

The Effect of Osteochondral Plug Graft Angulation on Articular Contact Pressure

Jason Koh, MD*

Adam Kowalski, BS⁺

Eugene Lautenschlager, PhD*

ACL Study Group

Sardinia, Italy, 2004



*Northwestern University, Chicago IL

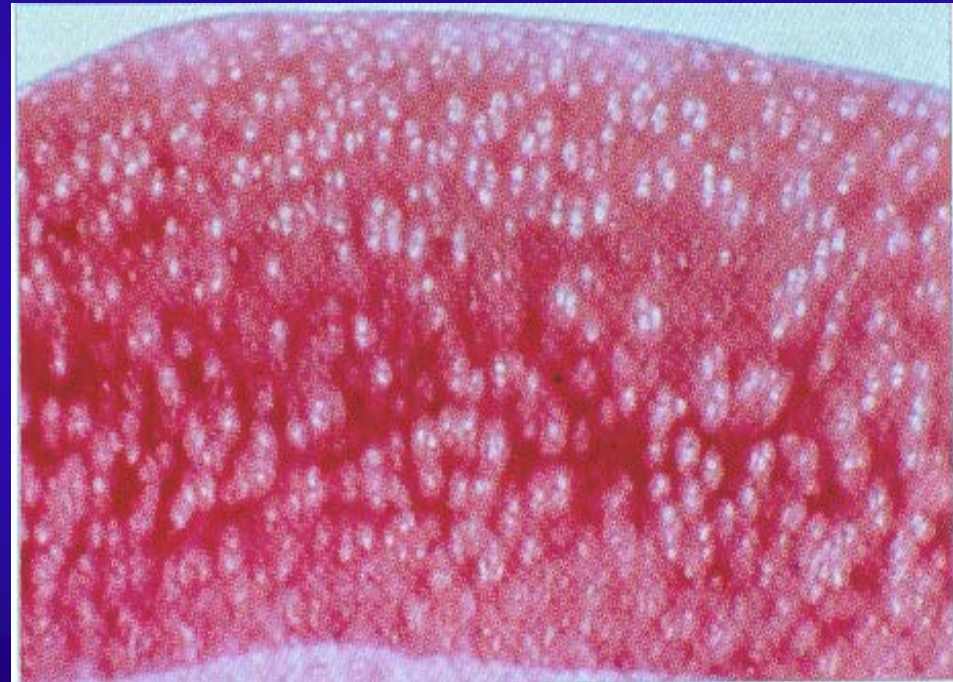
⁺Indiana University, Indianapolis, IN

Osteochondral Transplantation



Theoretical advantages: Biological

- Intact “ORGAN” that duplicates complex multilayer composition
- May duplicate normal biomechanical role
- Rapid healing and incorporation of bone



Theoretical advantages: Technical

- **One operation**
- **Small/arthroscopic incisions**
- **available tissue**
- **straightforward technique**
- **Technology available and not prohibitively expensive**

Potential technical difficulties

- adequate filling of defect
- appropriate graft congruity
- matching of donor to graft



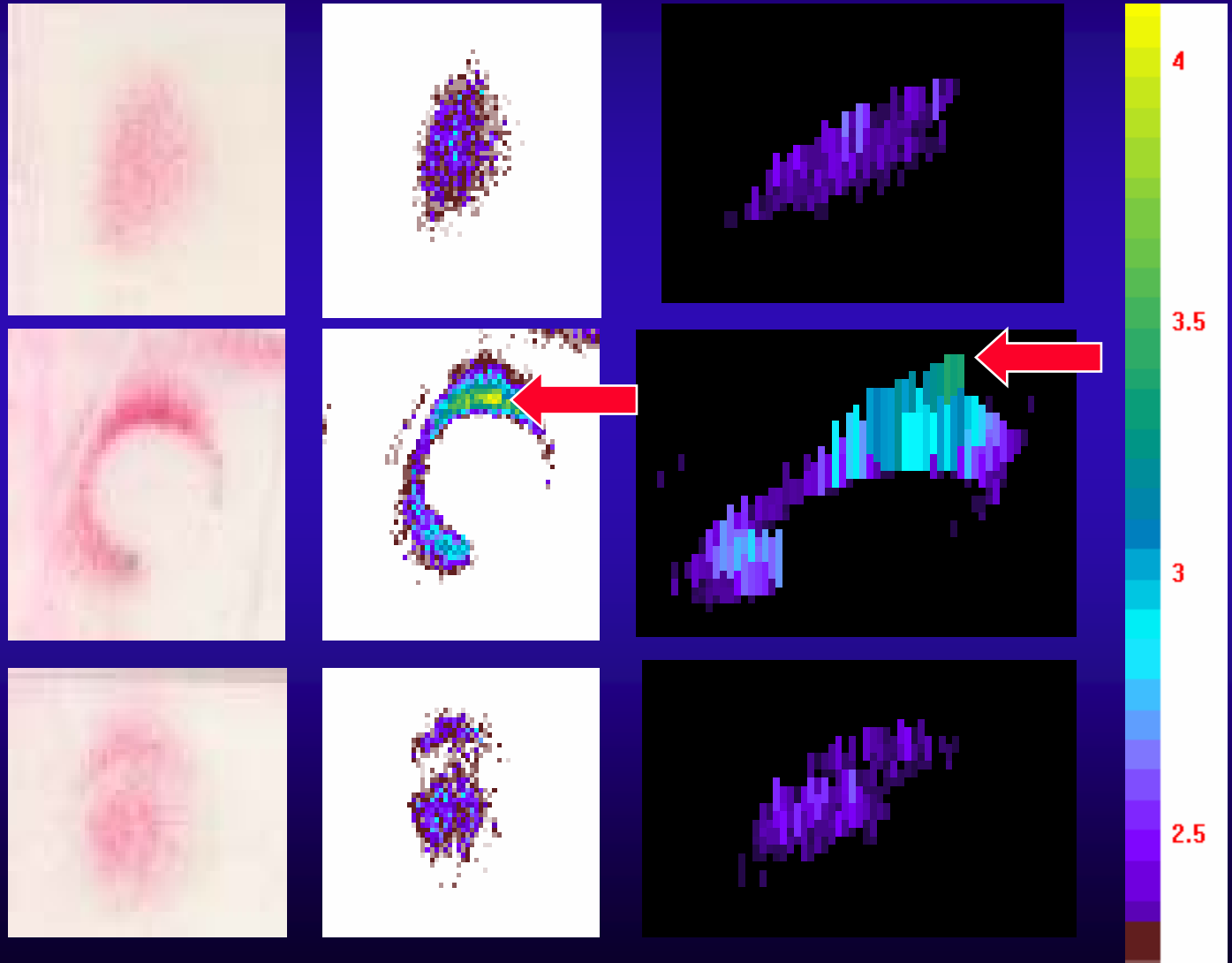
(Image courtesy of Vladimir Bobic)

