

Articular Cartilage Injury

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I have something to disclose

**All relevant financial relationships
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Limb Alignment

Significance:

- Limb alignment is the MOST important factor to consider in lower limb reconstructive surgery
- We as surgeons** need to hear this repeatedly!

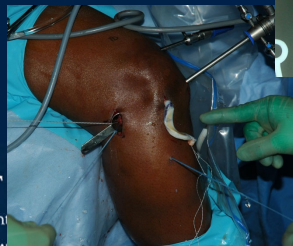
Think HTO



3

iBalance HTO Easily Combined with

- OCA
- MAT
- ACLR
- ALL as outpatient surgery



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iBalance HTO Solution



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Game Changer

Sta



"Invisible" PEEK iBalance, OsFeron, ACP



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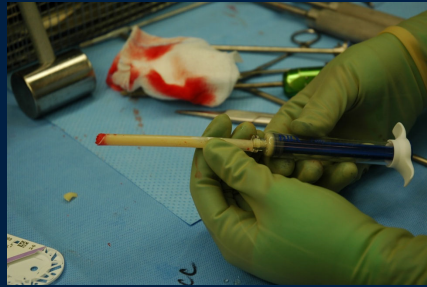


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HTO Grafting



OsFeron, B-TCP



7

Osferion Highlights

- **Strength** – Superior resistance to compression
- **Controlled Porosity** – Allows for cell communication and osteoconductivity
- **Convenient Packaging** – One wedge per pack allows user to customize the amount needed
- **Safety** – β -TCP is the inorganic bone component
- **Controlled Absorption** – Replaced ~ 12-18 m
- **Handling** – Easily trimmed to size using a rongeur



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High Tibial Osteotomy (HTO) with iBalance, Osferion and ACP

Clinical Trial Examining
Efficacy of Early versus
Delayed (6 wk) Weight
Bearing following HTO
with iBalance, Osferion,
and ACP



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Block Randomization: 2 Treatment Arms

GROUP I

- TOE TOUCH
WEIGHT
BEARING FOR 6
WEEKS

GROUP II

- WEIGHT BEARING
AS TOLERATED
- *off daytime
narcotics, pain less
than 3/10*



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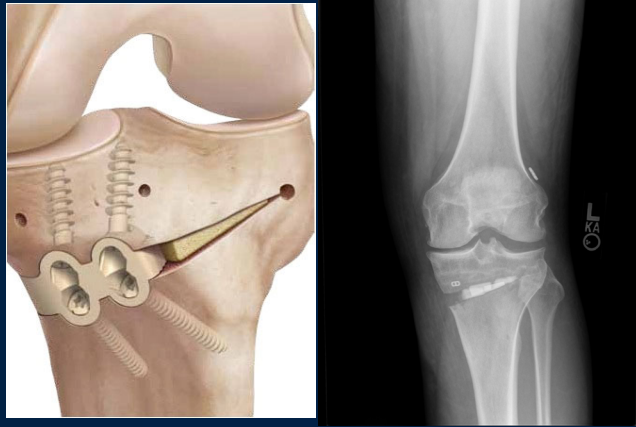


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Does HTO with the iBalance fixation system correct alignment?



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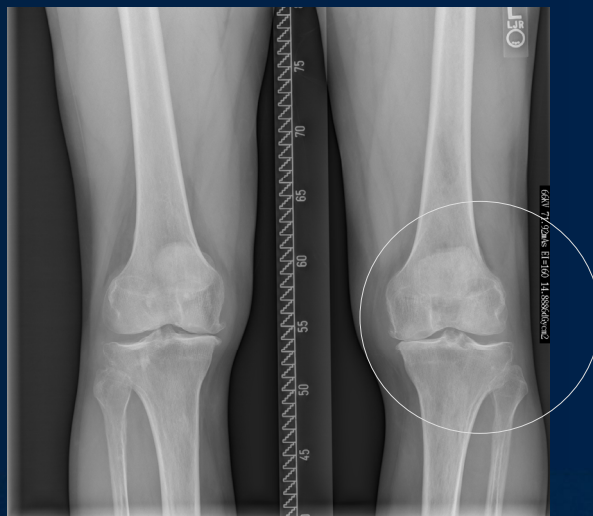
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Pre-Op Rosenberg



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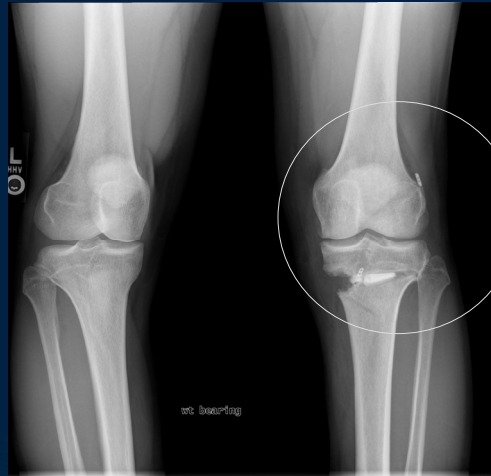


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12 weeks Post Op



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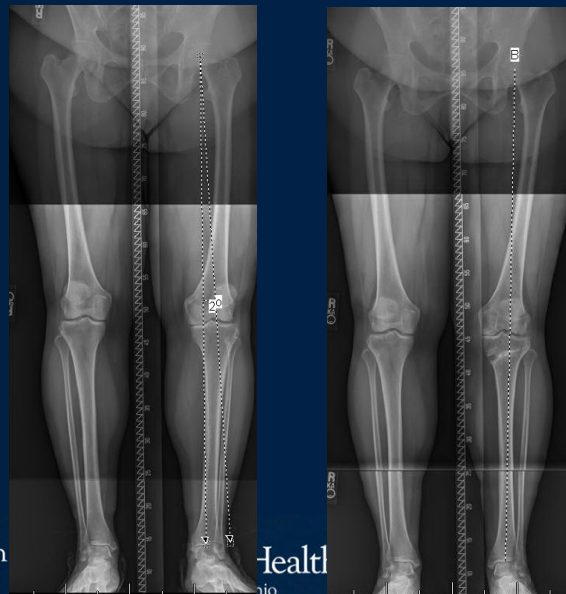
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Pre-Op

