

CARTICEL

AUTOLOGOUS CHONDROCYTE IMPLANTATION

BY R. THOMAS GROTZ, M.D.

T. Inman Lectureship May 8-9, 2008

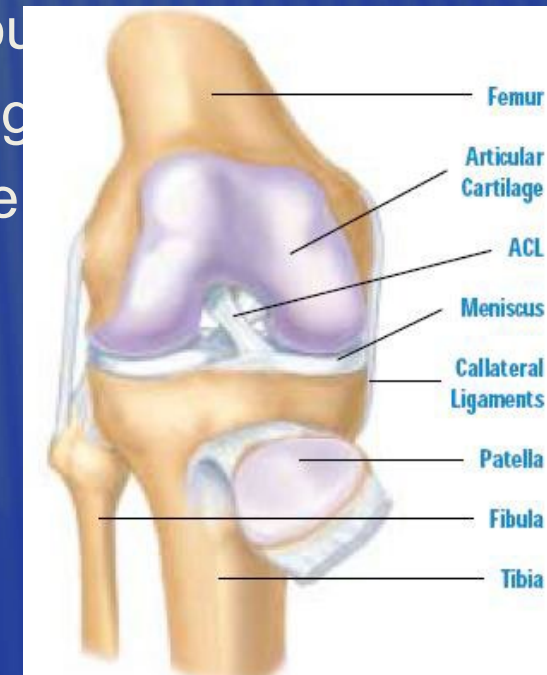
DISCLOSURES

- × InnvoSurg, Inc. Inventor/CEO
- × InnvoTec Surgical Inventor/Consultant
- × Acculine International Consultant
- × Cephalon Lecturer Amrix
- × Primus Lecturer Limbrel

HYALINE CARTILAGE



- × Hyaline or articular cartilage is made up of chondrocytes, which produce a smooth, hard, shiny matrix that lies on the knee's articulating surfaces.
- × It allows for the smooth interaction between two bones in a joint.
- × Hyaline cartilage is extravascular, meaning that it has no direct blood supply. This means that once injured it is notorious for not healing.
- × The breakdown of cartilage causes pain, swelling, and instability. It can also lead to a decrease in fluidity, loss of motion, and progressive degenerative changes, such as traumatic arthritis.
- × Once the joint surface is damaged, it develops cracks or fissures and tends to gradually break down further.



CARTILAGE BREAK DOWN GRADING



0 = Normal white shiny articular cartilage surface.

1+ lesion is a crack or fissure in cartilage towards the bone surface.

2+ lesion is a crack or fissure through cartilage to the bone.

3+ is to bone, with a flap breaking off.

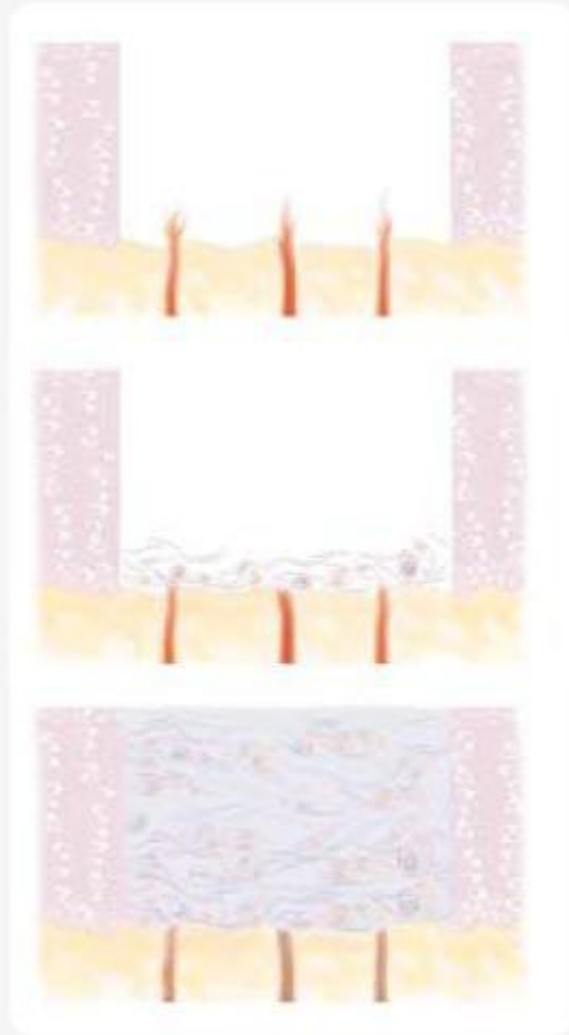
4+ is bone exposed.

- × Lesions that are 3+ almost always rapidly progress to 4+. Once a lesion has bone exposed, it wears away the opposite surface, eventually creating bone on bone that needs a joint replacement.
- × Consequently, 3+/4+ lesions which when debrided will equal 2 square cm warrant consideration of a Carticel implant.
- × **Note that 1.5 cm times 1.5 cm = 2.25 square centimeters**

ALTERNATIVES

- × “Picking” or “drilling” the lesion to create a blood supply can be helpful, and actually appropriate in very small lesions since the scar cartilage, or fibrocartilage, will bridge the gap between normal cartilage areas of shock absorption, and suffice.
- × Total joint replacement arthroplasty is often successful at reducing pain, but it is far from a normal knee. Often requires revision every 5-10 years and is prone to infection and loosening.
- × Fusion or amputation above the knee, are less attractive.

**Marrow Stimulating Techniques
(microfracture, drilling, abrasion)
create a fibrocartilage repair tissue.**



**Fibrocartilage is made to resist tension forces.
This "repair cartilage" has diminished resilience and
stiffness, and poor wear characteristics.**

**Carticel can create a hyaline
cartilage repair.**



**Hyaline (Articular) cartilage is made to resist
compression forces and distribute mechanical loads.**

PROVEN TECHNIQUE

- × It is FDA cleared in the femoral condyl and trochlear groove of the femur.
- × The 10,000th Carticel II implant was accomplished in 2004.
- × It has been under development for more that 20 years
- × 2-3 stage procedure:

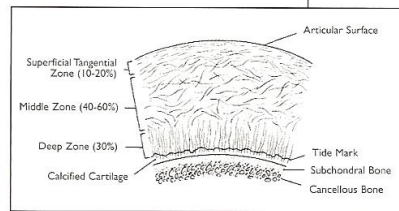
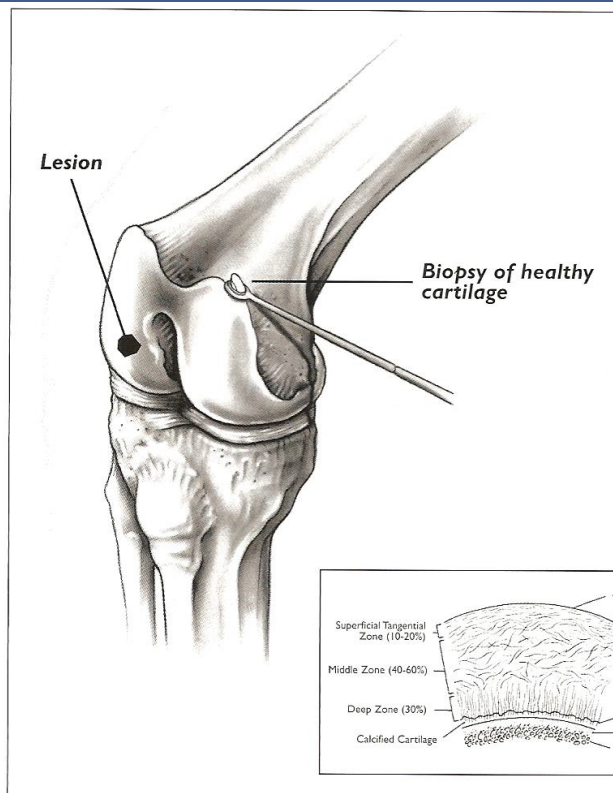


CARTICEL I BIOPSY

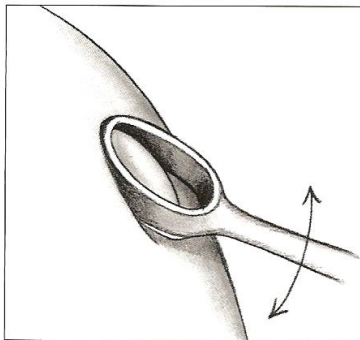
- × The first stage surgical procedure generally involves an arthroscopic biopsy of cartilage, whereupon it is sent to a tissue bank for preparation, storage, and cloning.
- × It takes 2-4 weeks to grow the cells and can be stored for up to 5 years.