Osteochondral grafting

- **common technique for treatment of articular cartilage defects**
- **Few biomechanical studies**
- **Flush, single plug graft has normal stiffness (Koh et al, ORS 2001)**
- **recreates normal contact pressure measurements (Koh, et al., ORS 2001, AANA 2001)**

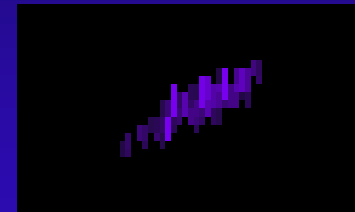
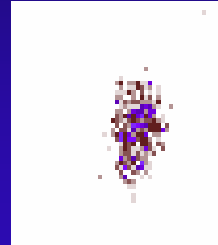
Contact pressure measurements of flush single plug graft

- Intact cartilage
- 6.5mm defect
- 6.5mm graft

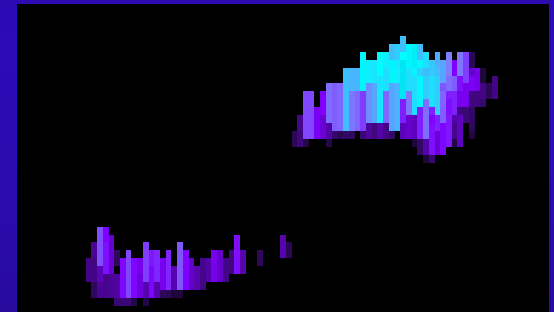


Contact pressure after 3-plug repair

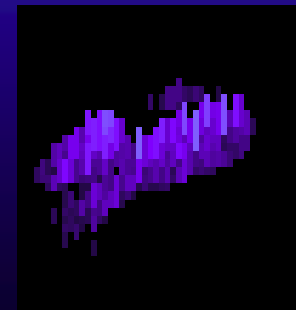
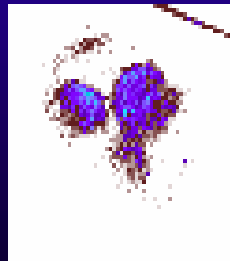
- Intact cartilage



