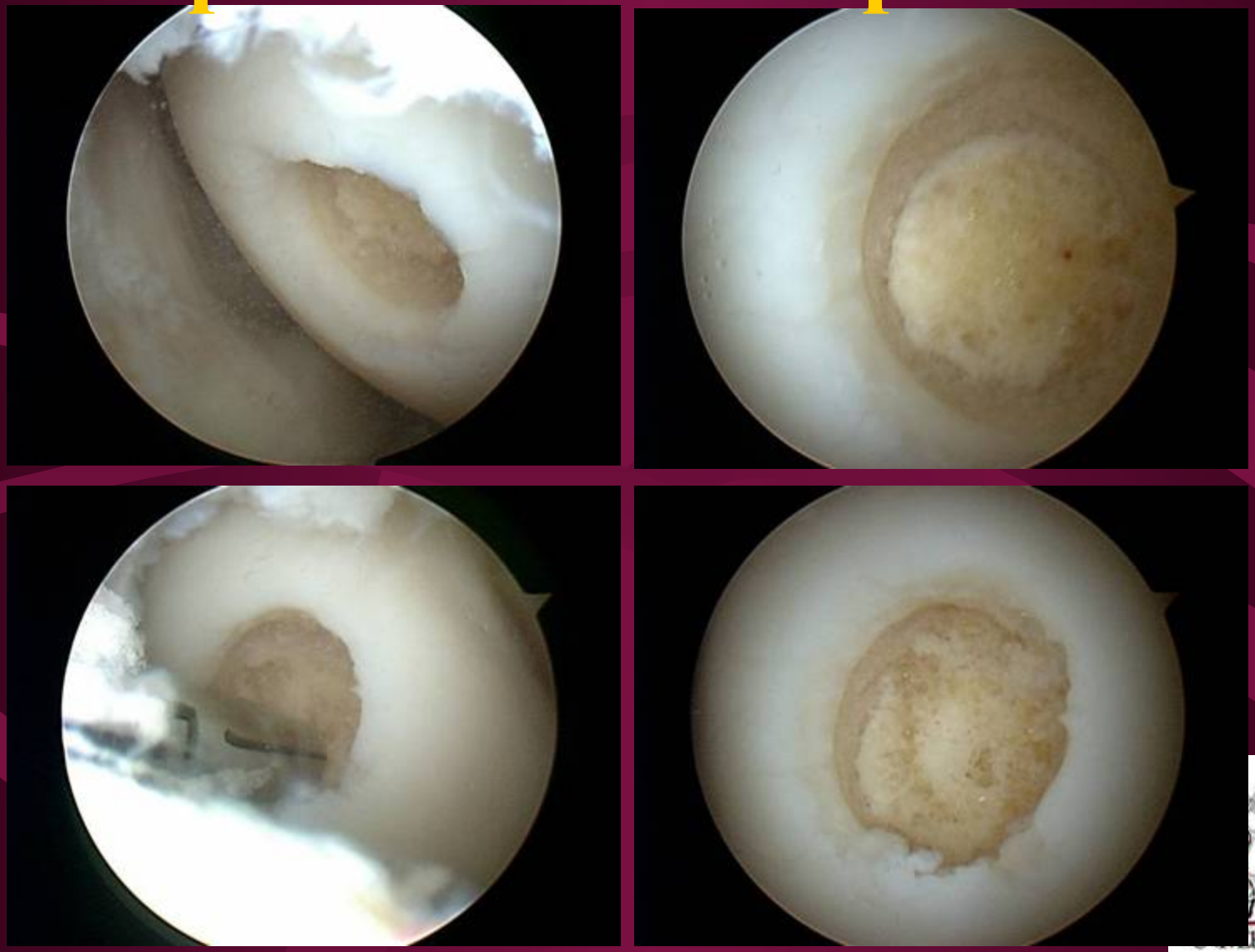
- Perpendicular graft insertion
- Joint congruity restoration
- < 400 N force insertion
- Flush or < 2mm recessed

