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Pullout Strength Of Single Verses Multiple Synthetic Chondral Implants

Disclosures

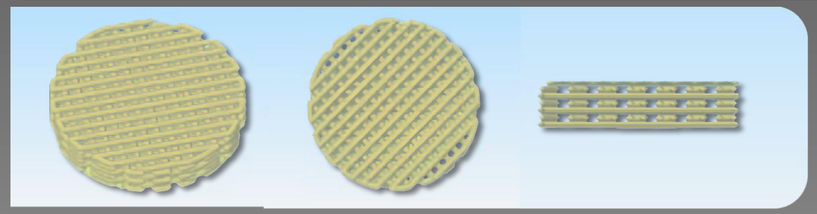
Consultant	Research Support	Committees
• Conmed – MTF • SBM • Depuy-Mitek • Smith & Nephew • Hyalex • Vericel • Anika • Nanochon	• Tissue Tech • MTF • Smith & Nephew • Conmed • Aesculap • Moximed • J&J Sports • Vericel • ZKR Orthopedics	• AOSSM Fellowship • AOSSM COD • AANA Fellowship • AANA Education

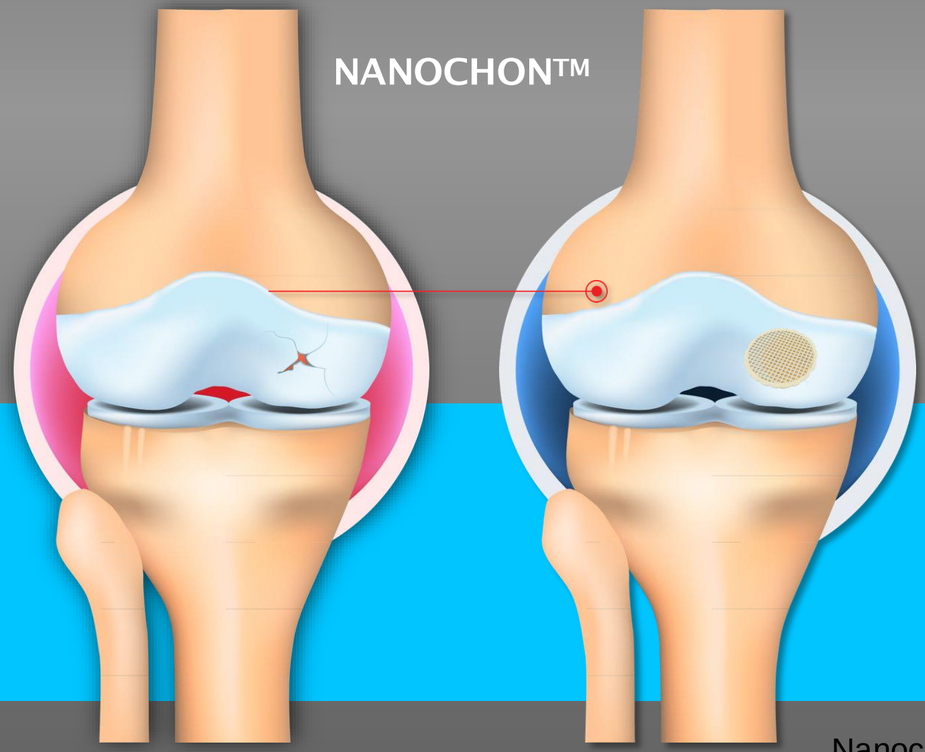
Cartilage defects are common

- 36% of athletes with full thickness focal chondral defects
  - MRI finds cartilage defects in 24% uninjured asymptomatic adults
- Can often be symptomatic and require treatment
- Current treatments are debridement, microfracture, MACI, osteochondral autografts and allografts
- Larger defects may need multiple implants
  - Previous studies have outlined bone bridge width to be 3-5mm

Flanigan et al, MSSE 2010
Culvenor et al, BrJSM 2018
Chimutengwende –Gordon et al, EFORT Open Reviews 2020
Eivind et al, JBJS Essential Surgical Techniques 2019
Vellios et al, Arthroscopy Techniques 2021