6 months post



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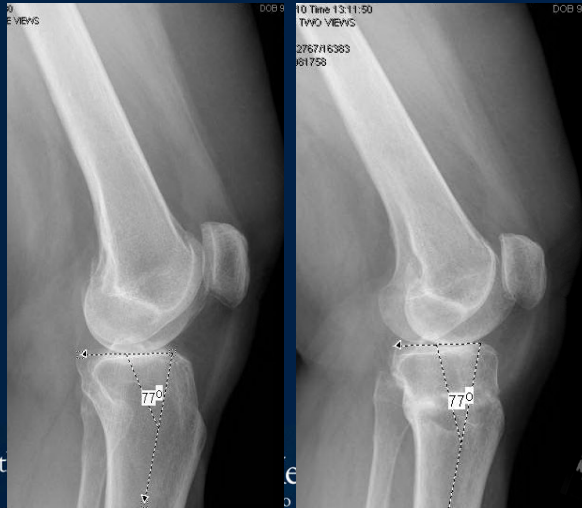
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Maintenance of Tibial Slope

Pre-Op

6 months post



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Will a minimally invasive approach lead to less morbidity postoperatively?



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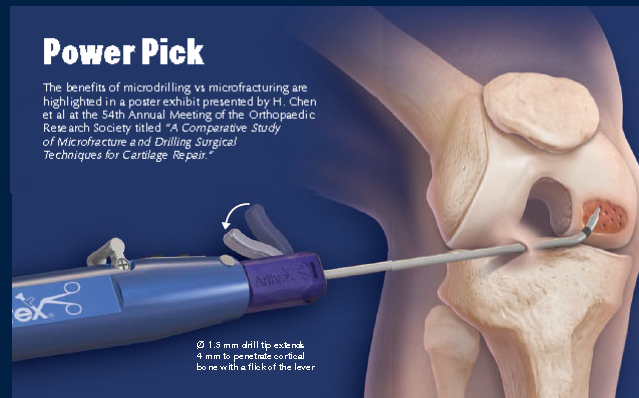


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PowerPick (aka Microfracture)



17

Primary Uses

- Microfracture
- ACL Femoral Tunnel locator

Features

- Unique Device
- Reduces surgical time
- Recommended speed = 6,000 rpm
- Outer tube pulls back
- Drilling better than Picking
- No thermal necrosis

PowerPick

1.5 mm x 30"

1.5 mm x 45"



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PowerPick Video



Microfracture
of an OCD
Lesion



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PowerPick cont.

Drill Depth = 4 mm

Note: articular cartilage "gone"

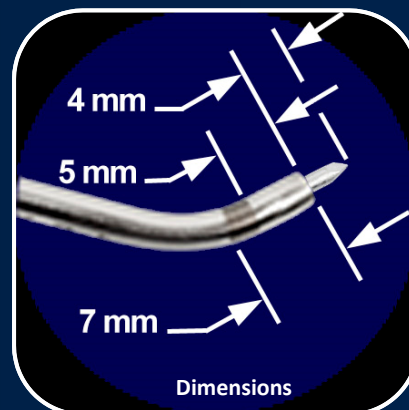
ACL Femoral Tunnel Position

Laser Mark Width = 2 mm

5mm and 7mm reference

Use back of mark

• 7 mm from "over the top"



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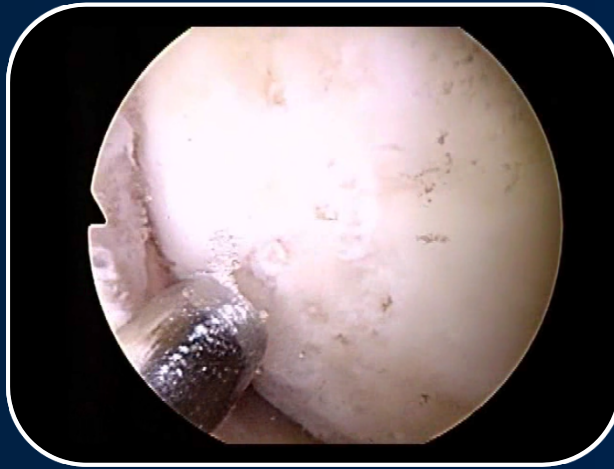


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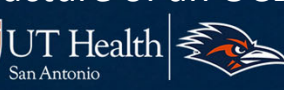
PowerPick Video



Microfracture of an OCD Lesion



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Historical: Fresh OCA

- Described nearly 100 years ago by Erich Lexer in 1908
- Pioneering work by Dr. Alan Gross and Marvin Meyers in the 1970s has led to greater understanding
 - Indications
 - Outcomes
 - Basic science



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Rationale

- Essentially transplantation of the intact organ--hyaline articular cartilage—into damaged area of the joint
- Mature cartilage surface is transplanted along with a thin layer of supporting subchondral bone 3 to 10 mm thick



23

Rationale

- Only requires a healing of host to allograft bone through allograft bone incorporation (creeping substitution)
- Success of a fresh osteochondral allograft is predicated on the survival of viable chondrocytes to maintain the cartilage matrix in concert with the appropriate host-allograft bone interaction



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Why Not Frozen?