- 10mm defect

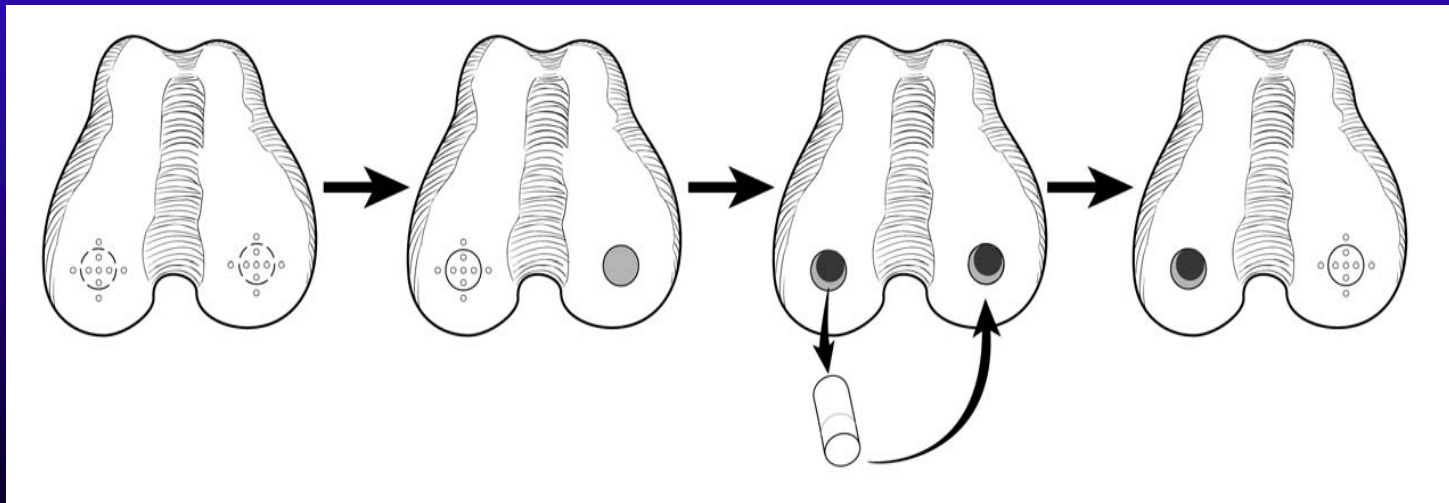


- 4.5mm plugs



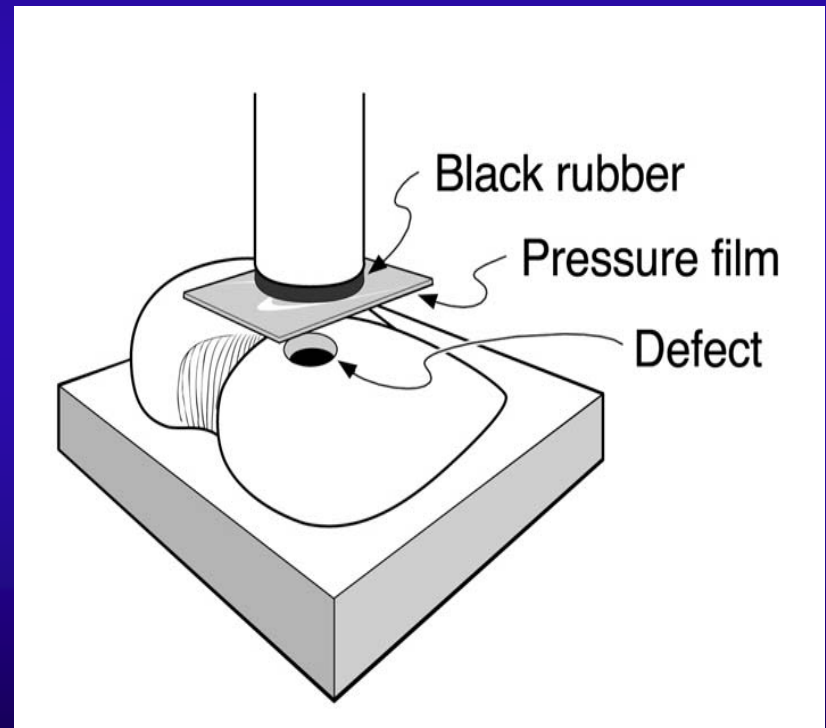
Biomechanical evaluation

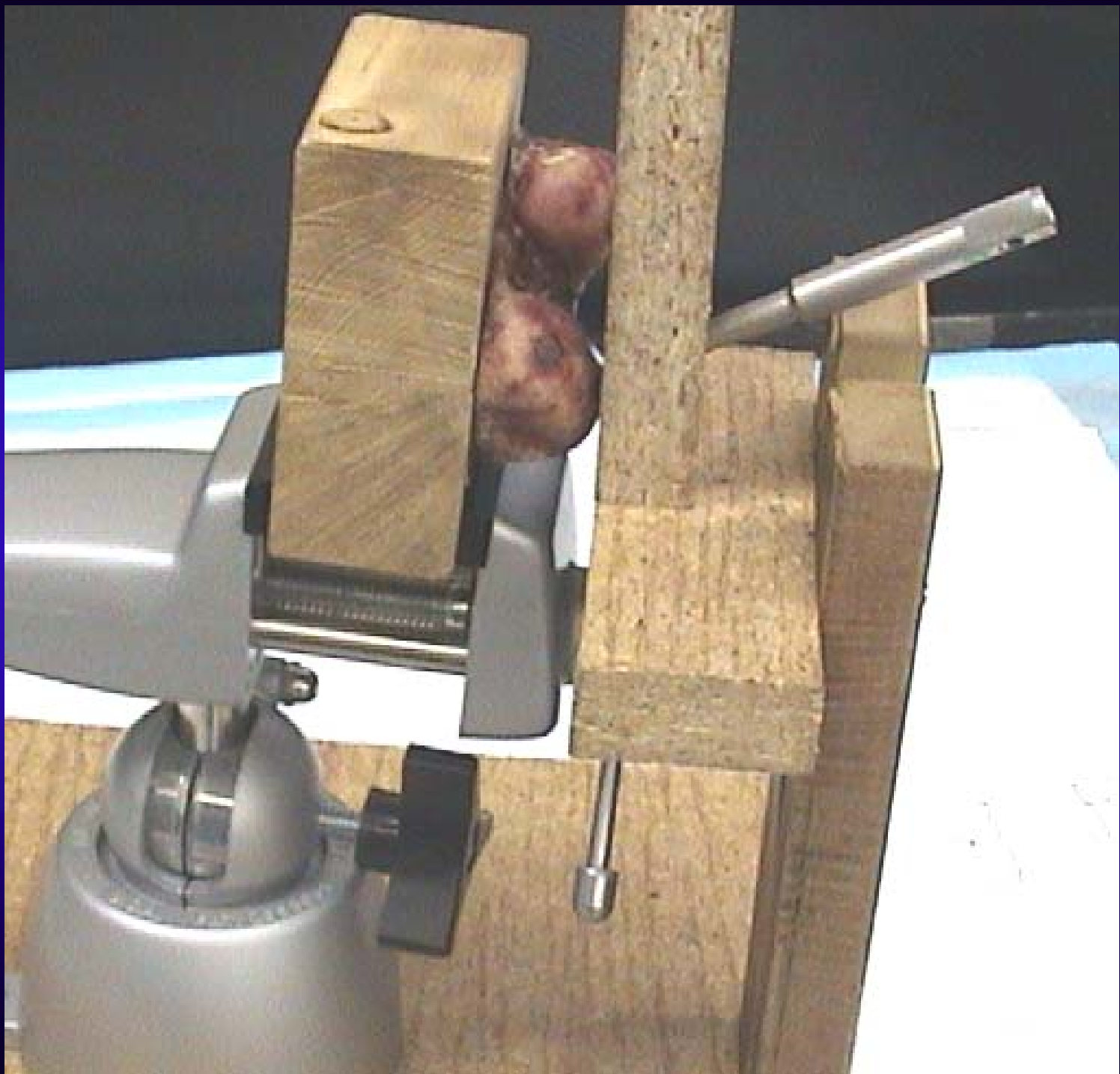
- 1) intact articular cartilage of the femoral condyle
- 2) condyle with a full thickness articular cartilage defect
- 3) condyle with an osteochondral autograft transplanted into the defect – flush
- 4) angled graft-elevated edge
- 5) angled graft-sunk edge