CARTILAGE

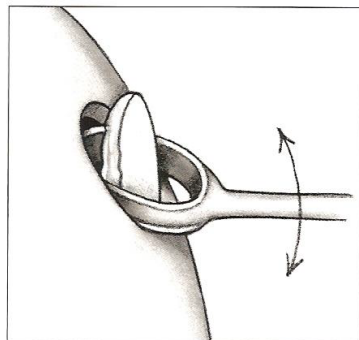
BIOPSY



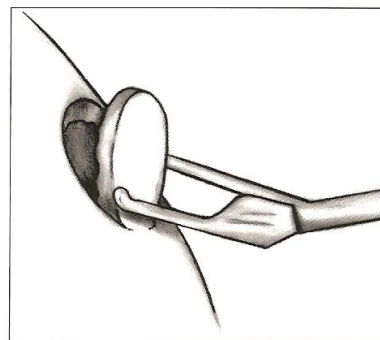
Step 1:
Medial superior ridge
Full-thickness specimens including small bone sample.



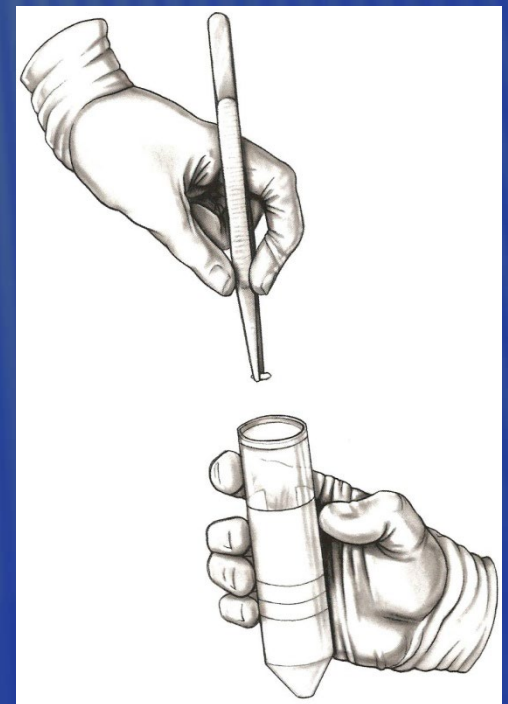
Step 2: Engage back of curette.



Step 3: Create a dowel of cartilage with a side-to-side motion.



Step 4: Keep the distal stump intact. Remove with a non-tooth grasper.



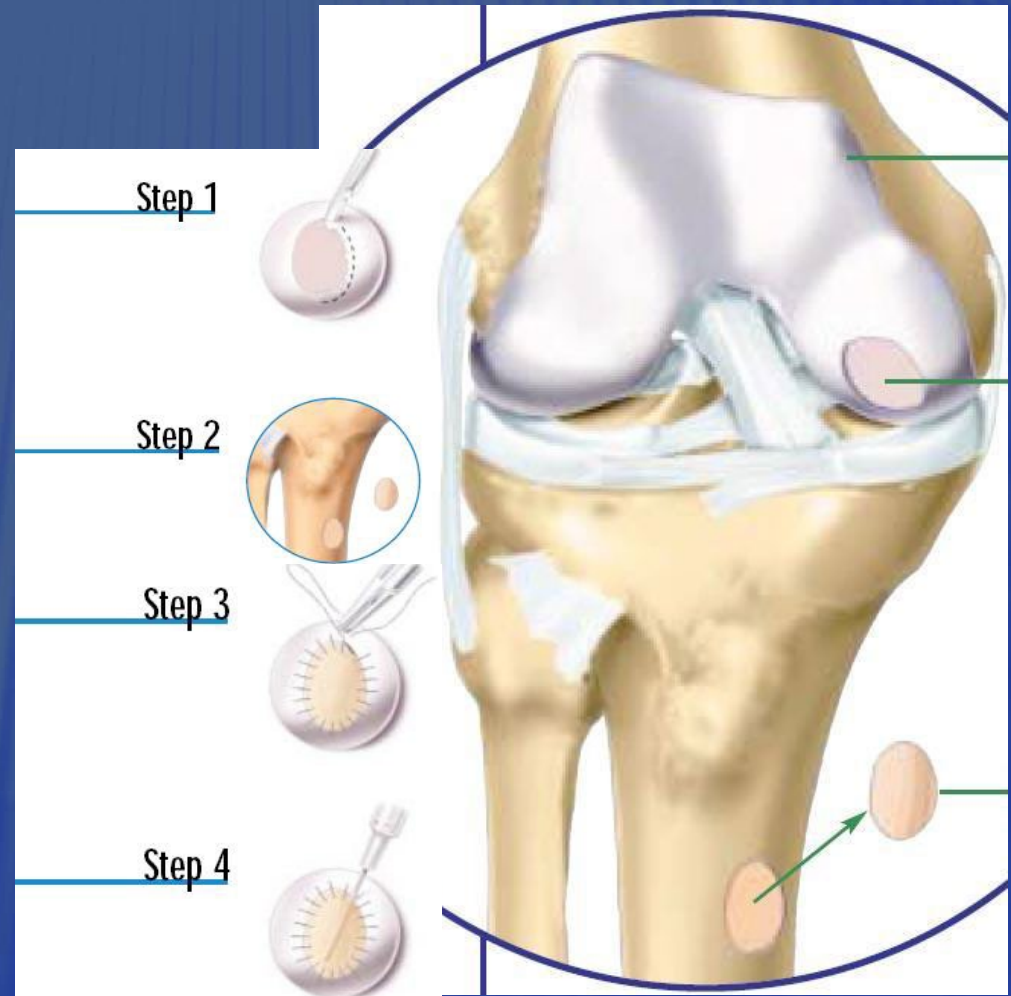
J.B. 10/12/04

- × Clinical History: 46 year old white, right arm dominant male police officer with bilateral knee arthropathies causing excruciating pain, instability in walking , standing, and pain at rest.
- × Diagnosis: Osteochondral defect over the lateral facet of the patella, 2x3 cm, and over the lateral tibial plateau, 3x3 cm, each 3 to 4+ /4
- × Procedure Performed: Right knee arthroscopic inspection, debridement of menisci; chondral surface chondroplasty; synovectomy and Carticel I biopsy.



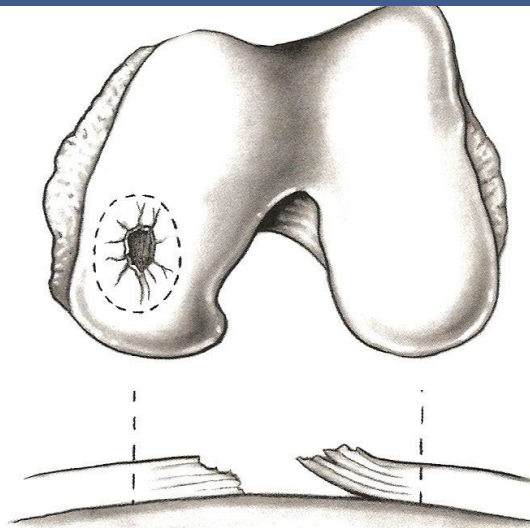
CARTICEL II – IMPLANTATION OVERVIEW

- × The second stage is the implantation of cloned cartilage.
- × The rough fissured cartilage is treated by cutting out the bad tissue, to create a firm vertical edge for fixation of the periosteal membrane and injection of cells.