- Chondrocyte survival is dramatically diminished after freezing, despite various cryopreservation techniques
- Fresh allografts have consistently shown superior chondrocyte viability
- **Favor fresh tissue**, despite the greater difficulties surrounding the availability, procurement, and use of fresh graft material



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Fresh OC Allograft

Characterized as a composite

- Nonliving structural bone (replaced over time by the host bone)

AND

- Living articular cartilage (nourished by the host synovial fluid)



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Indications

- Physically active
- Failed standard medical and surgical treatments
- Not a suitable candidate for TKR
- ABSENCE of ALL, but not limited to:
 - Steroid-induced osteonecrosis
 - Inflammatory or advanced DJD
 - Uncorrected instability or malalignment
 - Noncompliance with an extended period of non-weight-bearing and physical therapy



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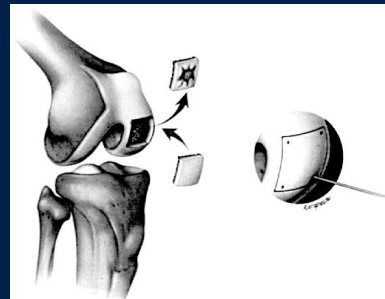


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Other Options

- UKR
- Osteotomy alone
- Autograft OATS
- Autologous Chondrocyte Implantation (ACI)
- Microfx
- Chondroplasty/debridement



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Immunogenicity

- Intact hyaline cartilage is considered relatively *immunopriveleged*
- Fresh allograft bone does generate a measurable immune response, but removing marrow elements prior to transplantation theoretically decreases the immunogenicity
- Immunology of fresh osteochondral allografts is not considered clinically important, and no attempt is made to match donor and recipient for immunologic parameters



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Fresh Osteochondral Allografts

- 126 knees ('72-'92), 111 trauma, 15 O.D.
- 81 males, 42 females, age 35 (15-64)
- Plateaus-63; condyles-50; bipolar-8; PF-2
- Success: 95% @ 5, 71% @ 10, 66% @ 20
- 18 failures; arthrodesis-1; TKR-8; decreased score-9
- Stressed importance of *osteotomies*



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Gross AE, AAOS 65th Annual Meeting, 1998

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Fresh Osteochondral Allograft Transplantation

- Effective treatment option with promising long-term clinical outcomes for focal posttraumatic defects in the knee for young, active individuals
- Histologic features of 35 fresh osteochondral allograft specimens retrieved at the time of subsequent graft revision, osteotomy, or TKA
- **Graft survival time ranged from 1 to 25 years** based on their time to reoperation



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Gross, et al. Fresh osteochondral allografts for posttraumatic knee defects: long-term followup . Clin Orthop Relat Res. 2008 Aug;466(8):1863-70

31

Fresh Osteochondral Allograft Transplantation

- Histologic features associated with long-term allograft survival: viable chondrocytes, functional preservation of matrix, complete replacement of the graft bone with the host bone
- Long-term allograft survival depends on graft stability by rigid fixation of host bone to graft bone
- With the stable osseous graft base, the hyaline cartilage portion of the allograft can survive and function for 25 years or more



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Postop Rehab

- Continuous passive motion
- Active exercise and early restoration of range of motion are encouraged
- Non-weightbearing usually for 6 weeks
- Sports allowed at 6 months with radiographs documenting incorporation of the allograft



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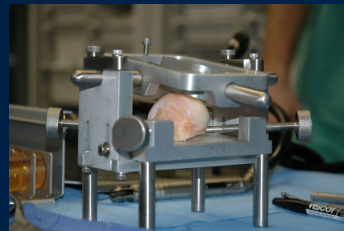
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Technique



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Technique



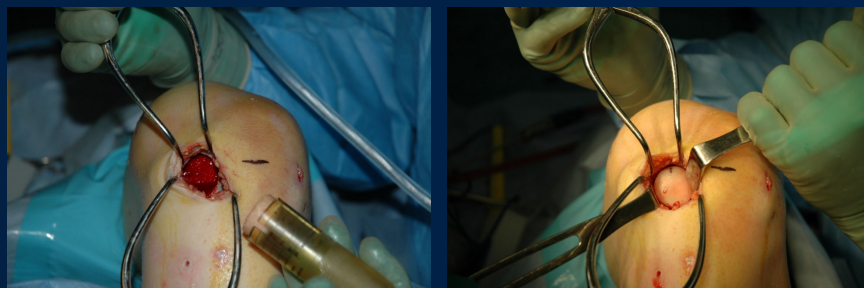
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Technique



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Conclusions

- Clinical outcomes and basic scientific investigations have supported the theoretic basis for this procedure
- Experience encourages this procedure as a primary treatment for both large and small articular cartilage defects in the young knee
- Success rate of fresh osteochondral allografting compares favorably with other cartilage repair and resurfacing techniques
- Failure of osteochondral allografts has been rare



37

Conclusions

- Fresh osteochondral allografting also appears to be effective in treating larger osteochondral lesions, where there are few other attractive alternatives
- Fresh osteochondral allografts can thus be used to treat a wide spectrum of articular pathology
- Technical refinements, and improvement in our understanding of graft-host interaction, as well as chondrocyte biology, should continue to improve clinical results



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OC Allografts: Final Thoughts

- Relative paucity of donor tissue
- Complexities in procurement and handling
- Possibility of disease transmission
- In the future, as tissue banking and cartilage storage technology advance, fresh allograft tissue may become more available, allowing more widespread use of fresh osteochondral allografting



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Case Example, Mini-open



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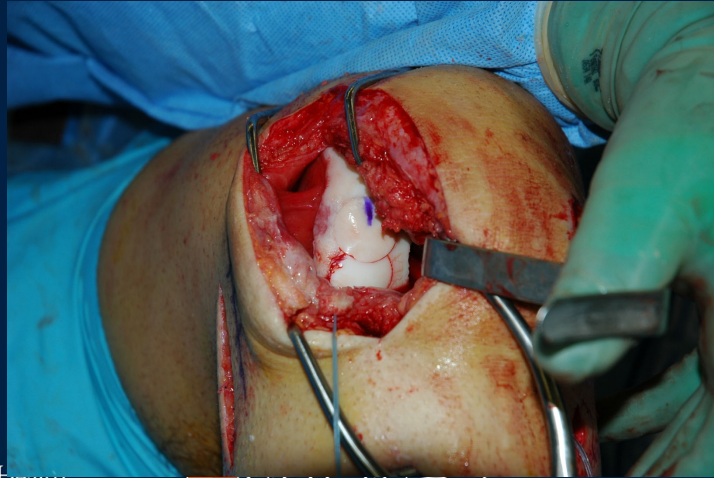