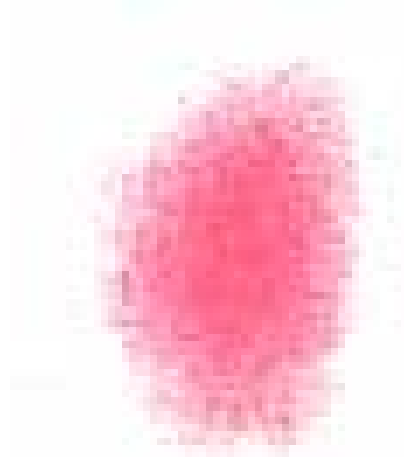
Contact pressure testing

- Porcine specimens mounted on MTS
- load 80N for 120 s against Fuji pressure sensitive film
 - 1) intact
 - 2) with defect
 - 3) with graft
- Scanned/digitally analyzed





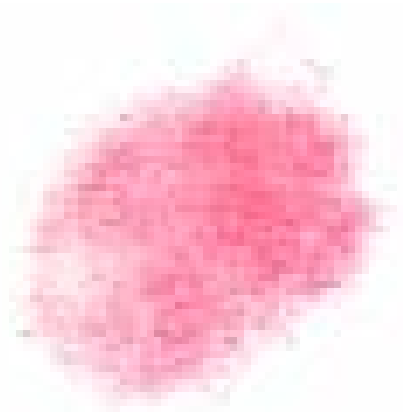




intact



defect



flush

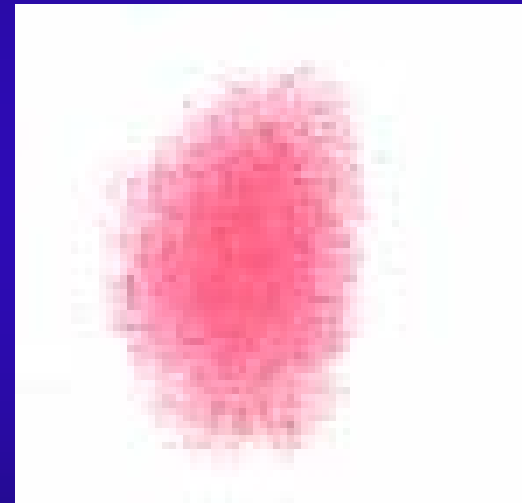


Elevated-
angled



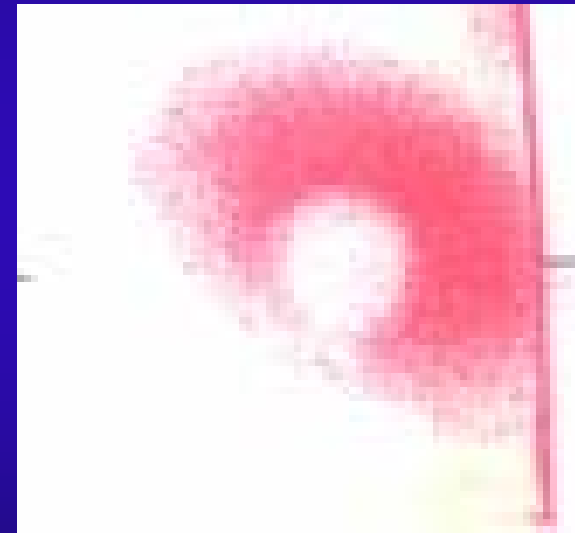
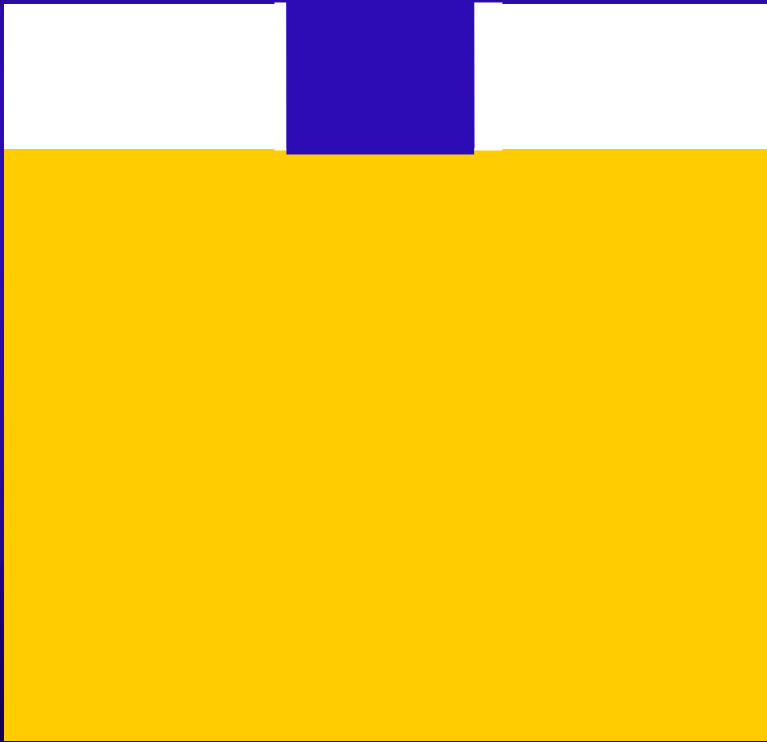
Sunk-angled