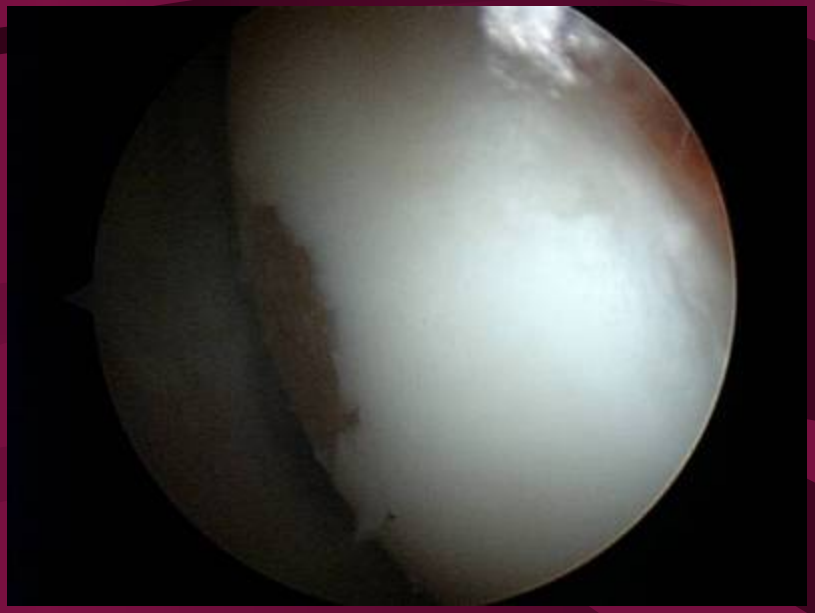


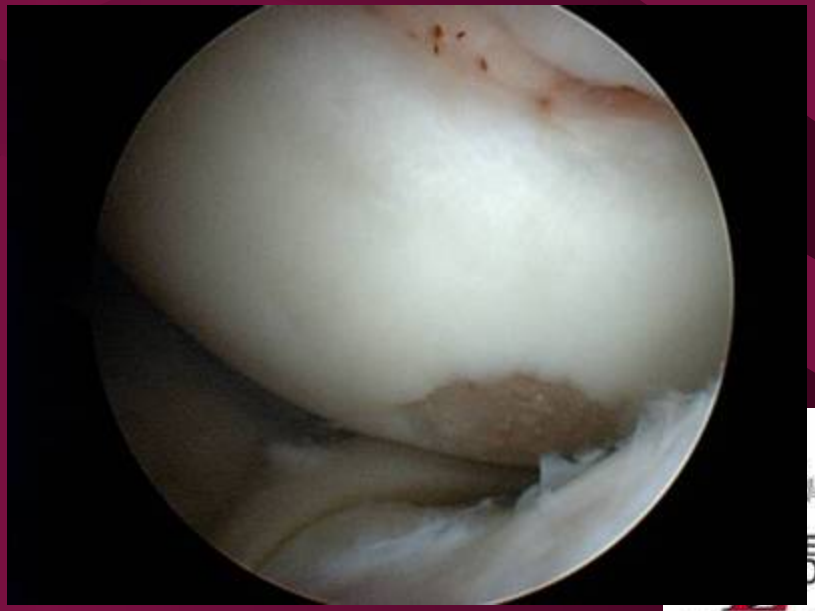
THE FUTURE

Synthetic Osteochondral Grafting TruFit™

Preparation of Recipient Site







2007 ICRS WARSAW
Cartilage Repair with TruFit CB Plug

Spaulding, et.al.