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Another Case: Not Miniopen “Snowman Grafts”



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A'scopic MFC OCA w/ Medial MAT Prior Staged HTO



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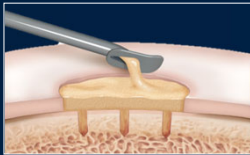


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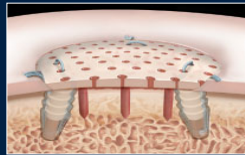
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Cartilage Restoration Algorithm



BioCartilage
Small, Contained Lesions



Cartiform
Small to Large Lesions
Minimal Subchondral Bone Loss



Fresh Allografts
Small to Large Lesions
Compromised Subchondral Bone



BioUni Instrumentation



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Joint Preservation Solutions

OATS

BioUni Instrumentation

BioCartilage

Cartiform

Fresh Precut

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Fresh Precut

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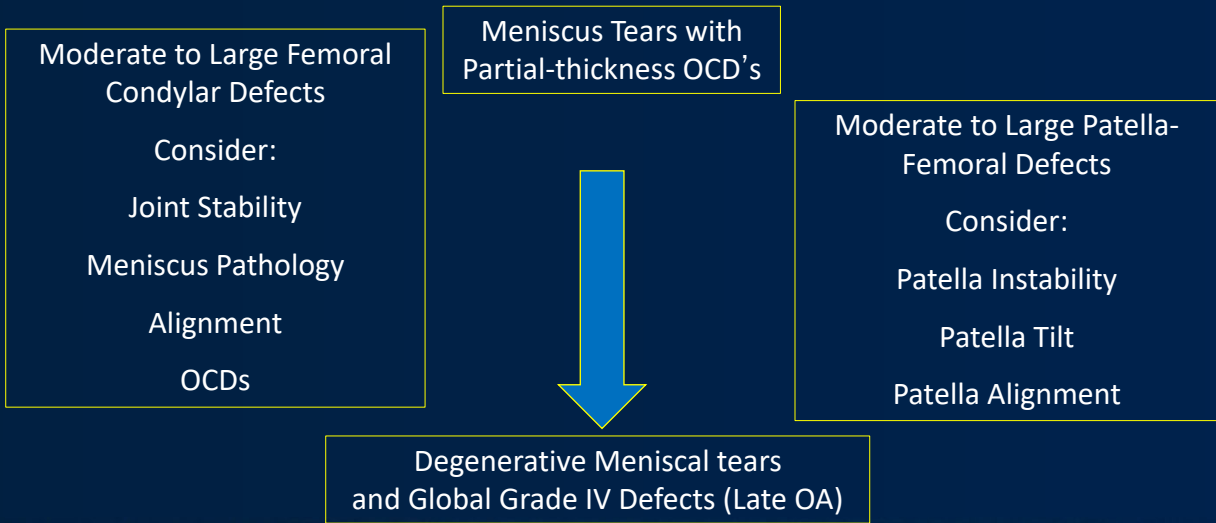
Algorithm Thoughts

- **Alignment**
 - Single Compartment
 - Dual Compartment
 - HTO
 - DFO
 - AMZ
- **Meniscal Problems**
 - Meniscal Repair
 - All inside
 - Inside-Out
 - Outside-In
 - Root Repair
 - Meniscal Transplant
- **Small Defect**
 - MicroFracture+
 - BioCartilage
- **Large Defect**
 - MicroFracture+
 - Cartiform
 - OATS
 - BioUni