Intact cartilage



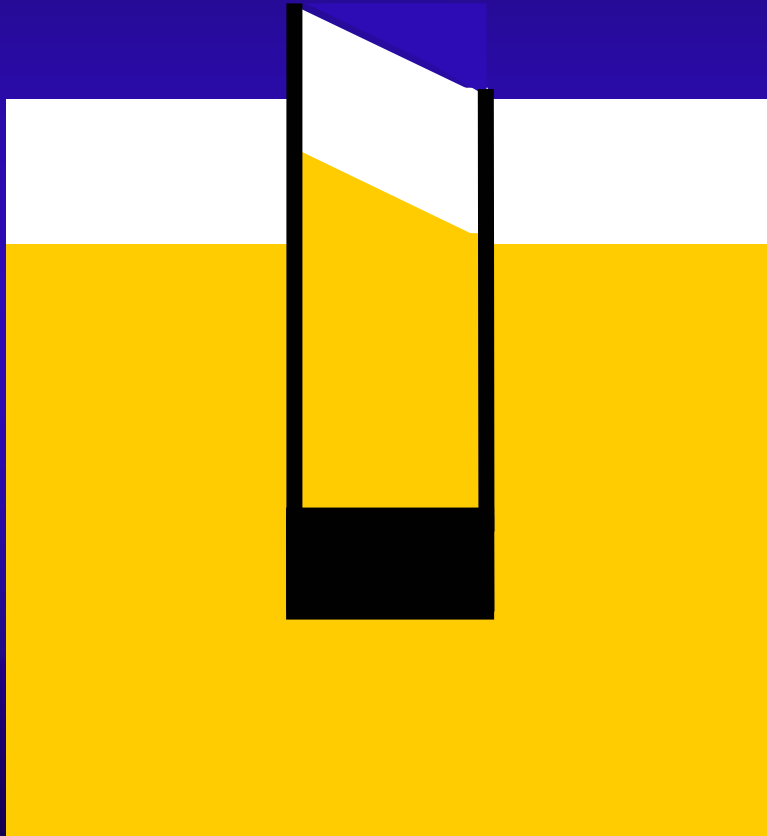
**Mean peak contact pressure
= 8.57 kg/cm²**

Defect



Mean peak contact pressure
= 12.0 kg/cm²
*** p < 0.01**

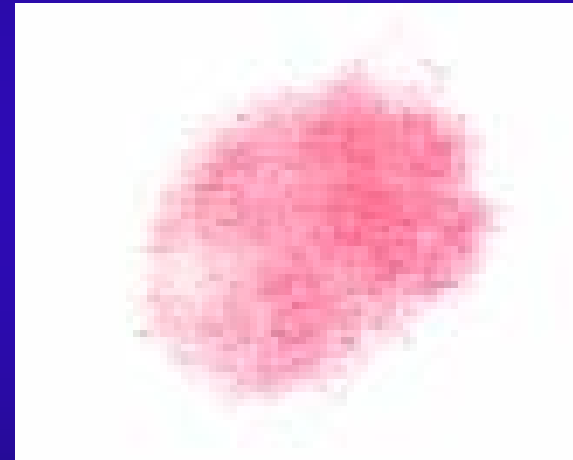
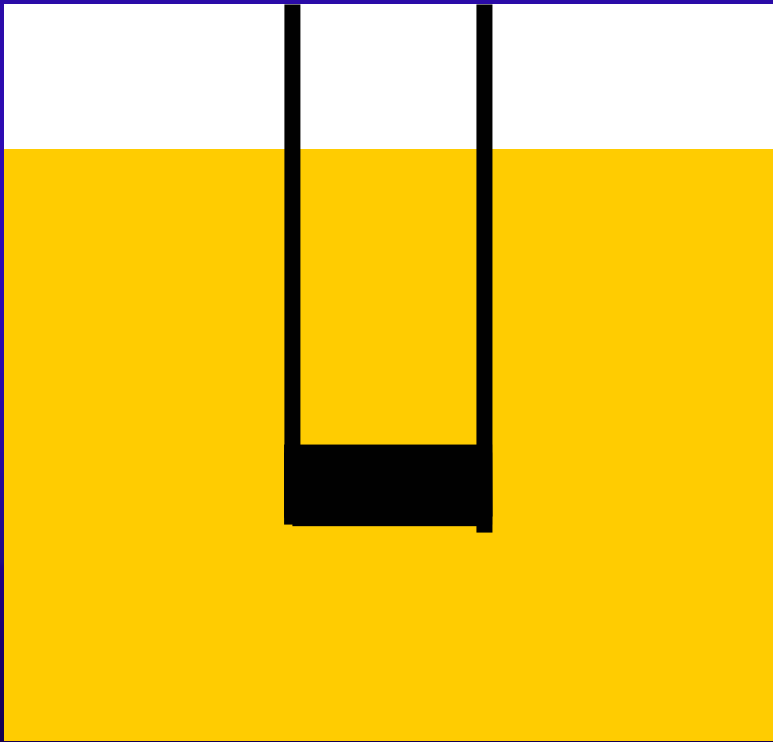
Elevated-angled graft



