


3:31 – 3:36 pm

Long Term Results of ACI of the Talus
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I. INTRODUCTION
A. In 1851, Paget said “There are, I believe, no instances in which a lost portion of cartilage has been restored, or a wounded portion repaired, with new and well formed permanent cartilage, in the human subject.”
B. Grade 0-4 classification of chondral lesions by ICRS
C. Treatment options include drilling, microfracture, ACI, OATS or mosaicplasty with autograft or allograft

II. Autologous Chondrocyte Implantation
A. Definition – implantation of in vitro cultured autologous chondrocytes using a periosteal or membrane tissue cover after expansion of isolated chondrocytes
B. ACI – Generations
1. Generation 1 – Carticel suspended under periosteal flap
2. Generation 2 – Carticel inserted under a tissue patch or onto a carrier scaffold
3. Generation 3 – Carrier-free immature cartilage tissue
C. Indications for ACI in the Ankle
1. Indications
   a. Patients aged 15 to 55
   b. Focal defect
   c. Unipolar (only talus affected)
   d. Contained
   e. Edge loading
   f. Failed previous surgery
   g. Large lesions with extensive subchondral cystic changes
2. Relative Indications
   a. Multifocal unipolar lesions
   b. Uncontained lesions
D. Contraindications for ACI in the Ankle
1. Relative
   a. Kissing (bipolar) lesions
   b. No previous surgery
   c. Early degenerative changes
2. Absolute
   a. Osteoarthritis
   b. Uncorrected malalignment
   c. Uncorrected instability

E. Surgical Procedure for ACI – Step 1
1. Biopsy procedure
   a. Chondral biopsy 200-300 mg
   b. Biopsy done in intercondylar notch of the knee arthroscopically
2. Simultaneous ankle arthroscopy
   a. More carefully assess lesion
   b. Treat associated problems that are not accessible by malleolar osteotomy

F. Surgical Technique – Step 2
1. Medial or lateral malleolar osteotomy performed under fluoroscopic control
2. Defect preparation includes removing all damaged cartilage from subchondral bone and debriding defect on the calcified cartilage layer without penetrating bone
3. Harvest periositeum from distal tibia along the medial malleolus or from just distal to the pes anserinus and the proximal anterior tibia
4. Mark non-cambium layer of periosteum
5. Periosteum fixation
   a. Place periosteum in the defect with the cambium layer down, suture with 5.0 or 6.0 Vicryl suture and seal with fibrin glue
6. Special membrane
   a. Absorbable porcine bilayer collagen I/III membrane used by dentists in the United States for a number of years
   b. Recently has been used in knee and ankle ACI in place of periosteum, but this indication is not FDA approved
   c. Has a rough and smooth layer
7. Aspirate cell vial contents and resuspend cells
8. Implant via catheter through opening in the periosteum
9. Close hole in the periosteum and use fibrin glue; then reattach osteotomy
10. Wound closure
    a. Re-insert pre-drilled guide pins and insert appropriate length screws in the medial malleolus
    b. Insert lag screws in fibula, then appropriate size plate and screws
11. The patient goes into short leg cast in neutral position

G. Surgical Technique with “Sandwich Procedure”
1. Done for large cystic lesion > 6mm deep
   a. Best measured on CT scan in coronal and axial planes with sagittal reconstructions
2. Excise cystic lesions and bone graft defect after drilling the base
3. The periositeum is sewn over the bone graft site, with the cambium side up, and the area is sealed with fibrin glue; tourniquet is then released
4. Second periositeal flap is sutured at the level of adjacent healthy cartilage with cambium side down
   a. Fibrin glue used to seal the entire periositeum with hole left to inject the cells
   b. The cells are injected between the two periositeal flaps and the hole in the periositeum is sutured
5. BioGide can be used in place of periositeum here as well

H. Results of ACI – First Generation (ACI-P)
1. Baums et al. (2006)
   a. 12 patients
b. Mean follow-up 63 months  
c. Hannover score increased from 40 to 86 points  
d. AOFAS increased 45 points  
e. Patients involved in competitive sports were able to return to their full activity level