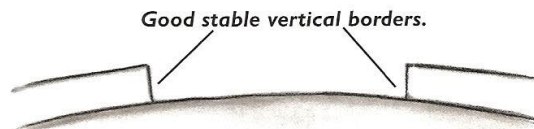


CARTICEL II

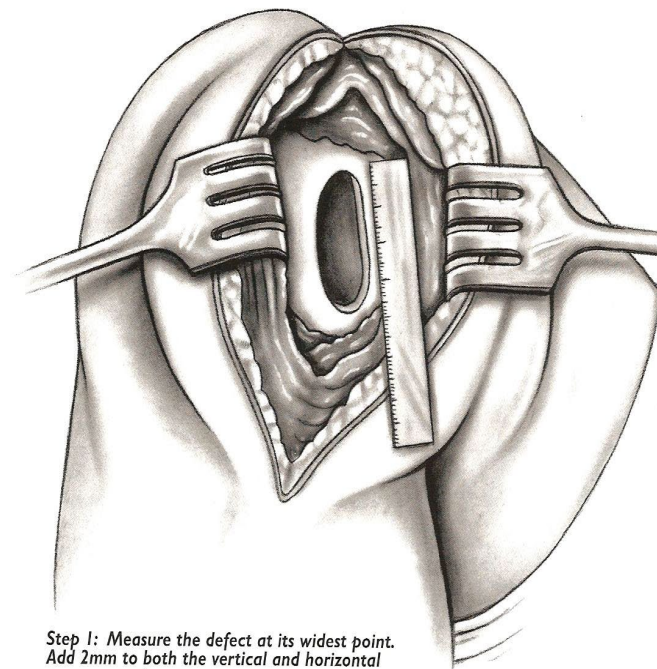
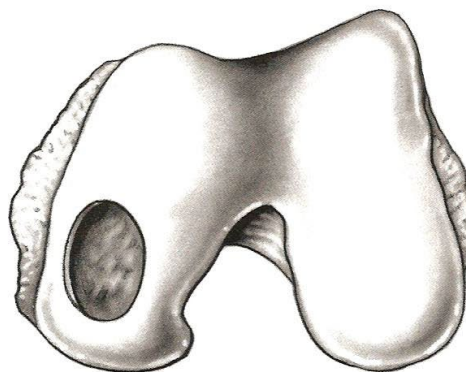
DEFECT PREPARATION



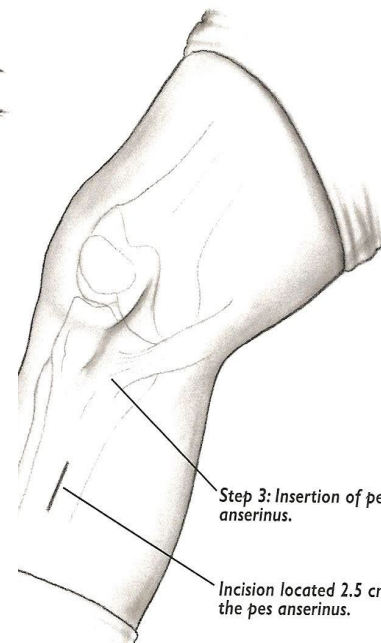
Step 1: Use an open ring curette to excise damaged cartilage from the defect.



Step 5: The bone plate must be intact. Remove fibrous covering.



Step 1: Measure the defect at its widest point. Add 2mm to both the vertical and horizontal measurement.



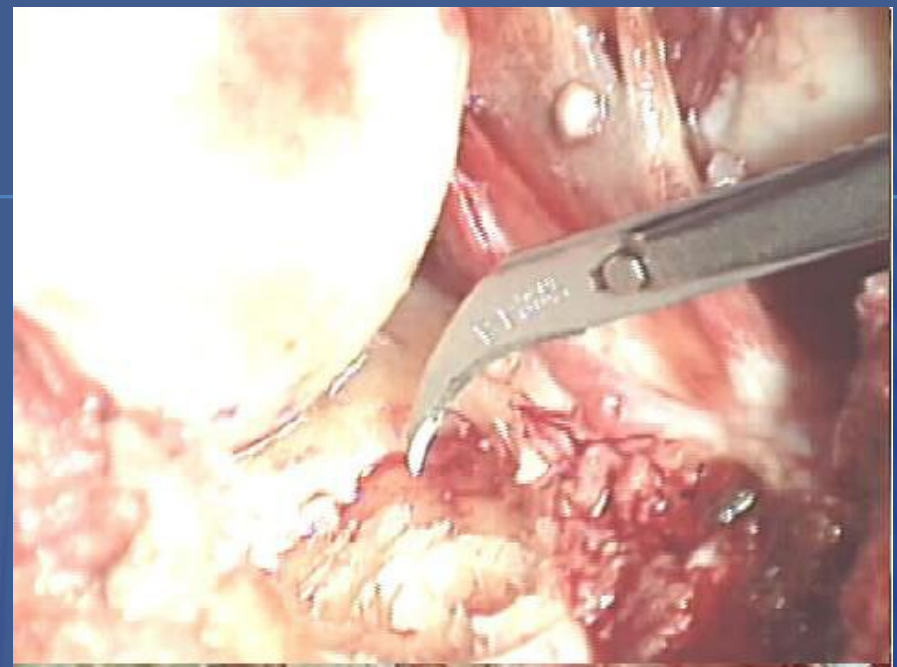
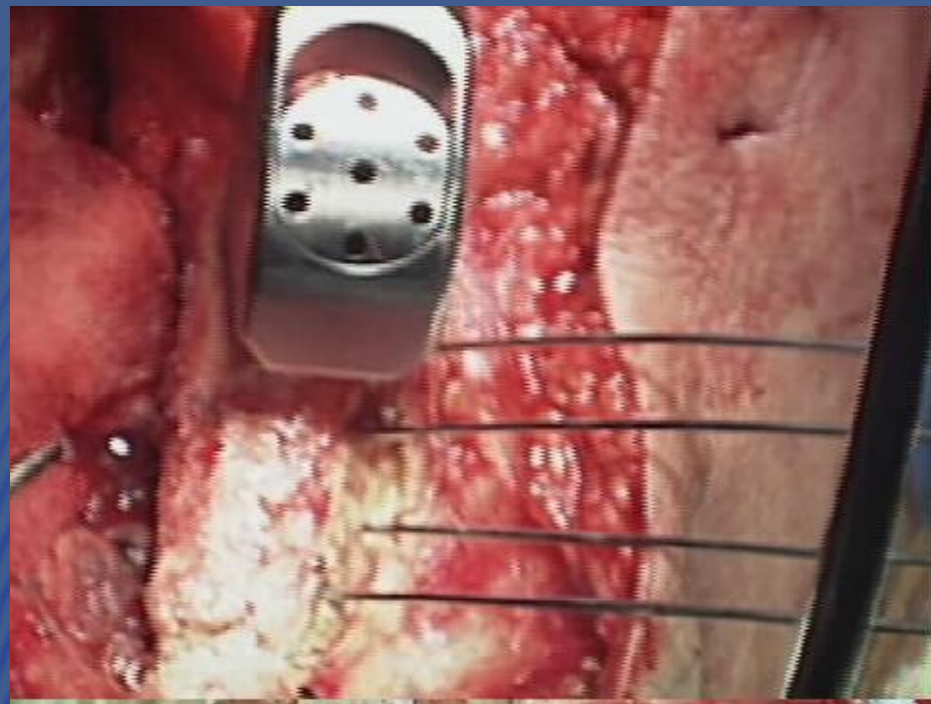
Step 3: Insertion of pes anserinus.

Incision located 2.5 cm below the pes anserinus.

CARTICEL II - J.B. 1/11/05

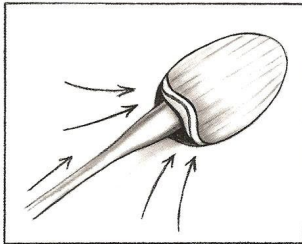
- × Diagnosis: 1) Retropatellar full-thickness defect 3 x 2 cm
- × 2) Lateral tibial plateau defect 2 x 2.5 cm
- × Procedure Performed: Right knee open chondrocyte implantation, quadplasty with medial and lateral release, anteriorization of PF joint with placement of 7.3 screws/washers under image intensifier



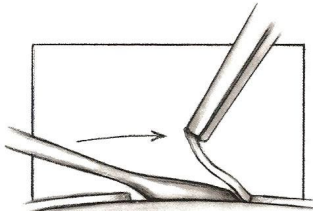


CARTICEL II

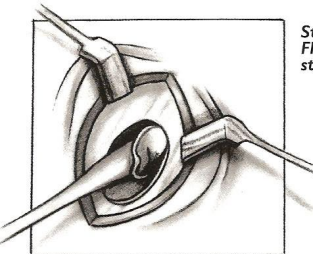
PERIOSTEUM HARVESTING FROM TIBIA



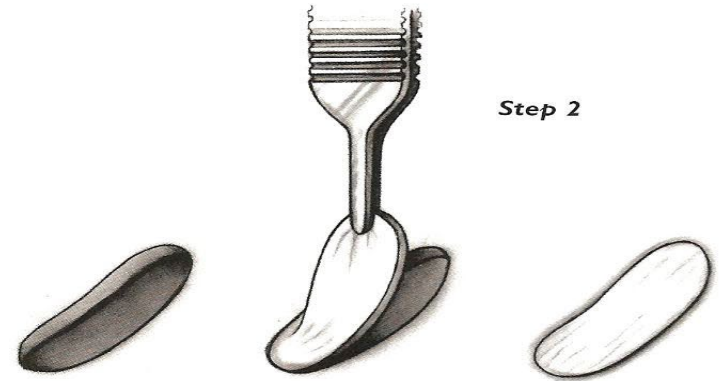
Step 1: Start with the edges around the periphery.



