



Cartilage repair and regeneration.

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Disclosures: Kensey Nash Board of Scientific Advisors, Arthrex consultant

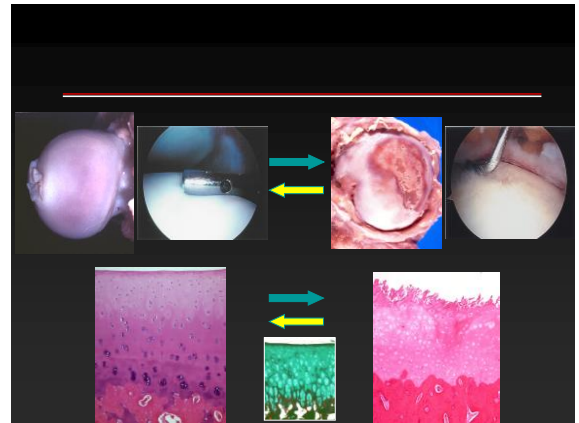
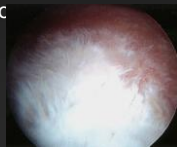
Goal?

- Repair, restore, regenerate cartilage
- Reduce pain
- Restore function



Cartilage Damage

- Pathophysiology of degeneration
 - The joint as an organ
 - Biomarkers for pain
- Injury
 - Biomarkers for those that lead to OA
- Widespread degenerative
- Terminal repair

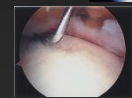


Available tools

- Microfracture
- ACI / MACI
- OATS
- OC allografts
- BMAC
- Synthetic scaffold

Damage to repair

- Chondromalacia
- Focal cartilage damage
- OCD
- Wide spread OA
- Co-morbidities
 - Meniscus, ACL
 - Terrible Triad
 - varus, MM deficient, MFC



Indications for surgery

- Pain
- Effusion
- Mal-alignment
- Instability

Microfracture

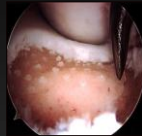
- Indicated in small full thickness defects
 - Not through subchondral bone
- Superclot = fibrin + growth factors + cells



Microfracture - evidence

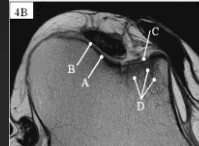
- Horses, non-human primate, humans

Frisbie. 1999. *Vet Surg* 28: 242-255.
Frisbie. 2003. *Clin Orthop Relat Res* 215-227.
Steadman. 1997. *Operative Tech Orthop* 7: 300-304.
Knutsen. 2004. *J Bone Joint Surg Am* 86-A: 455-464.
Gill. 2005. *Am J Sports Med* 33: 680-685.



- Increased fill in defect
- Diminished pain
- Return to function
- Durable?

Microfracture 8mo post-op. 3T MRI



moderate echo time FSE

- A: subchondral bone
- B: cartilage
- C: fibrocartilage
- D: subchondral sclerosis

Microfracture leads to increased failure rate of ACI. Minas, et. al. *AJSM*, 2009

Sclerosis

Central osteophytes

When to microfracture?