- 8 patients
- Failed debridement or microfracture
- IKDC from 44.6 to 79
- 8 month f/u

2007 ICRS WARSAW
TruFit Early Results

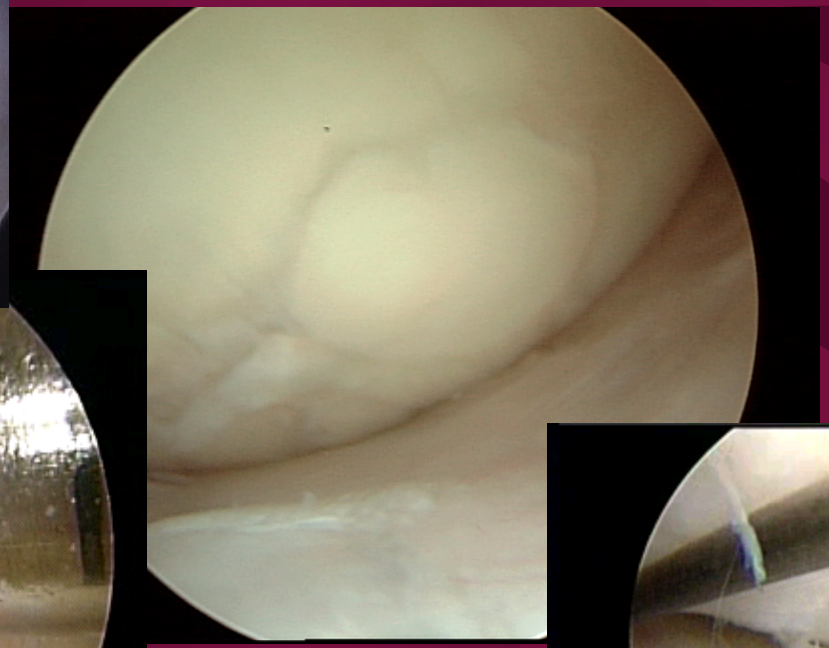
Sciarretta, et.al.

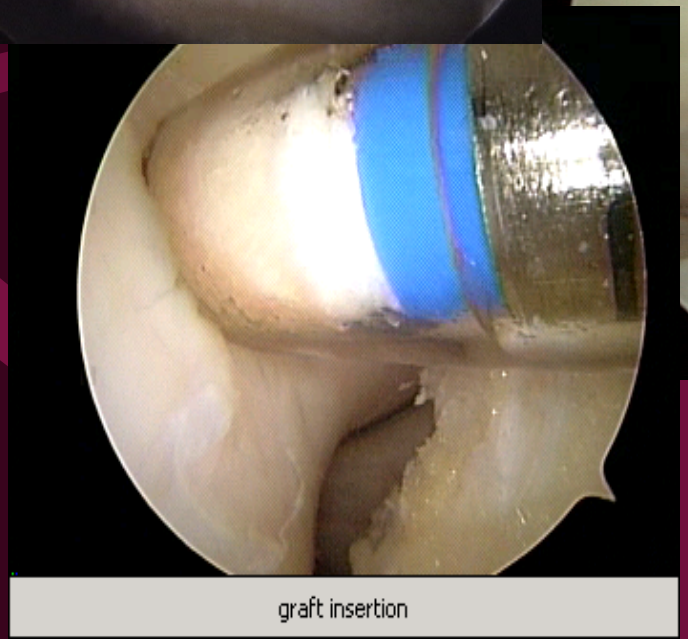
- 15 patients
- 11 mm plugs
- Early improvemrnt with IKDC scoring

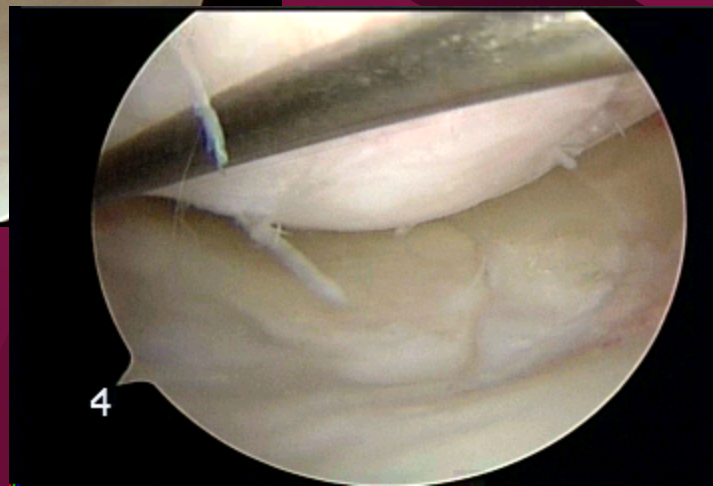
Verhaegen et al
Tru Fit Plug
Systematic Review of Literature
Cartilage 2015