Mean peak contact pressure
= 14.50 kg/cm²

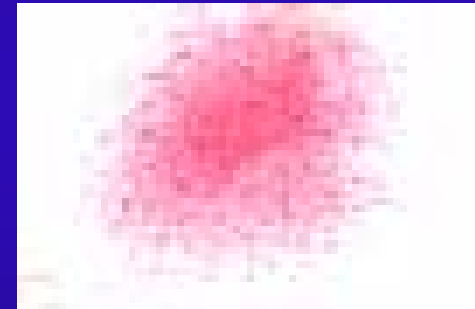
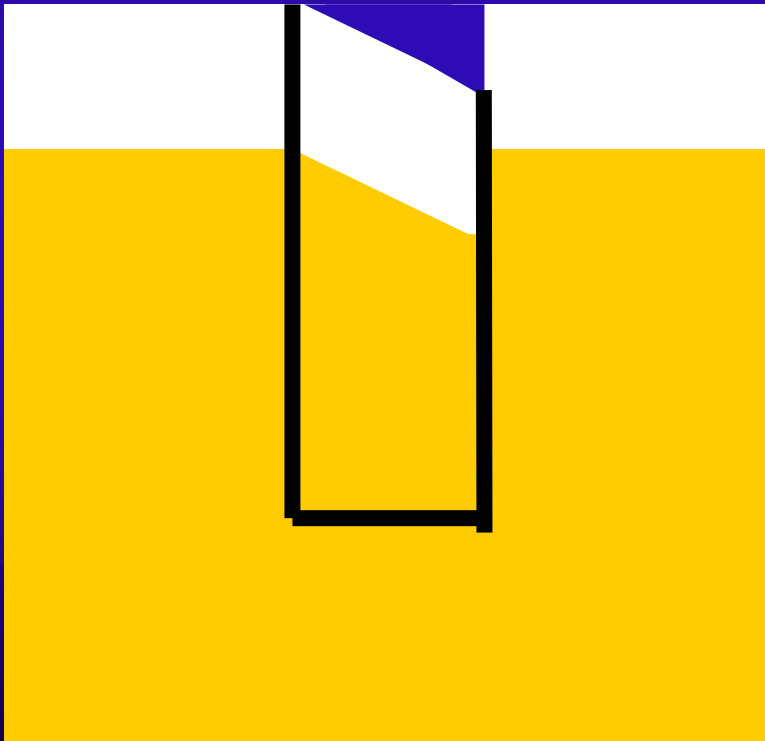
* $p < 0.01$

Flush graft



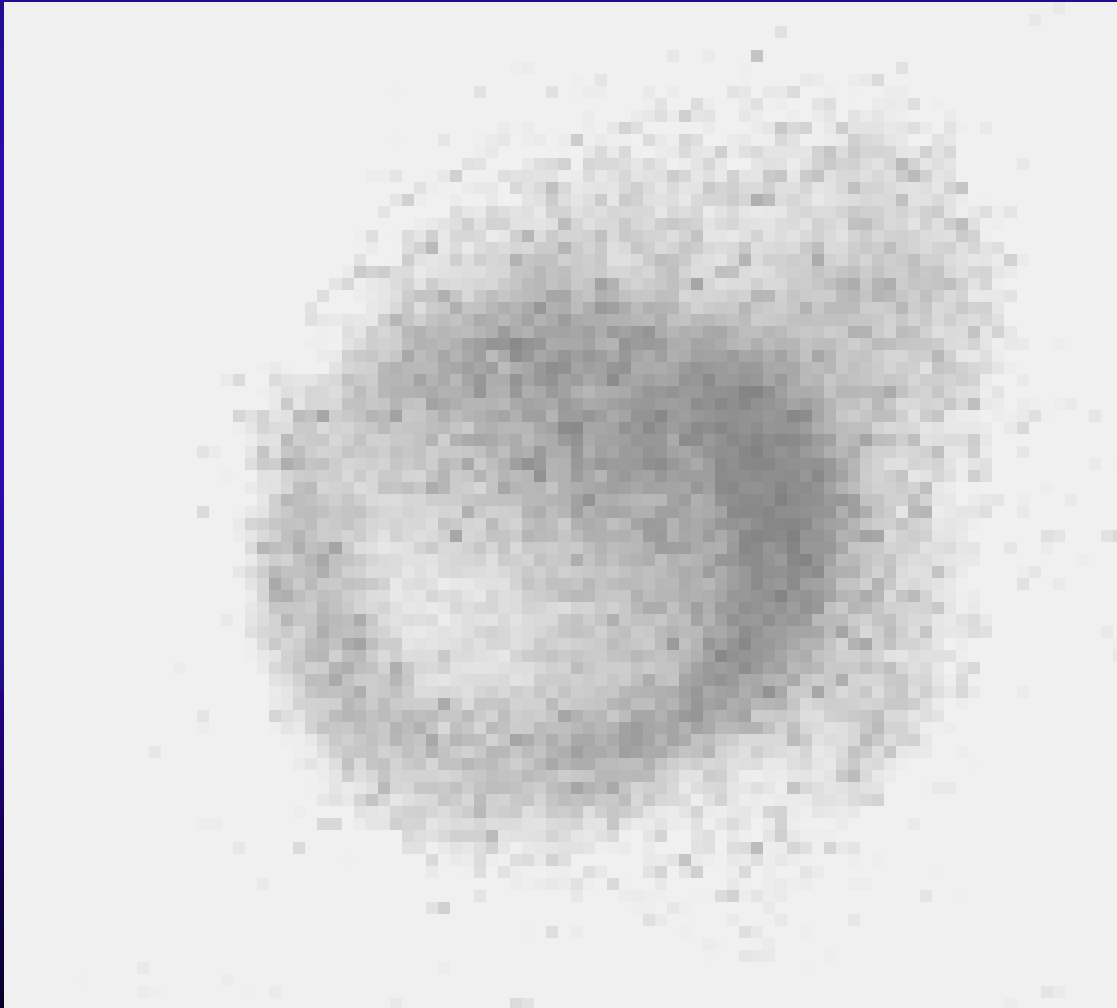
Mean peak contact pressure
= 9.81 kg/cm²
* p < 0.01