2. Ferkel (2009)  
a. 32 patients done; the first 11 patients have been reviewed and published in AJSM  
b. 11 patients, 6 female and 5 male; average age = 35; average follow-up = 36 months (24-58)  
c. 9 medial and 2 lateral lesions  
d. All patients failed previous surgery  
e. 6 patients had "sandwich" procedure with bone grafting of large cystic underlying defect and use of two periosteal grafts back to back  
f. Oldest patient almost 6 years out and is now running and doing all sports with only occasional discomfort  
g. 2nd look arthroscopy on 10/11 (91%) patients; cartilage was graded by palpation on all patients, and firmness of the articular cartilage increased with longer follow-up. All lesions were covered by "cartilage-like" surface  
h. 82% G-E, 18% fair. 91% improved on outcome scoring.  
i. Tegner went from 1.3 to 4.0  
j. AOFAS preop 47; postop 84  
k. Currently all patients being re-evaluated. Second looks have been done in 25 of 32 (79%). The latest and current data will be presented during the talk.

I. Second Generation ACI  
1. A variety of scaffolds being used in Europe, implanted either through a small arthrotomy or arthroscopically.  
a. Used as a patch and cells inserted underneath  
b. Cells seeded onto the scaffold membrane  
2. Collagen-covered autologous chondrocyte implantation (CACI or ACI-C)  
a. Absorbable porcine bilayer collagen I/III membrane  
b. Membrane with one compact and one porous surface  
c. Gooding found no difference in results between periosteum and membrane cover in knees with CACI  
3. Hyalograft C  
a. Benzyl ester of Hyaluronic acid  
b. Bioabsorbs in 3 months  
c. Marcacci et al. presented 175 patients with grafts in the knee with 46 month mean follow-up. Results were 93% improvement at ICRS 2006  
d. Giannini et al. (2008) – 46 patients in ankle  
(1) Mean age 32; follow-up 3 years  
(2) Preop 57; postop 90 mean AOFAS score  
(3) Biopsies collagen type II  
4. Membrane/matrix autologous chondrocyte implantation (MACI)  
a. Highly purified type I/III collagen membrane  
b. Guillen and Abelow presented first 50 cases (42 knees; 8 ankles)  
c. 8 ankles (ages 22-46)  
d. Large full thickness cartilage lesions of the talus (2-6 cm)  
e. 5/6 good & excellent results with follow-up 4 months-2 1/2 years

J. Third generation ACI  
1. Use carrier-free, immature cartilage tissue  
2. Lack of carrier scaffold  
3. Avoids carrier integration, degradation and biocompatibility complications  
4. Jubel et al. used an alginate matrix to produce cell-rich chondrocyte disc in MFC of 48 sheep  
5. Chondral defects treated with De Novo cartilage transplantation showed qualitatively better micro and macroscopic regeneration than those with periosteal flaps alone

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III. Recommended reading on current and future innovations on ACI and treatment of osteochondral lesions of the talus
A. Safran, Kim and Zaffagnini in JAAOS, 2008
B. Mitchell, Giza, Sullivan in JAAOS, 2009
C. Getgood, Brooks, Fortier, Rushton in JBJS (Br) 2009
D. Gikas, Bayliss, Bentley, Briggs in JBJS (Br) 2009
E. O’Loughlin, Heyworth, Kennedy in AJSM 2009
F. Ferkel, Scranton, Stone, to be published in Instructional Course Lectures in 2010

IV. Summary
A. Zengerink et al. has nicely summarized when to use which treatment for OLT (see Table 1)

<table>
<thead>
<tr>
<th>Lesion</th>
<th>Treatment</th>
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<tr>
<td>Type 1: asymptomatic lesions, low-symptomatic lesions</td>
<td>Conservative</td>
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<td>Type 2: symptomatic lesions &lt; 10 mm</td>
<td>Debridement and drilling/microfracturing</td>
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<td>Type 3: symptomatic lesions 11-14 mm</td>
<td>Consider debridement &amp; drilling, fixation, an osteochondral graft or ACI</td>
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<tr>
<td>Type 4: symptomatic lesions &gt; 15 mm</td>
<td>Consider fixation, graft or ACI</td>
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<td>Type 5: large talar cystic lesions</td>
<td>Consider retrograde drilling + bone transplant, or ACI with sandwich procedure</td>
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<td>Type 6: secondary lesions</td>
<td>Consider osteochondral transplant</td>
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For types 4 through 6, debridement and bone marrow stimulation can always be considered a treatment option.


References