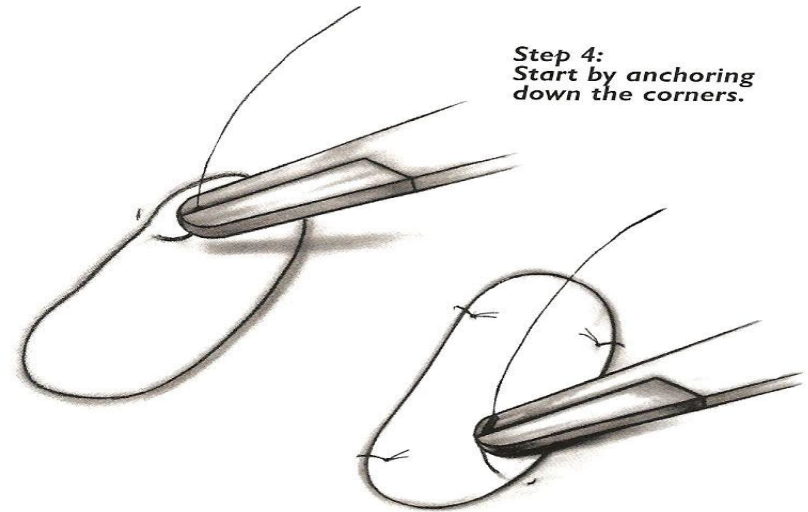
Step 2: Angle the periosteal elevator. Do not damage the subchondral bone.



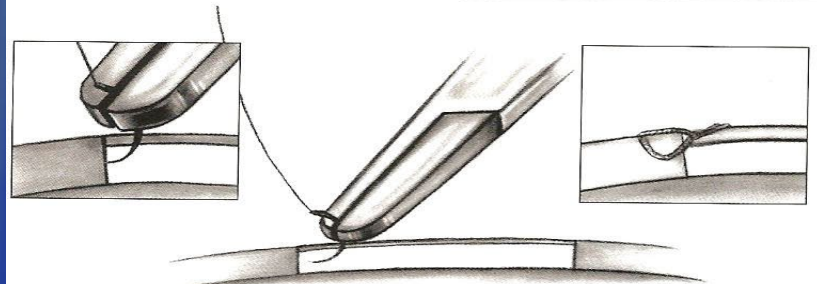
Step 3: Elevate periosteum. Flap may roll or curl up; gently straighten after removal.



Step 2

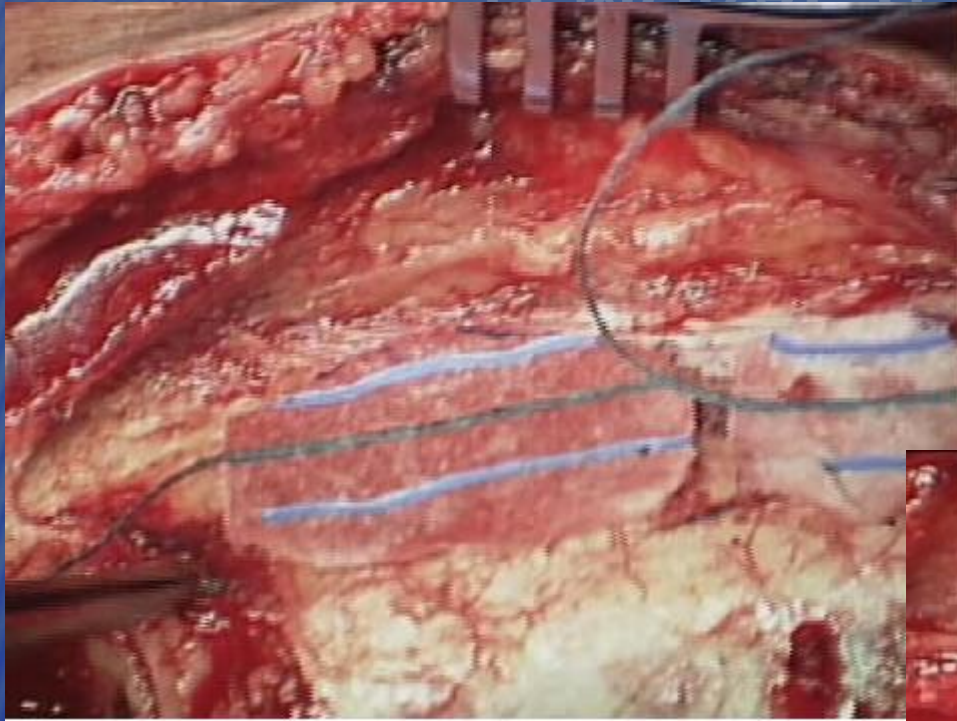


*Step 4:
Start by anchoring
down the corners.*

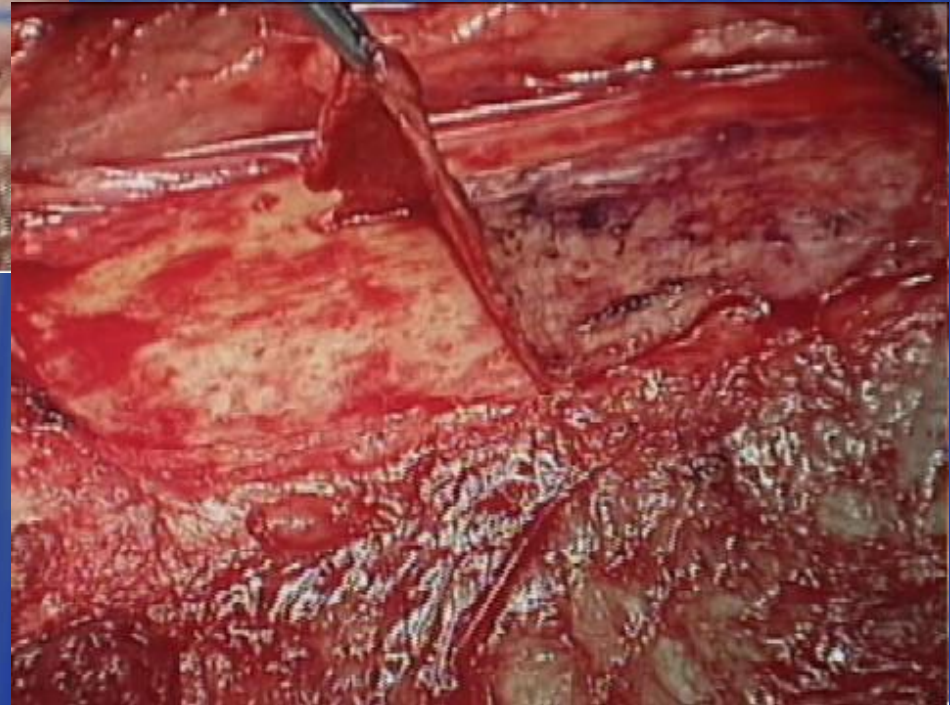


Step 7: Angle the needle toward the surface to obtain a cartilage bite. Tie knot on side of periosteum, not on the cartilage rim.

FEMORAL TEMPLATE →

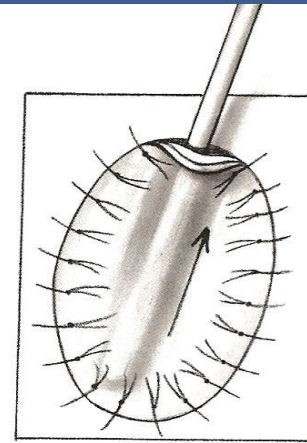
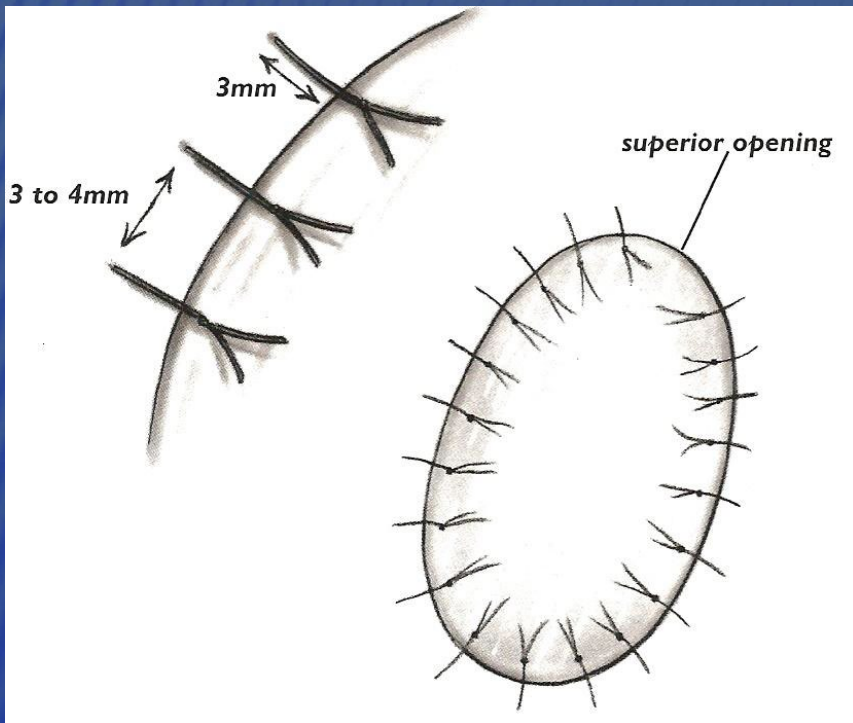