45

Cartilage Disease Spectrum

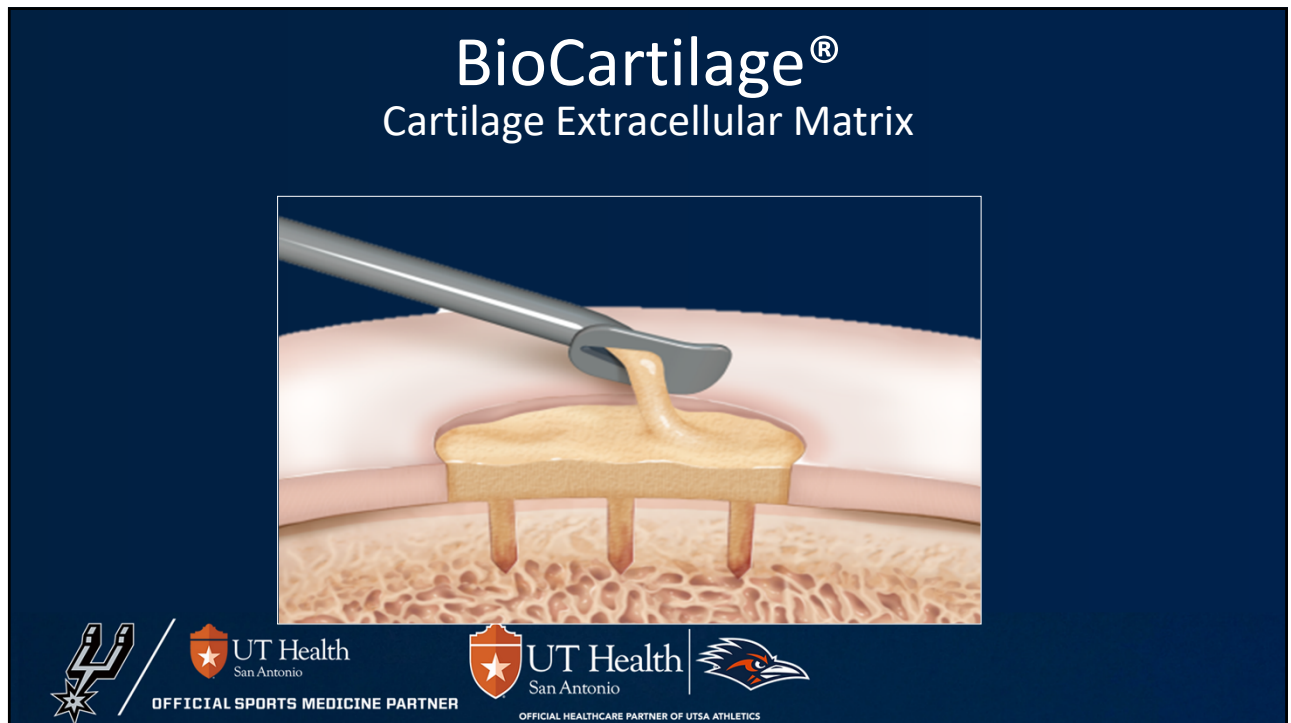


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BioCartilage®

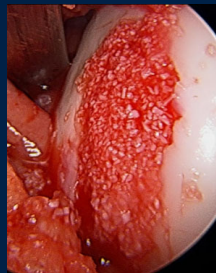
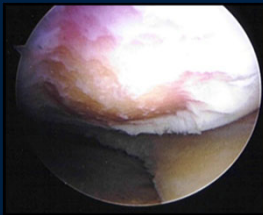
Cartilage Extracellular Matrix

- What is BioCartilage?
 - Allograft cartilage extracellular matrix (ECM)
 - Type II collagen, cartilaginous growth factors
- How is BioCartilage recovered?
 - Cartilage is dehydrated then particulated
 - Final particle size 100-300 microns
 - Aseptically packaged, ambient temperature storage, 5 year shelf-life
- How is BioCartilage intended to be used?
 - Provide a scaffold to repair site
 - Improve the tissue quality formed after utilizing a bone marrow stimulation technique



49

Cartilage Restoration Options

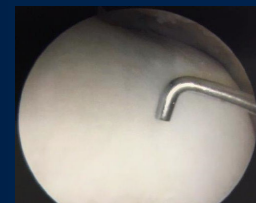


Pre-Op



BioCartilage

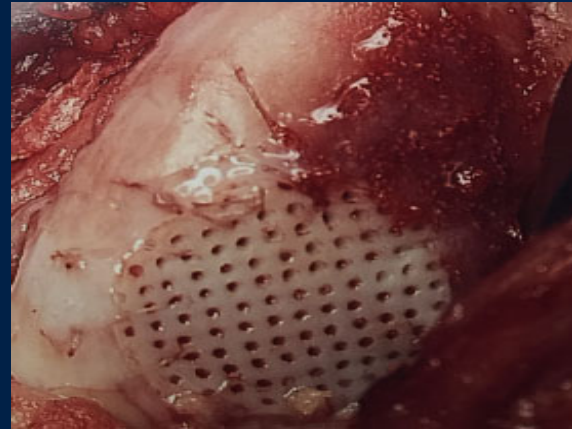
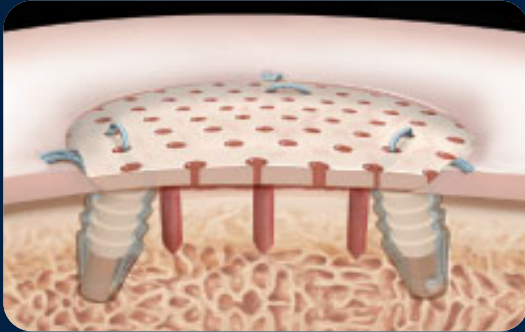
2 Years post-op



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Cartiform



- Cryopreserved viable osteochondral allograft
- Comprised of beneficial factors that promote proper articular cartilage repair
 - ❖ Extracellular matrix (ECM)
 - ❖ Viable chondrocytes
 - ❖ Chondrogenic proteins



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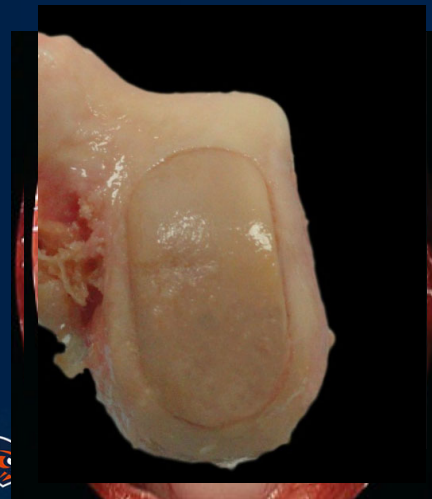


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Operative Techniques

- Mosaicplasty
- OATS
- Double OATS
 - MasterCard/Snowman
 - Technique Dependent
 - Available good cartilage
 - Removal of healthy cartilage
- BioUni OATS