- 5 clinical studies reviewed
- NO data to support superiority or equality compared to conservative treatment including microfracture

CONCLUSIONS







Indications

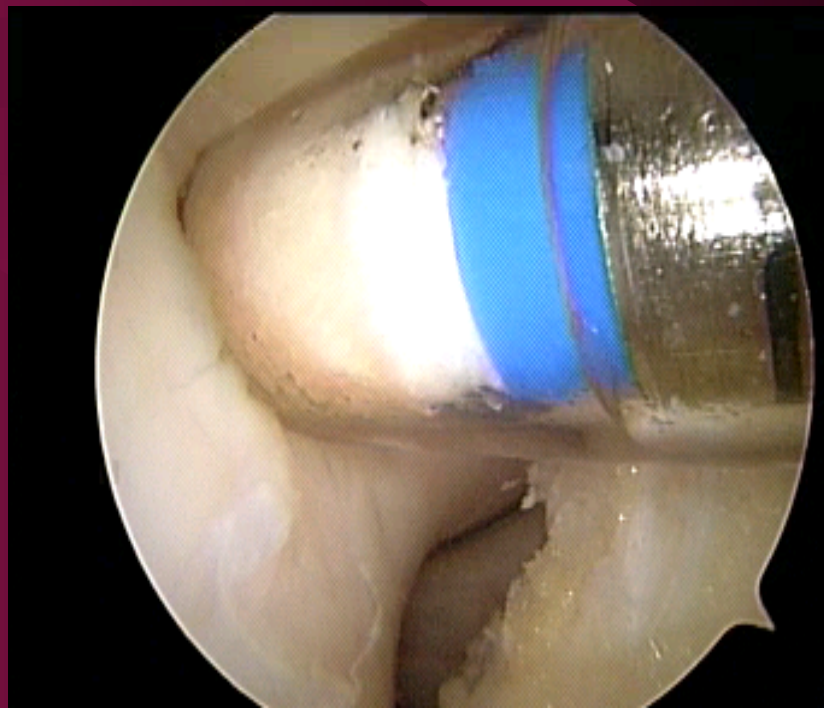
- Contained lesion
- 1cm to 3cm defects
- Normal mechanical alignment
- No kissing lesions

Contraindications

- Osteoarthritis
- Instability
- Patellar maltracking
- Mechanical malalignment

Technique Keys

- Perpendicular graft insertion
- Joint congruity restoration
- < 400 N force insertion
- Flush or < 2mm recessed



Ideal Cartilage Scaffold

- Synthetic and biodegradable
- Designed to match the physical and mechanical properties of the recipient tissue
- Integrates to reproduce the native properties of articular cartilage
  - Biomechanical
  - Histological
  - Biochemical
- Safe, effective and durable results
  - IKDC, Cincinnati, KOOS or other validated measures
  - MRI and/or similar quantitative assessments
  - Minimal adverse events, reoperations and failures

THANK YOU

FUTURE NEEDS

- More clinical studies
  - Long term
  - MRI evaluations
  - Bone scan evaluations
  - Ultrasound evaluations
  - Computerized mapping techniques

FUTURE NEEDS

- More basic science studies
  - Stiffness and biomechanical studies
  - Edge integration studies
  - Plug depth and Press-fit stability
  - Pulsed Electromagnetic field studies

Krych et al 2012 JBJS Autograft vs. Microfracture

- 96 pts
- 1-6 cm with 2.65 cm mean
- Autograft patients with superior outcome to microfracture