Sunk-angled graft

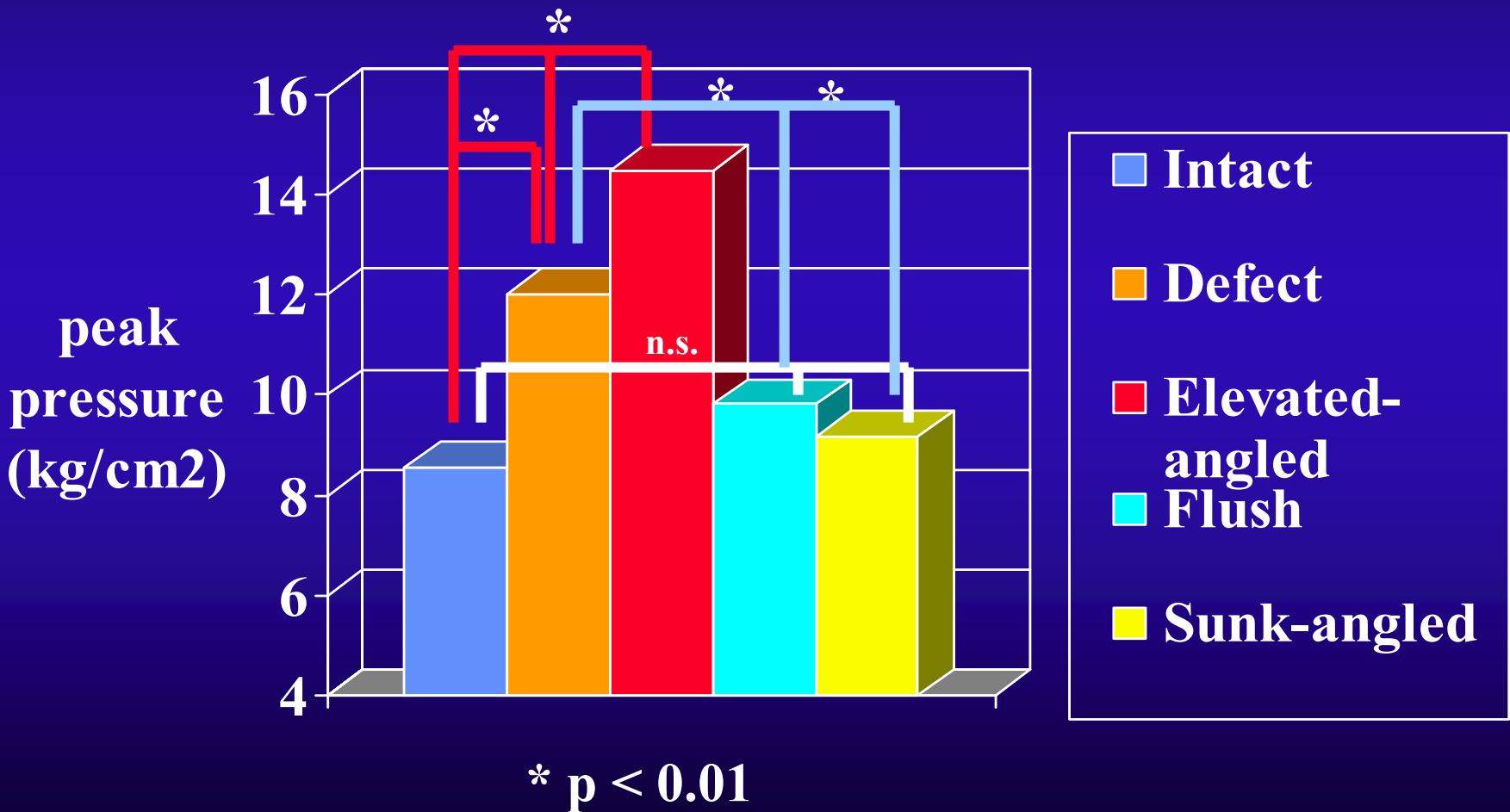


Mean peak contact pressure
= 9.15 kg/cm²
* p < 0.01

Peak pressure gradient - sunk



Peak pressures



Discussion

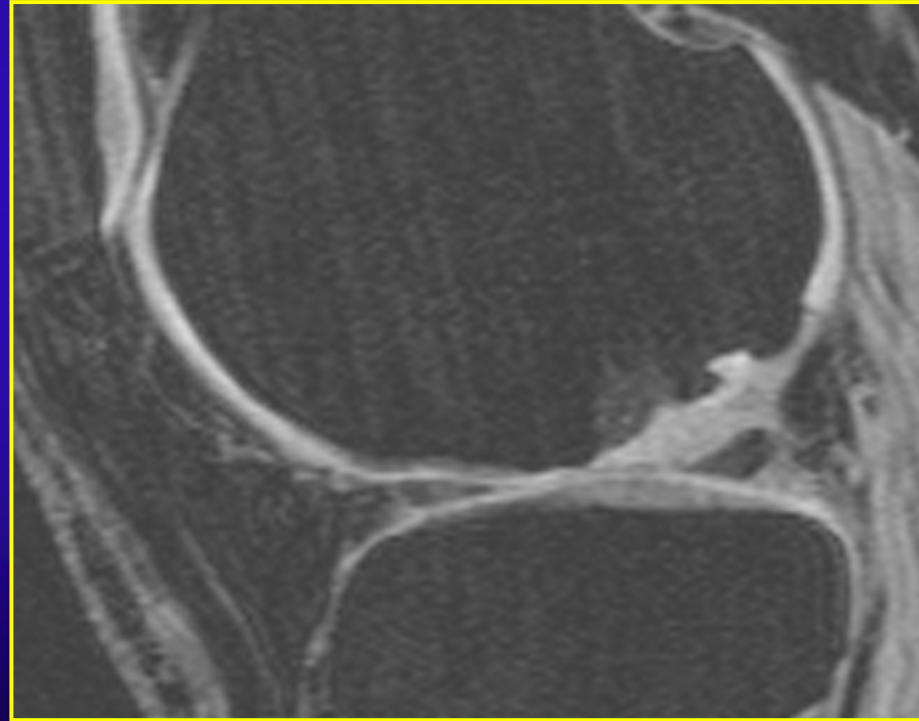
- **Articular surface congruity may be difficult**
- **Unclear how to implant angled graft**
- **Initially more favorable contact pressure when edge of graft is not elevated**