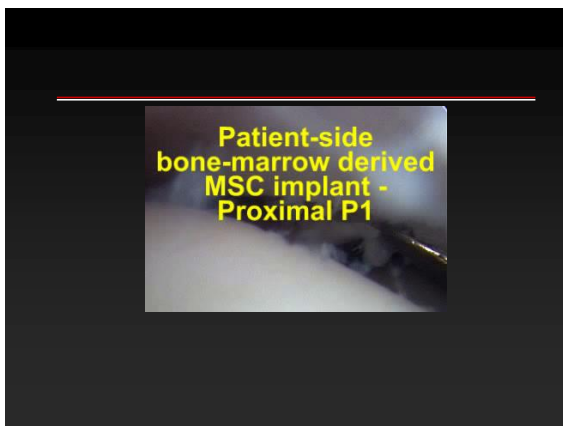
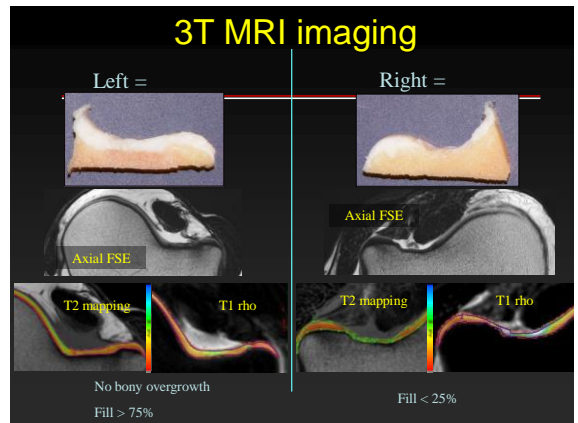
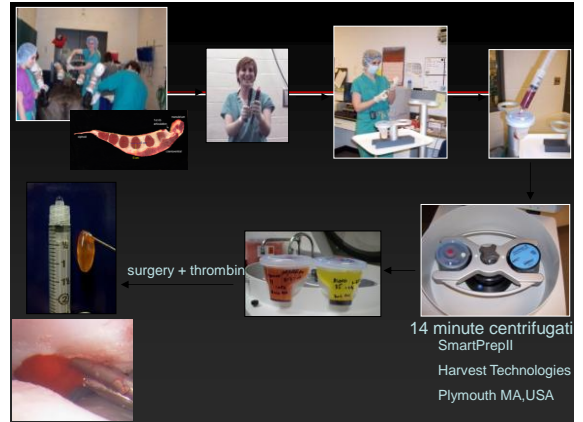
- Lesions < 2.3 cm²
- Vertical wall and remove calcified cartilage
- Younger, lower BMI

Single stage cartilage repair

- Cartilage Autograft Implantation System (CAIS)
- DeNovo NT
- DeNovo ET
- Augmented microfracture
 - Bone marrow concentrate
 - BST CarGel
 - Cartilix
 - Celcotec
 - Gelrin C
 - AMIC (Autologous Matrix Induced Chondrogenesis)

BMC

- Bone marrow aspirate concentrate
 - Increases stem cells as compared to PRP
 - Fortier et. al. *JBJS*, in press.

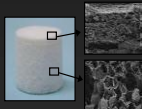


Single stage cartilage repair

- Scaffolds
 - TruFit (Smith and Nephew)
 - Osseofit (Biomet)
 - ChondroMimetic (OrthoMimetic)
 - KNC CRD (Kensey Nash)

Purpose of study

- Hypothesis: a biphasic graft (KNC CRD) would be safe and improve osteochondral repair compared to microfracture
 - KNC CRD (Kensley Nash Corporation Cartilage Repair Device)
- Bioresorbable biphasic scaffold
 - Collagen type I - β -TCP/PLA
 - Soak in bone marrow aspirate



Courtesy, KNC

Study design

- 12 horses (2-5 yrs)
 - GLP
 - PE, lameness evaluation, radiographs
- Lateral femoral trochlear ridge
 - 10 x 10 mm osteochondral defect
- KNC CRD
 - Soaked in bone marrow aspirate
 - Press fit into defect
 - ROM