Nanochon Chondrograft™ is an Effective Implant



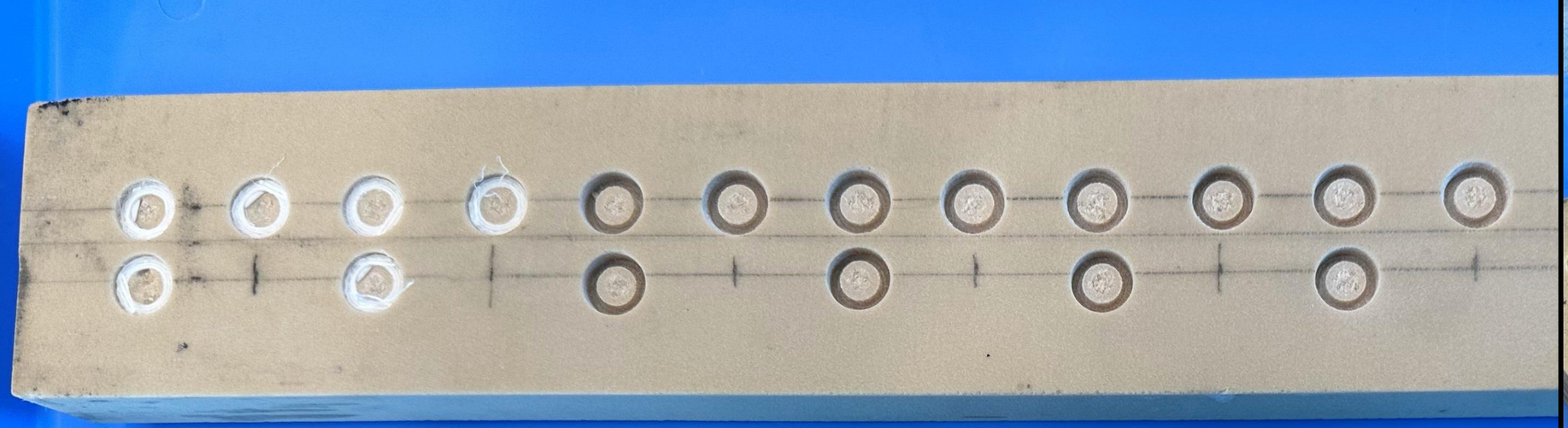


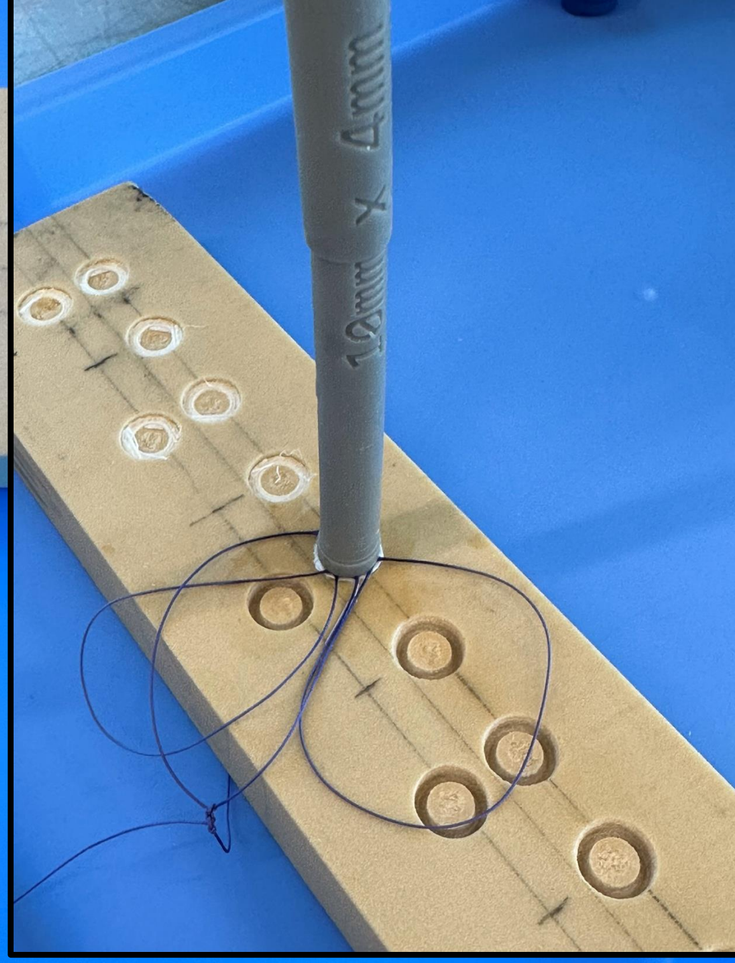
- Nanochon is a **highly porous** 3-D printed
- **Replaces** lost or damaged cartilage, degrades and fosters **new tissue growth**
- **Allows** *immediate weight bearing and motion*
- Potential to *profoundly reduce the cost* of arthritic joint care