USED TO CREATE
PERIOSTEAL GRAFT
FROM TIBIA

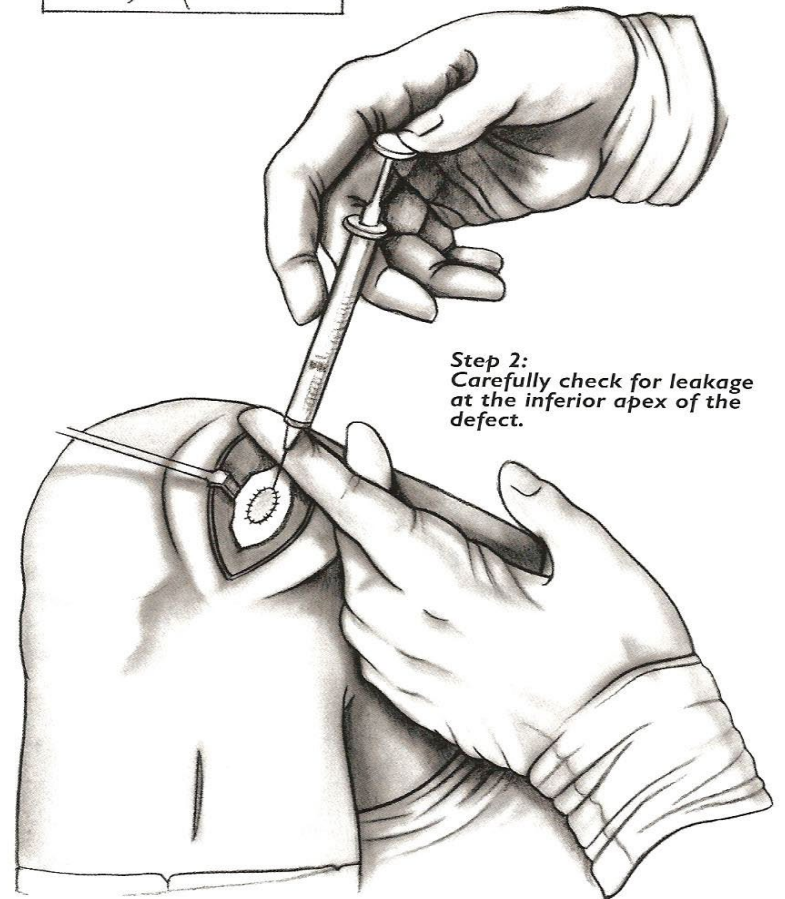


CARTICEL II

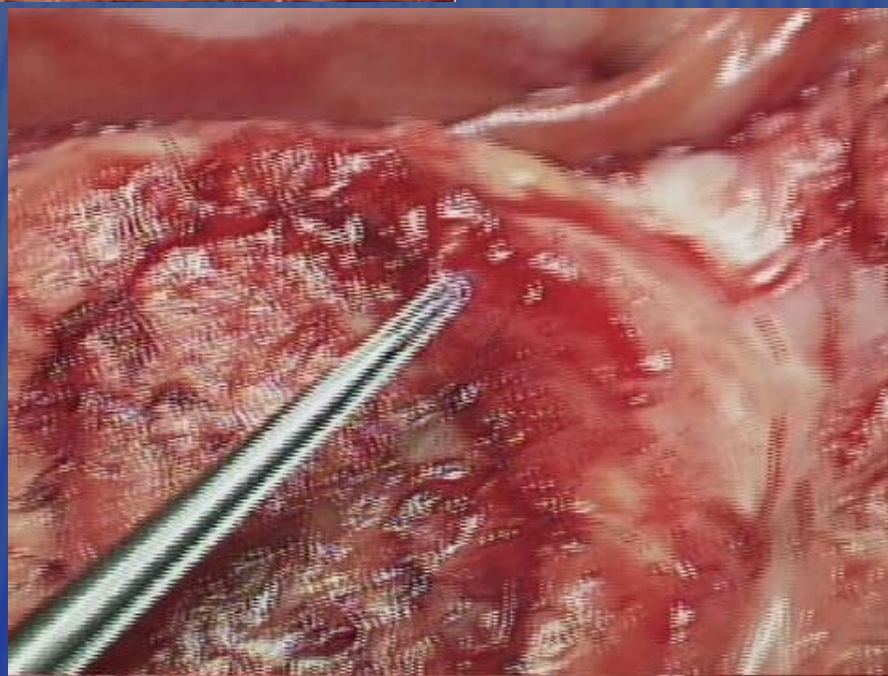
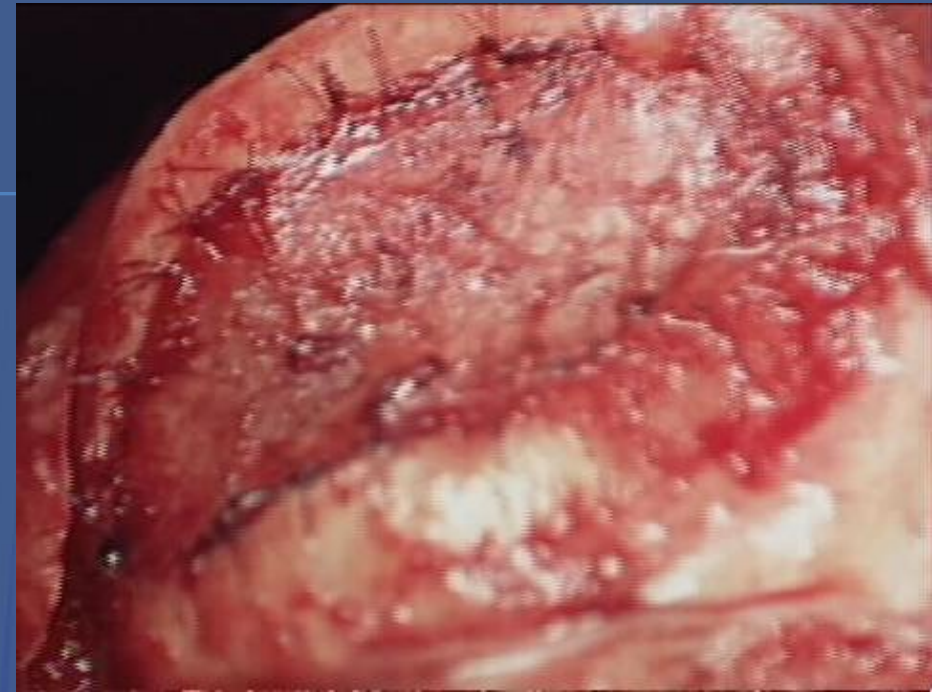
WATERTIGHT SEAL



Step 1:
Ensure that the superior opening accommodates an 18 gauge catheter.