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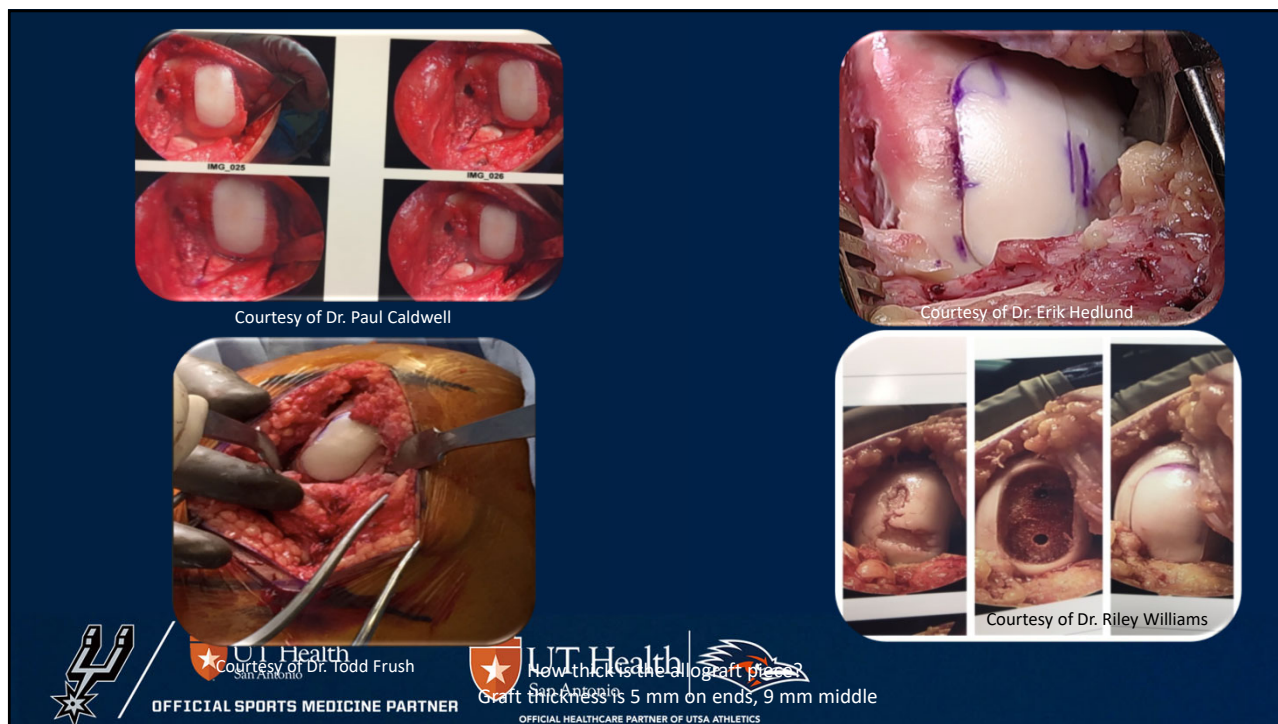
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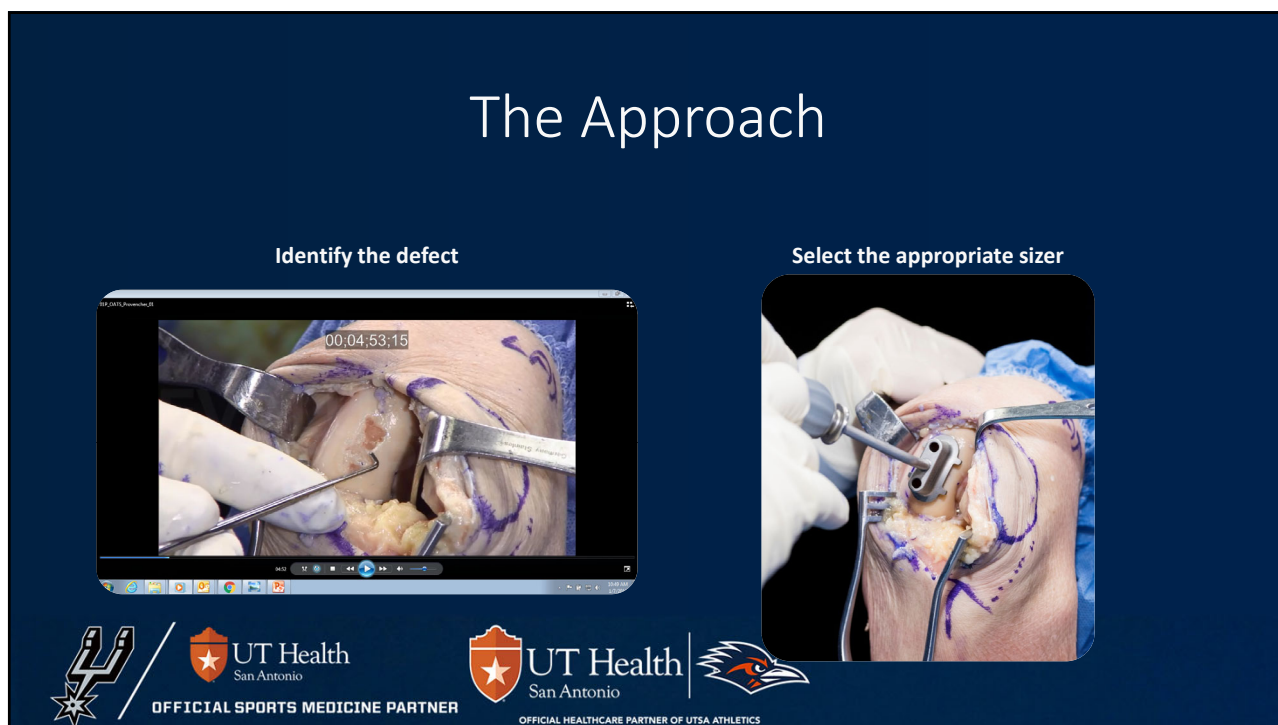
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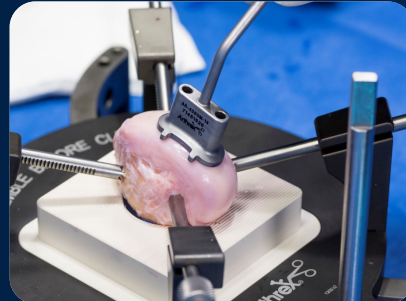
Donor Prep

Donor site (flush)



Confirm a flush fit from all angles. If its flush on the patient and flush on the donor cartilage, then the recovery location is a match

Donor site (flush)



Trace around the sizer with sterile marking pen. Mark the 12 o'clock position on the surface of the cartilage



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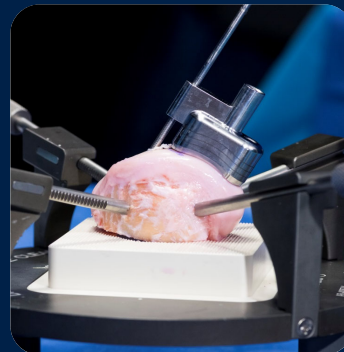
Donor Preparation

Oblong cutters



Grab associated pieces that match the size of the trial. Insert appropriate nylon insert into cutter

Pin insertion



Acquire the 2.8mm guide pin and drive it fully through the graft. It's acceptable to cut the pin to about 4 inches in length