Nanochon's Chondrograft™ device is not currently approved/cleared for use in the United States.

Hypothesis

A 3mm distance between implants would not affect pull out strength





Methods

- Bone foam representing subchondral bone PCF 40 was utilized for initial testing
- Holes were 10mm in diameter and 5mm deep
- Control group had sets of one hole solitarily reamed verses the testing group had two holes reamed 3mm apart

Testing

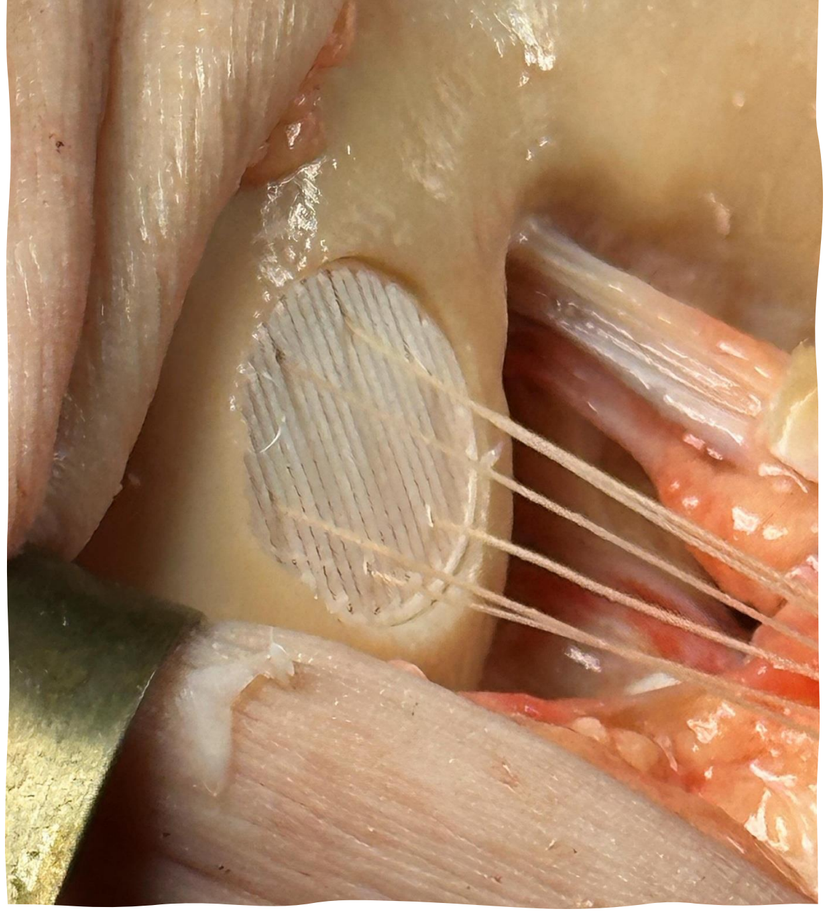
Implants were sutured* and implanted using Chondrograft Instrumentation Set according to the surgical technique.