Operative procedure

c



KNC CRD



microfracture

Arthroscopic implantation



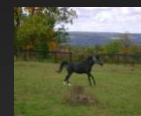
Study design

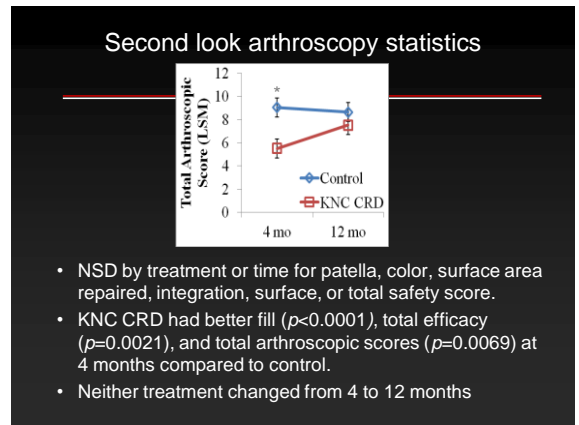
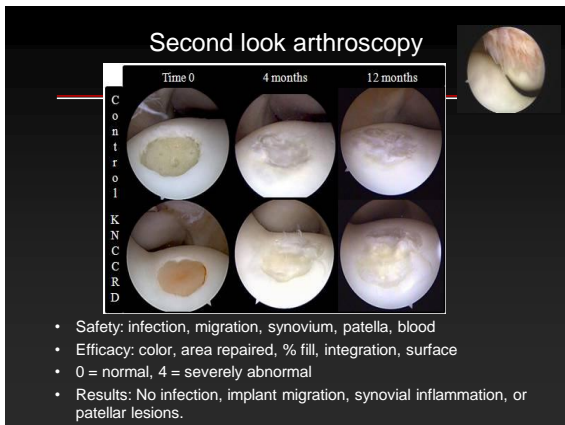
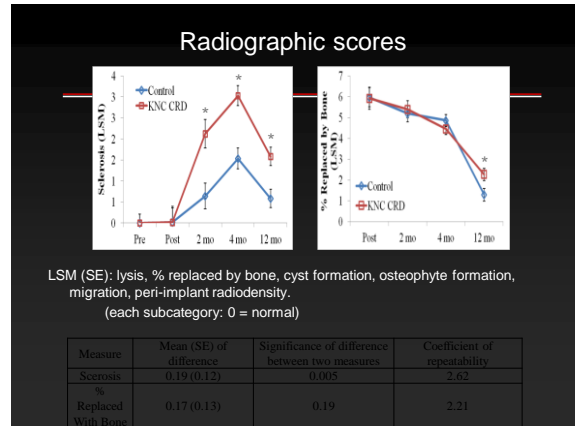
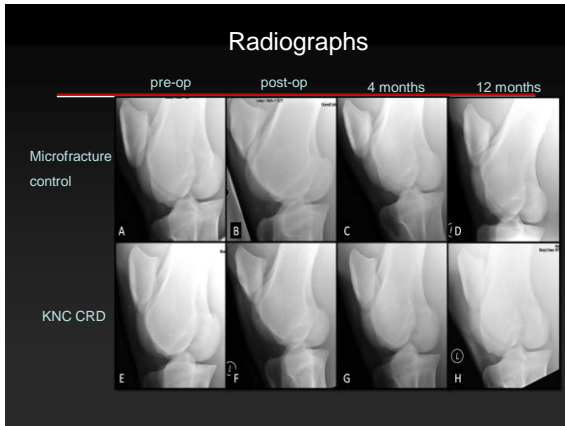
- Patellofemoral joint radiographs
 - T = 0, post-op, 4, 12, 24 months
- Rehabilitation
 - Weekly lameness (pain on palpation, lameness, effusion, ROM)
 - Stall rest 6 wk, hand walk 10 wk, turn out (1/3 acre paddock)
- Second-look arthroscopy
 - 4 months, 12 months
 - Modified ICRS scoring system
- Euthanized 24 months



Results

- KNC CRD and microfracture
 - No pain on palpation, lameness, heat, soft tissue swelling, joint effusion, decreased ROM





Conclusions

- KNC CRD (12 month study)
 - Safety
 - no adverse reactions, no migration
 - Improved early repair compared to microfracture
 - defect fill
 - total efficacy score
 - overall gross cartilage repair score
- Long term (24 month) efficacy and durability of repair presently being assessed.

Osteochondral autograft / allografts

- Cartilage replacement?
- Indications:
 - Larger, deeper lesions
 - OCD, post traumatic, failed prior tx
 - Use allografts <28 days, minimize bone, press fit
 - Autograft: OATS

Evolution of ACI Cell Therapy

CARTICEL®

- 1st described by Brittberg et al NEJM 1994
- Autologous cultured chondrocytes in suspension.
- Implanted beneath surgically applied periosteal patch
- On market in US since 1995

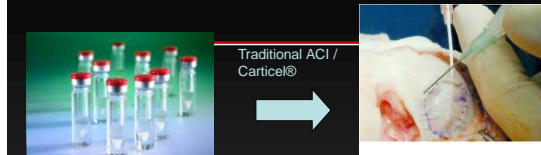


MACI®

- 3rd generation product, represents a significant improvement over traditional ACI
- Autologous cultured chondrocytes on bio-compatible collagen membrane
- Membrane fixed in place typically with fibrin sealant
- On market since 1998: 18 countries in Europe, Middle East and Asia Pacific region.
- Pivotal trial ongoing, will support basis for global registration



Courtesy, Genzyme



Courtesy, Genzyme

When to use ACI / MACI?

- Lesions >2cm²
- Femoral condyle, talus, patella

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What strategy?