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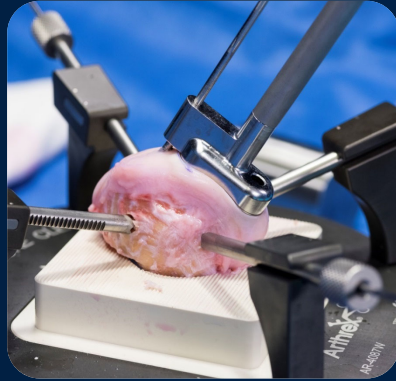
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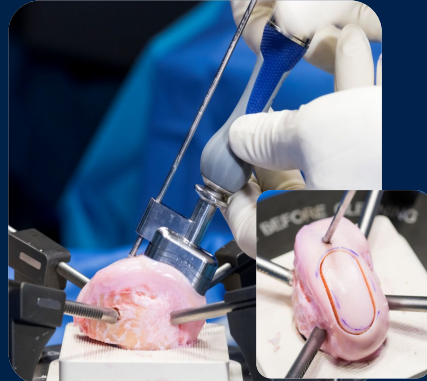
Donor Prep

Drive impactor handle



Impact until 3rd laser line is flush

Remove pin and cutter



Use distractor tool to remove the oblong cutter



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Retrieving the Graft

Sagittal cutters



Advance the Sagittal Guide over the Sagittal Cutter and secure with the Impactor Handle

Flush fit



Advance the cutter until all 4 stops are in contact with the cartilage across all planes.



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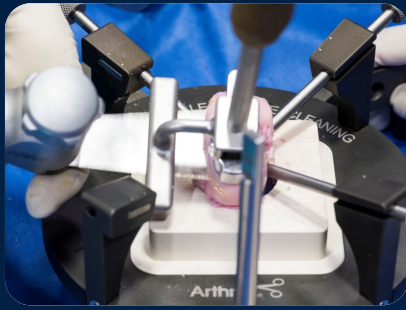
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Release the Graft

Cut through guide



Retrieve and confirm



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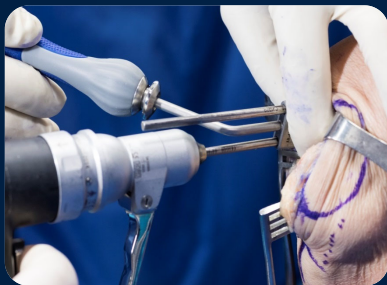


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Recipient Prep

Confirm location



Ensure its flush!



Utilize the same trials/sizer and place over defect again. Ensure its FLUSH!
Drive 4mm drill pins 2-3cm into condyle

All sides must be flush! Remove trial/sizer



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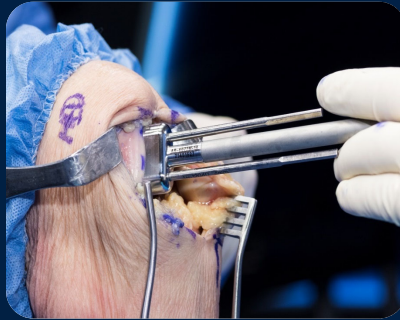
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60

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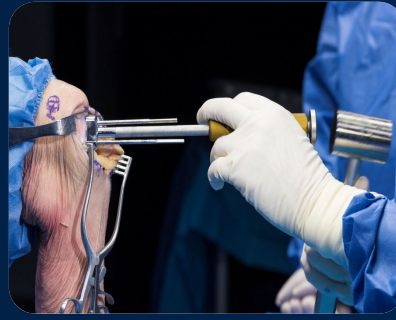
Recipient Prep

Scoring device



Apply the scoring device to the impactor and insert over the drill pins. Make sure its flush to the cartilage

Protecting the cartilage



Staying parallel to the pins, advance the scoring device 2-3mm into the cartilage to protect the cartilage outside the preparation area



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61

Adjusting the depth of the recipient site

Depth Stop and Reamer



Select the matching reamer based on the sizer. (14,17,20). Acquire the appropriate depth stop. Ream one side and then switch them and repeat the steps.

- Depth stops come in 12 sizes.
- S (shallow, flush, deep)
- M (shallow, flush, deep)
- L (shallow, flush, deep)
- XL (shallow, flush, deep)
- Shallow = Use if donor cartilage piece is recessed in the donor trial
- Flush = Use if donor cartilage piece is flush in the trial
- Deep = Use if donor cartilage piece is proud in the donor trial



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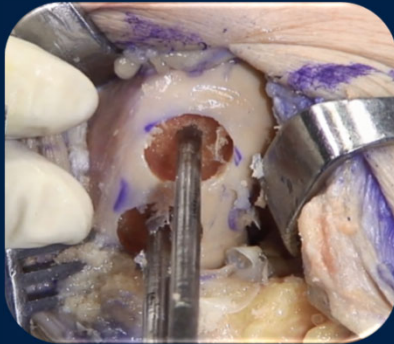


62

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Remaining Cartilage Cleanup

Reamed sockets



The reamer and depth stops creates the initial depth of the socket. Due to the curvature of the femur, the socket increases from 5mm up top to 9mm in the middle and back to 5mm on the bottom.

Box cutters



Insert the appropriately sized box cutter over the pins and advance in a parallel fashion until it bottoms out



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63

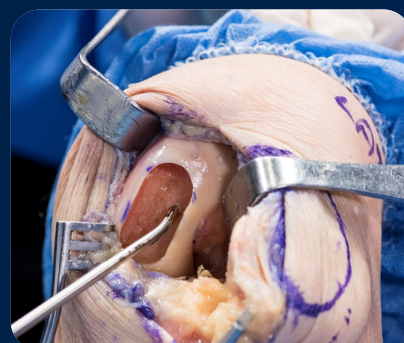
Final Recipient Site Prep

Recipient trial



Insert the appropriately sized trial and impact until flush with surrounding cartilage

Power pick



Prepare the recipient base by using a power pick or awl to get to a bleeding bed



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Final Preparation

Graft preparation



Insertion preparation



Soak the allograft bone PRP (ACP) or Bone Marrow Concentrate.