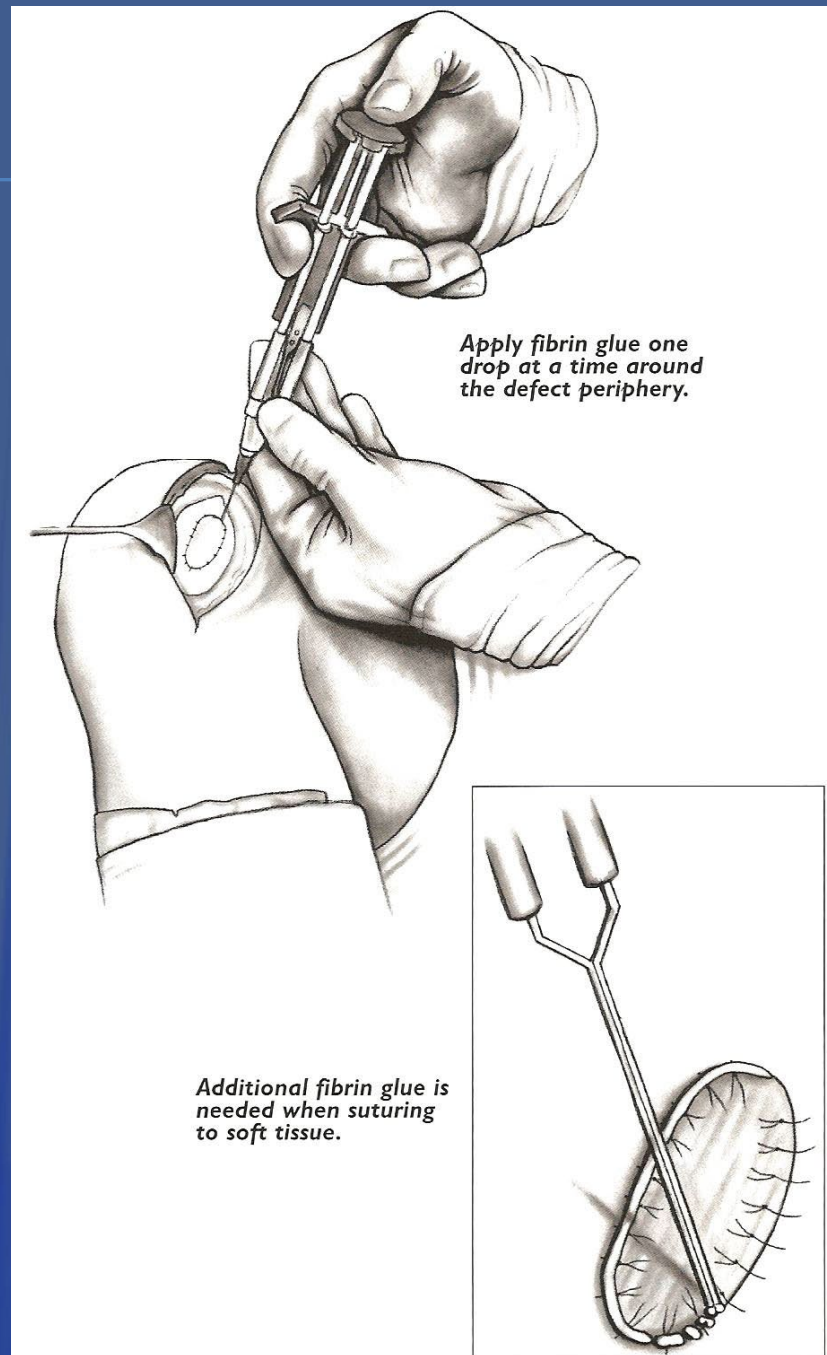
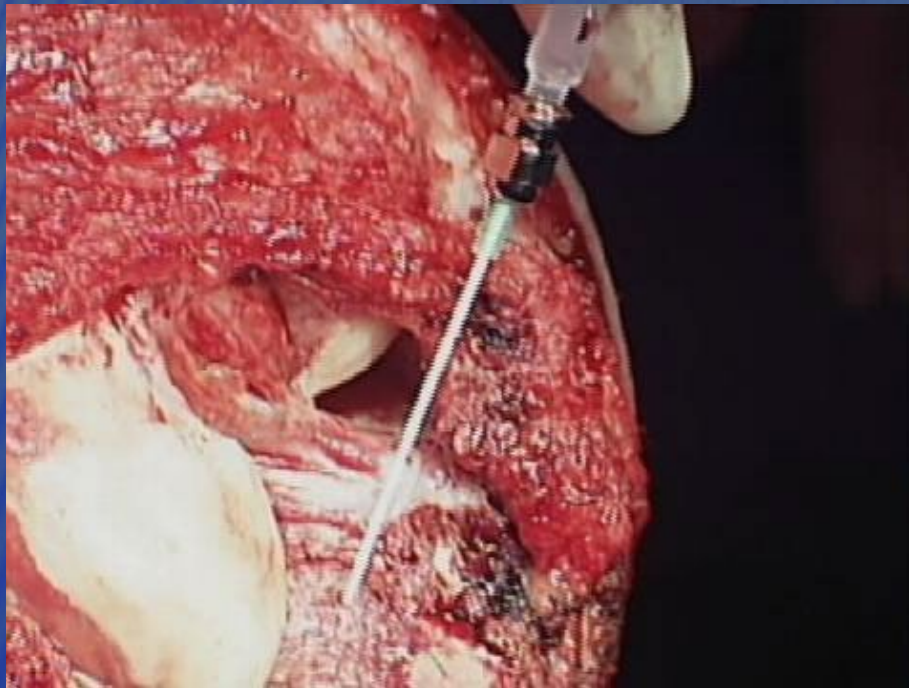


Step 2:
Carefully check for leakage at the inferior apex of the defect.



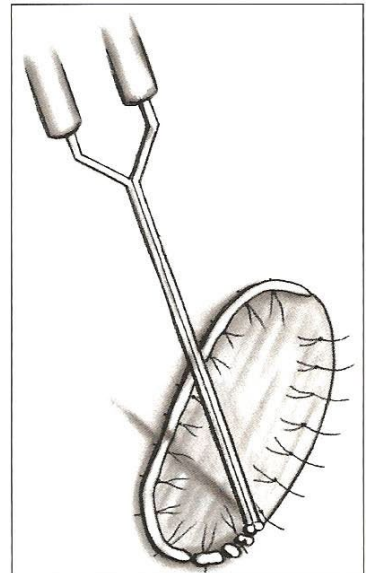
CARTICEL II

FIBRIN GLUE

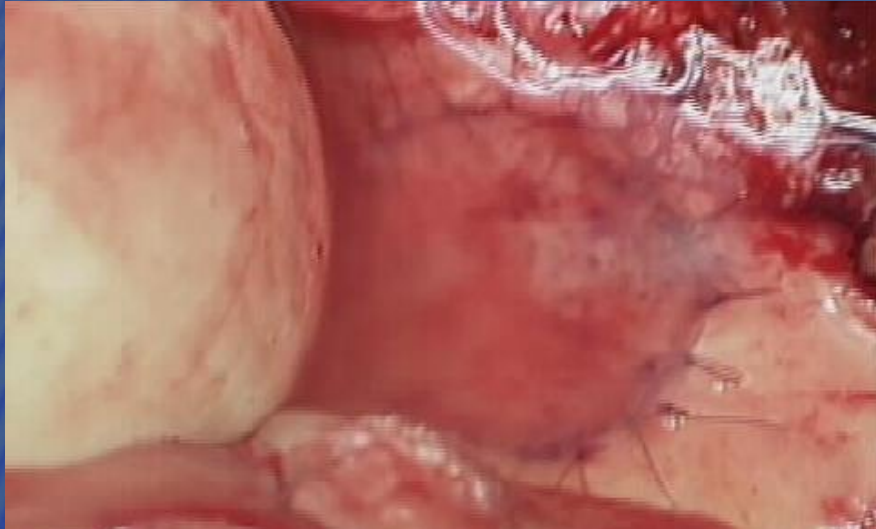


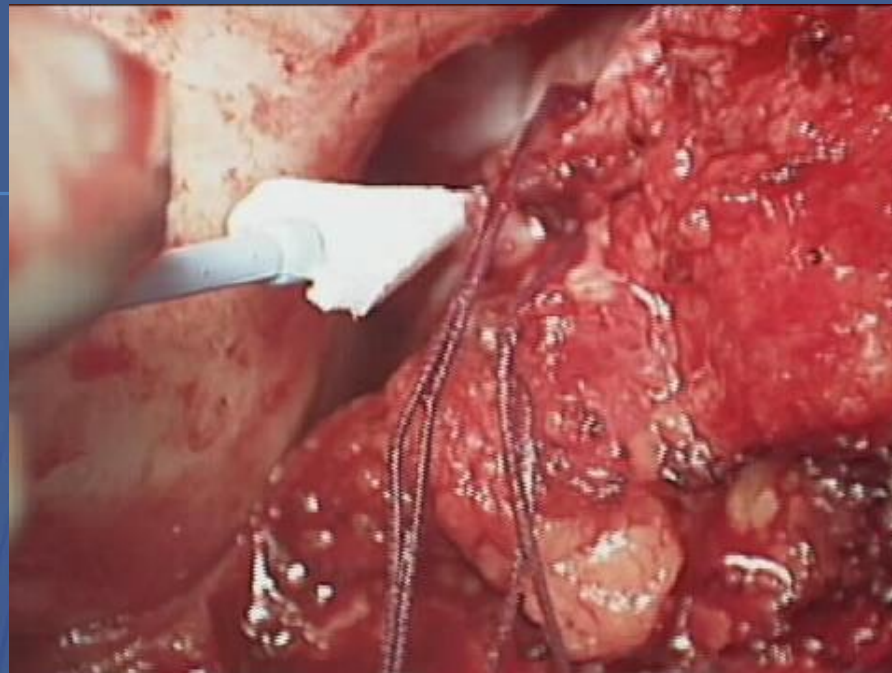
Apply fibrin glue one drop at a time around the defect periphery.