Attached sutures were then pulled using a handheld digital force gauge

Recorded pull out force in Newtons

T test used to compare groups

* Sutures were used to facilitate testing and are not part of the standard surgical technique



Cadaveric confirmation

- 3 cadaveric specimens were used to confirm results
- 10-, 15-, 20-mm implants were implanted and tested in a similar method
- Various areas of the knee was used in testing:

  femoral condyle, trochlea

Bone Foam Results

Difference between groups is not statistically significant (p=0.28)

Group Number	Control (N)	Experimental (N)	
		Implant 1	Implant 2
1	25.3	27.9	24.6
2	34.3	27.8	27.5
3	16.0	28.1	33.5
4	34.7	27.2	43.4
5	27.2	34.9	42.8
Average (StD):	27.5 (7.67)	31.8 (6.71)	

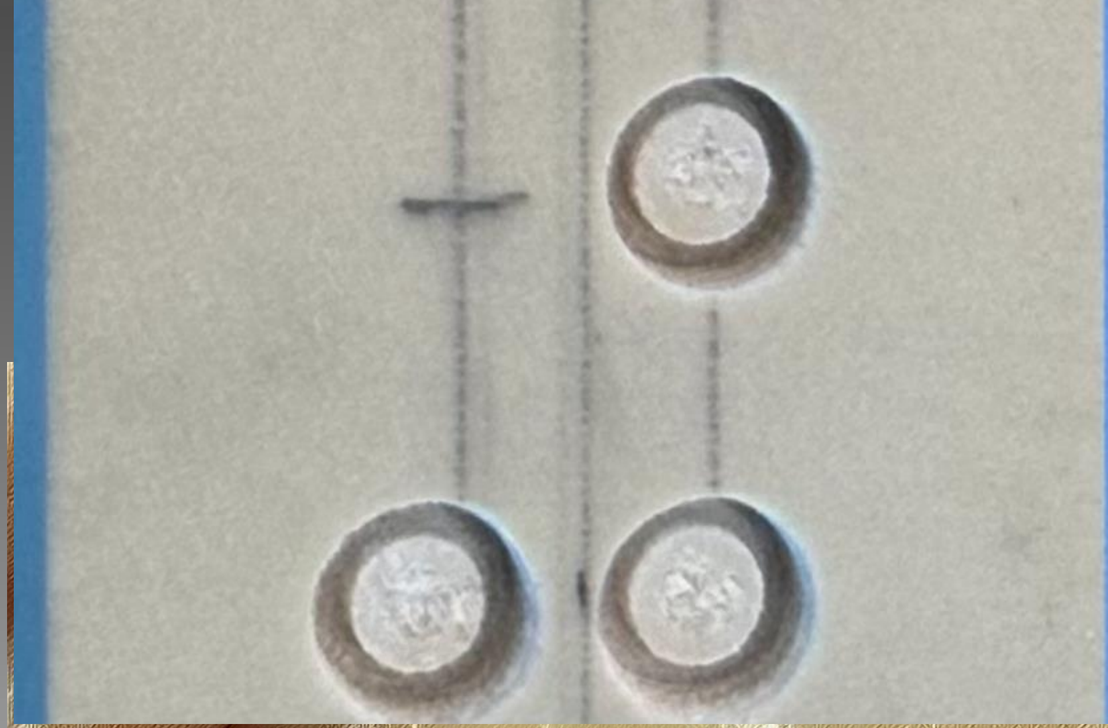
Cadaveric Results

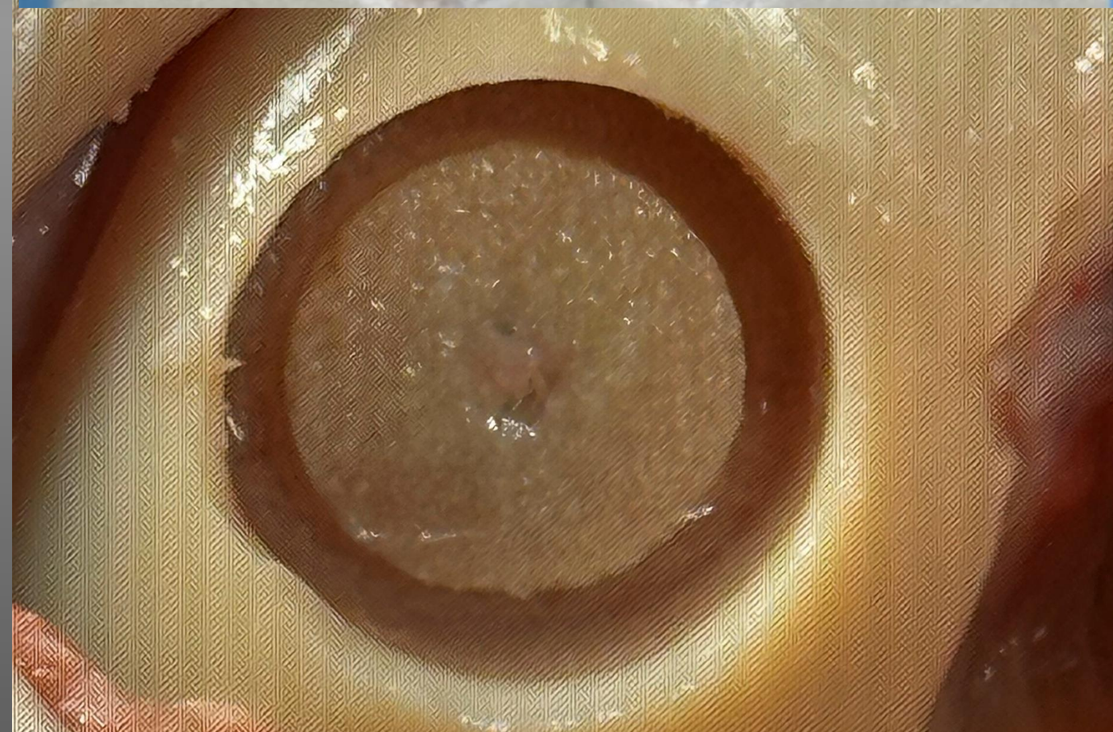
- Strength similar to bone foam
- Average strength was 31.7 N (10.2)

	Implant Diameter		
	20mm	15mm	10mm
Pullout Force (N)	42.8	31.3	32.9
	16.4	23.0	
	23	43.8	
		40.1	

Limitations

- Small sample size
- Bone foam does not fully represent the cartilage bone interface
- Average age of cadaveric specimen was over 60 which could affect pull out strength





Conclusions

The Nanochon Chondrograft is an effective implant

3mm is a safe distance between implants

Fixation strengthen did not differ between solitary and grouped implants

Further Research Needed

- Further research is needed in this novel scaffold to address cartilage defects in the knee including:
  - Sheer forces with motion
  - Large animal studies
- First in human studies are coming in the near future

Resources

- Flanigan et al, Prevalence of chondral defects in athletes' knees: a systematic review, MSSE 2010
- Culvenor et al, Prevalence of knee osteoarthritis features on magnetic resonance imaging in asymptomatic uninjured adults: a systematic review and meta-analysis, BrJSM 2018
- Chimutengwende-Gordon et al, Current solutions for the treatment of chronic articular cartilage defects in the knee, EFORT Open Reviews 2020
- Eivind et al, Osteochondral Autograft Transplant (Mosaicplasty) for Knee Articular Cartilage Defects, JBJS Essential Surgical Techniques 2019
- Vellios et al, Osteochondral Autograft Transfer for Focal Cartilage Lesions of the Knee With Donor-Site Back-Fill Using Precut Osteochondral Allograft Plugs and Micronized Exracellular Cartilage Augmentation

Thank you!

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