Bulletize the edges of the graft to help with insertion



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65

Insertion

Utilize nylon tamps



Gently tamp



Insert the appropriately sized nylon tamp

Final look before closure



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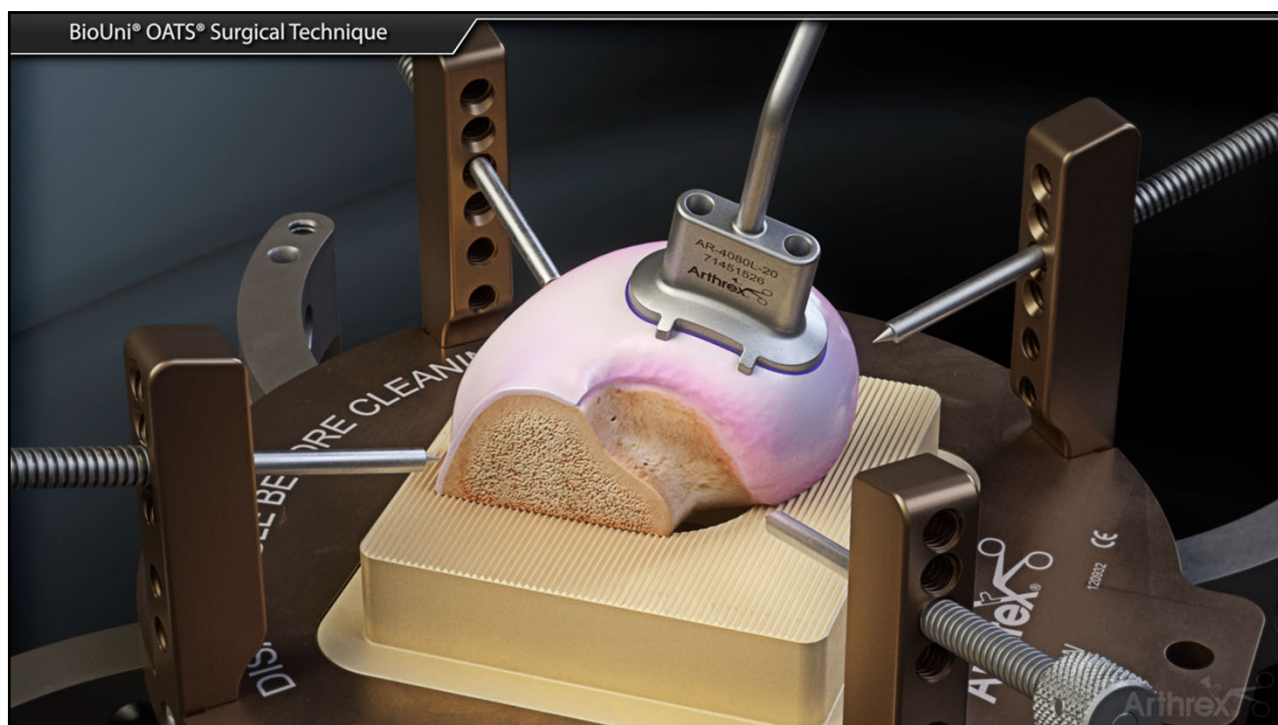


66

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67



68

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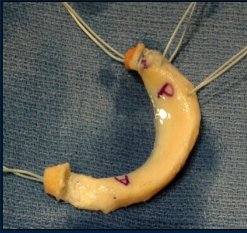



69



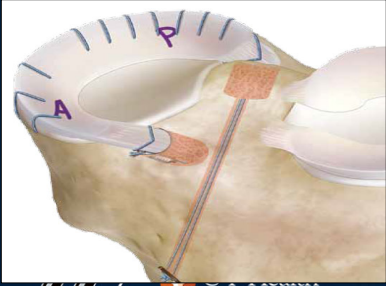

70


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Meniscal Transplant

Double Bone Plug DoveTail Technique












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71

BIOLOGIC ALGORITHM FOR ARTICULAR CARTILAGE REPAIR

	Fresh 10 mm Plugs	BioCartilage®	Cartiform®	Fresh Allograft
ALGORITHM	<ul style="list-style-type: none"> • Small, contained lesions with bony involvement that are less than 10 mm in diameter 	<ul style="list-style-type: none"> • < 2.0 cm² in the knee • < 1.5 cm² in the ankle • Small, contained lesions without bony involvement • Augment marrow stimulation 	<ul style="list-style-type: none"> • > 2.0 cm² in the knee • > 1.5 cm² in the ankle • Small to large, contained and uncontained lesions with minimal bony involvement • Microfracture Revision or Primary 	<ul style="list-style-type: none"> • > 2.0 cm² in the knee • > 1.5 cm² in the ankle • Large, uncontained lesions with bony involvement • OCD, AVN, Traumatic Lesions, Failed Mx, Failed ACL, Failed Juvenile Cartilage, Revision OCA
FEATURES AND BENEFITS	<ul style="list-style-type: none"> • 28-day shelf life • Viable chondrocytes • Intact cartilage with bony structure • Fresh processed and cold stored (refrigerator) • 10 mm in diameter and 12 mm in length • Press-fit fixation 	<ul style="list-style-type: none"> • Cartilage extracellular matrix (type II collagen, proteoglycans, and cartilaginous growth factors) • Arthroscopic implantation techniques available • 1 cc and 0.75cc volumes available • Mixed with autologous fluids such as PRP, BMC or whole blood • Allograft cartilage 	<ul style="list-style-type: none"> • Cryopreserved osteochondral allograft with 2-year shelf life • Viable chondrocytes • Bony portion reduced such that the implant is flexible and may be contoured and trimmed to fit the lesion • Fresh processed and stored at -80°C 	<ul style="list-style-type: none"> • Up to 45-day shelf life (JRF 28 days, LNH 45 days) • Mature cartilage with bone structure • Multiple sizes • BioUni™ instrumentation allows surgeon to resurface elongated defects (14, 17, 20 mm widths)
				
	<small>Cartiform is a registered trademark of Osiris Therapeutics, Inc.</small>			



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72

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Thank You

Questions?



73

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