- **May be some role for remodeling/repair tissue**

Remodeling to Congruent Surface

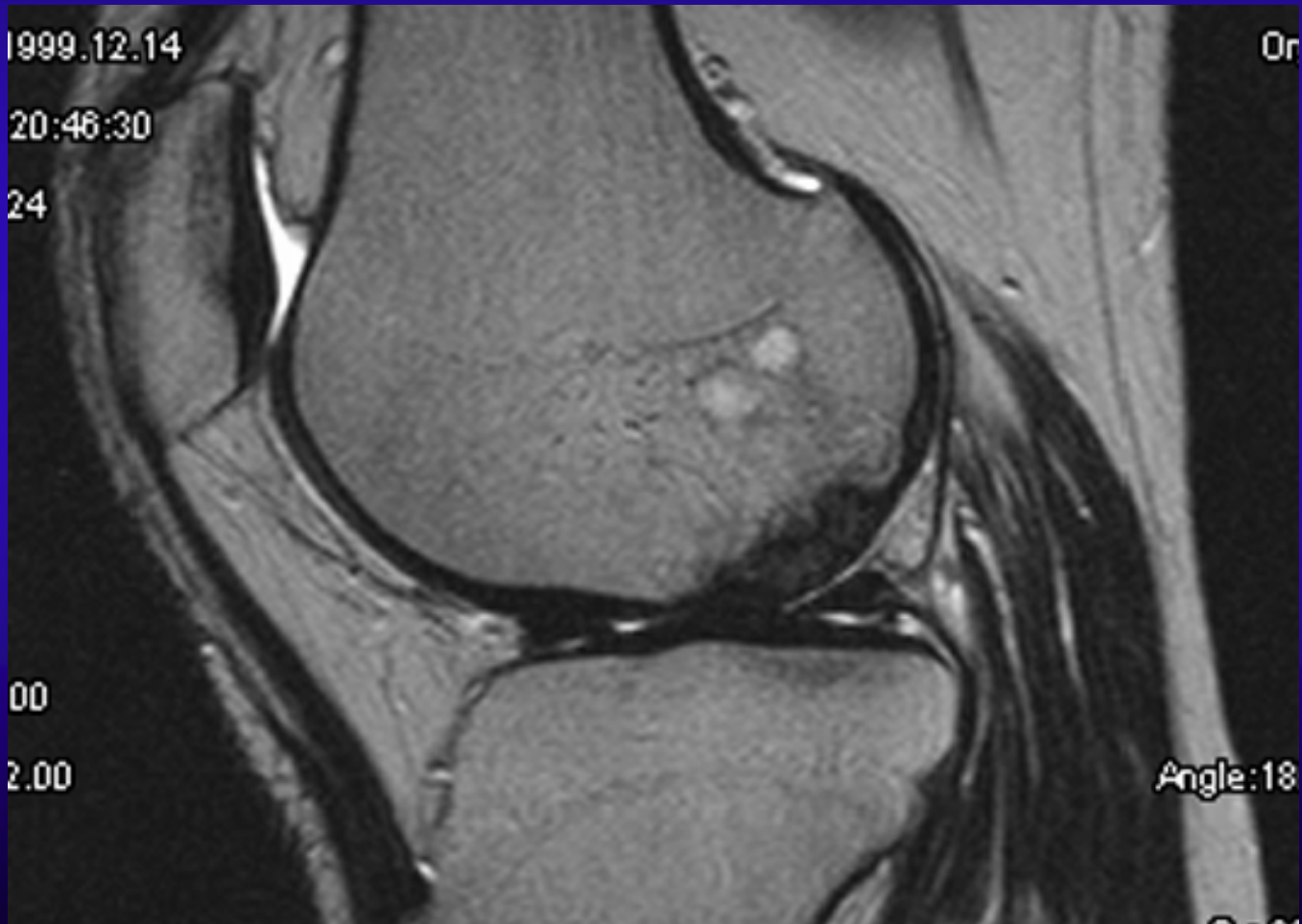
- 3 months postop



- 2 years postop



Remodeling of countersunk plugs



Conclusions

- **articular surface congruity important**
- **Recommend use of a tamp wider than the defect to achieve conformity**
- **If graft is not level, make highest point flush with surrounding cartilage**



GRAZIE!