Additional fibrin glue is needed when suturing to soft tissue.



CHONDROCYTE IMPLANTATION

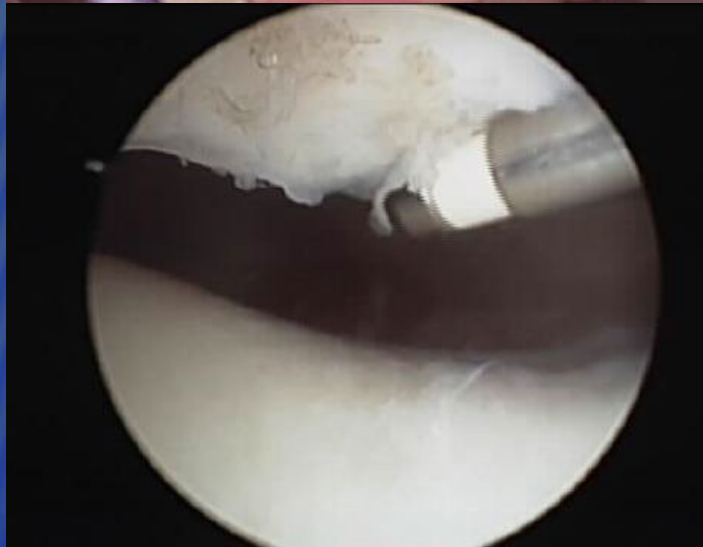
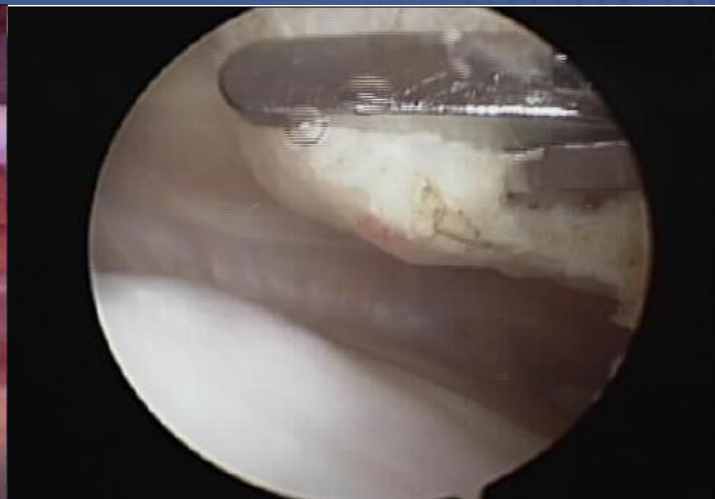


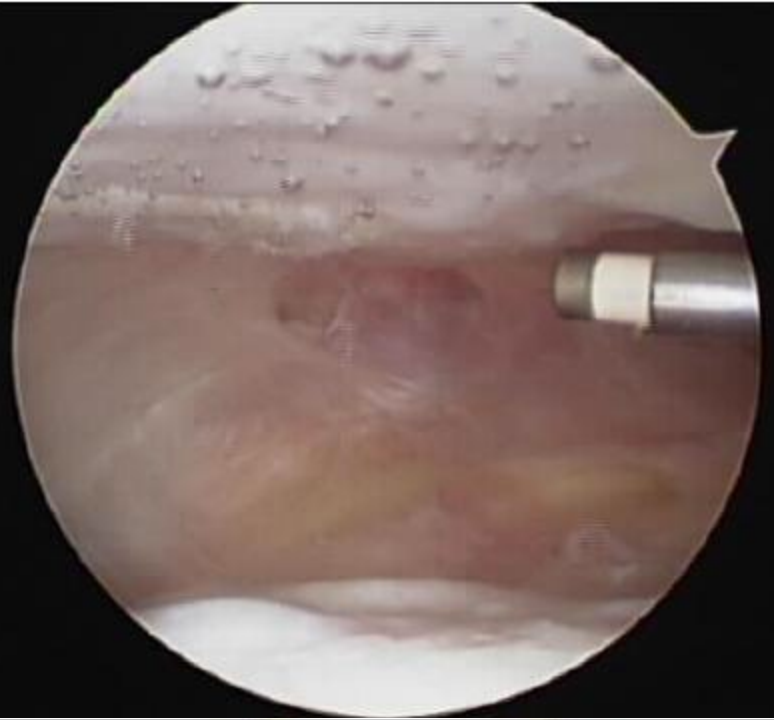


CARTICEL III ADHESIOLYSIS

- × This third stage is sometimes needed to break up adhesions that have formed.
- × The package insert cleared by the FDA says that adhesions develop in 8% of cases, though most major cases required at least one additional procedure after implantation.
- × In large defect/osteotomy cases, this third procedure allows inspection, fine tuning of the joint, and will be required more often.

J.B. CARTICEL III 6/7/05





R. THOMAS GROTZ, M.D., INC.

ORTHOPEDIC SURGERY
MICROSCOPY



× Clinical History:

- × 41 year old Hispanic Spanish-speaking right arm dominant female 5'5" 255 # female janitor slipped, fell, and impacted her left knee. Pain was described as 10/10. Despite conservative Rx, weight loss efforts, and two scope debridements by prior surgeons, persistent severe left knee pain, locking, clicking, giving way with a positive movie sign persisted.
- × PE: marked limp to left,
- × Left knee ROM was -18/98; Right 0-120. Left Tender medially, + McMurry's.
- × MRI mm tear, effusion, etc.



CARTICEL I PROCEDURE

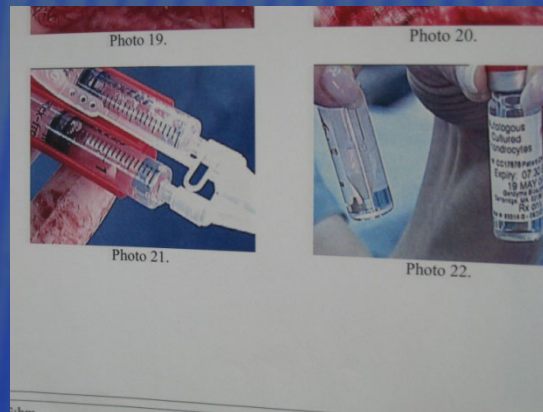
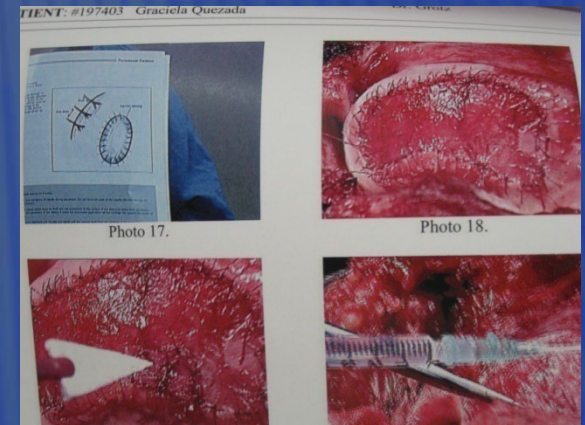
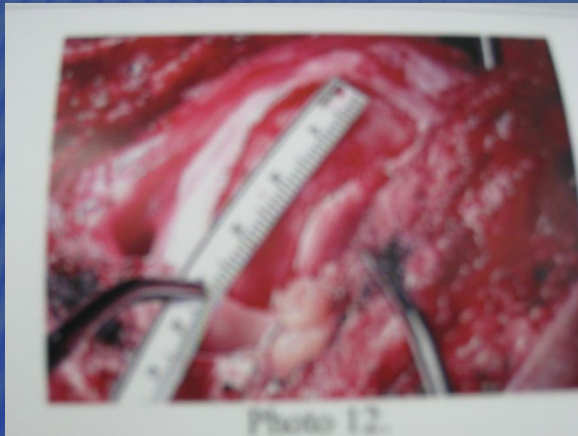
Left knee DA, debride, K wire drill, C I bx

Diagnosis: Osteochondral defect over the medial femoral condyle appeared 2x2 cm in size; minimal tibial plateau wear



CARTICEL II

MFC LESIONS MEASURED; PERIOSTEUM HARVESTED FROM TEMPLATE; SECURED WITH 6-0 VICRYL



CLOSURE WITH SEPRAFILM TO LIMIT ADHESIONS



Photo 23.



Photo 24.



Photo 25.

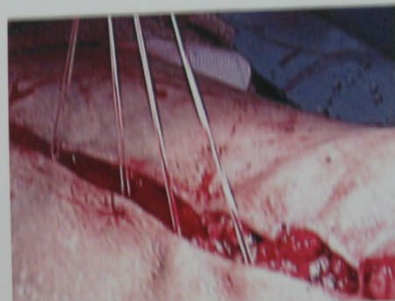


Photo 26.



Photo 27.

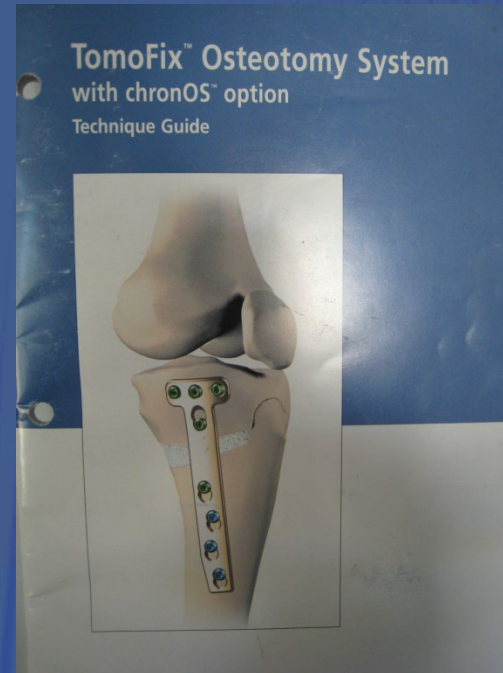
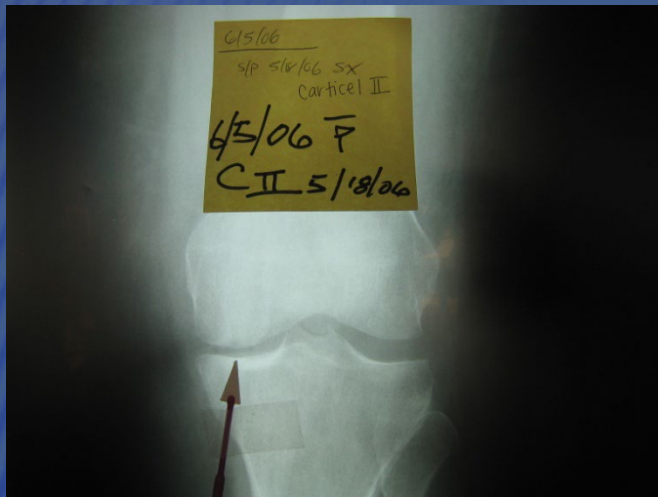


Photo 28.

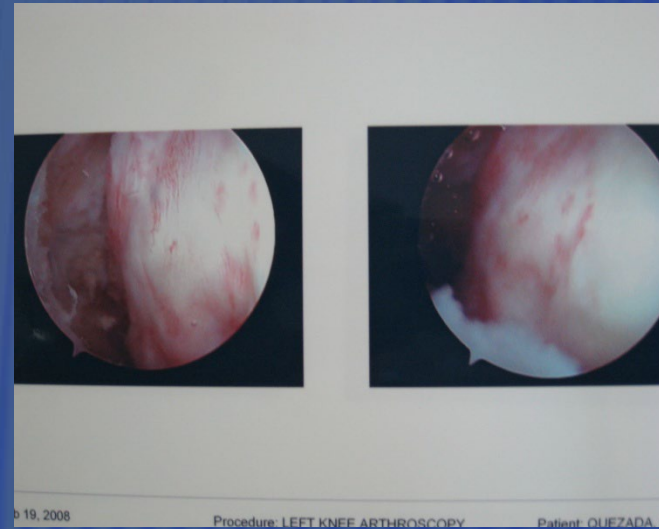
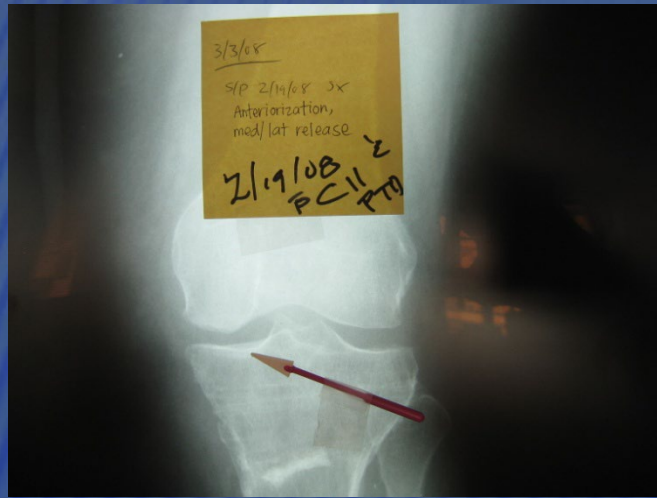


PTO WARRANTED TO UNWEIGHT MEDIAL COMPARTMENT

× Proximal Tibial Osteotomy (PTO)



CARTICEL III WITH IMPLANT REMOVAL



PATIENT DENIES ANY CURRENT KNEE PAIN, WALKS WITHOUT LIMP, ENJOYS INCREASED ROM, IS HAPPY AND HEALING



RESULTS

- × According to a study by Lars Peterson, M.D, Thomas Minus, M.D., in Clinical Orthopedics and Related Research, “Two to Nine Year Outcome After Autologous Chondrocyte Implantation to the Knee,” good to excellent clinical results were noted in the following cases: Isolated femoral condylar lesions 92%, multiple lesions 67%, osteochondritis desiccans 89%, patella 65%, and femoral condyle with anterior cruciate ligament repair 75%.
- × Dr. Thomas Minus, in an article entitled “Chondrocyte Implantation in the Repair of Chondral Lesions of the Knee: Economics and Quality of Life,” reported in the American Journal of Orthopedics, he stated that **quality of life was dramatically enhanced**, as measured by the short form, 36 physical component summary. The cost-benefit ratio, fairly considered, demonstrated that the procedure is merit-worthy. This conclusion is logical since it is essentially the only scientific way to restore a patient’s knee toward normal.

STAR STUDY - 1/30/08

PRESENTER: B. COLE, M.D.

154 patients:

- 68% single lesion; 32% multiple defects
- Average size defect: 4.64 cm²
- Average # operations pre-carticel II: 2.9

If patients make it the first 2 years, they will probably improve or stay the same thereafter.

Results:

- 76% success rate at 4 years of patients who failed prior operations.
- 49% had subsequent surgical procedures most commonly adhesiolysis.
- 66% get better after subsequent operation.

Conclusion:

- Prospective multicenter study validates Carticel.

Clinical Data RTG

Carticel I 10/22/96 to 3/13/08 185 biopsies taken

Carticel II 11/6/97 to 4/2/08 110 patients implanted

Carticel III 60 patients adhesiolyses/hardware removal



Osteotomies

Narrowing \leq 50%

Patellafemoral

Anteriorization

2-4 7.3 cannulated screws/washers

45/110 cases

Femorotibial

Proximal tibial osteotomy

synthes tomofix with ChronOS system

18/110 cases



OSTEOCHONDRAL DEFECTS

Number of lesions per joint:

Single lesion– 54 patients

Double lesion – 48 patients

Triple lesion– 10 patients

Size range of lesions: 2.5 to 38 cm² of joint surface covered

Average combined lesion size per knee joint: 9.86 cm²

Lesion location :

97 'on label'; femoral condyles/trochlea

13 'off label'; 9 retropatellar/4 tibial plateau



RTG CLINICAL ACI RESULTS

82% success with 3-4 year follow-up

54% required Carticel III

75% improved further after CIII

5 patients went on to TKA

3 patients required hemiarthroplasty, allowing retention of cruciates/PF joint

3 patients required bilateral knee Carticel procedures

Most patients were happy with less pain, improved function, and would have the procedure again



CONCLUSION

- ✘ Autologous chondrocyte implantation offers a viable alternative to joint replacement arthroplasties, for patients with substantial articular surface damage.
- ✘ Thank you

