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# Autologous Chondrocyte Implantation Utilization is Increasing While Reoperation Rates Are Decreasing

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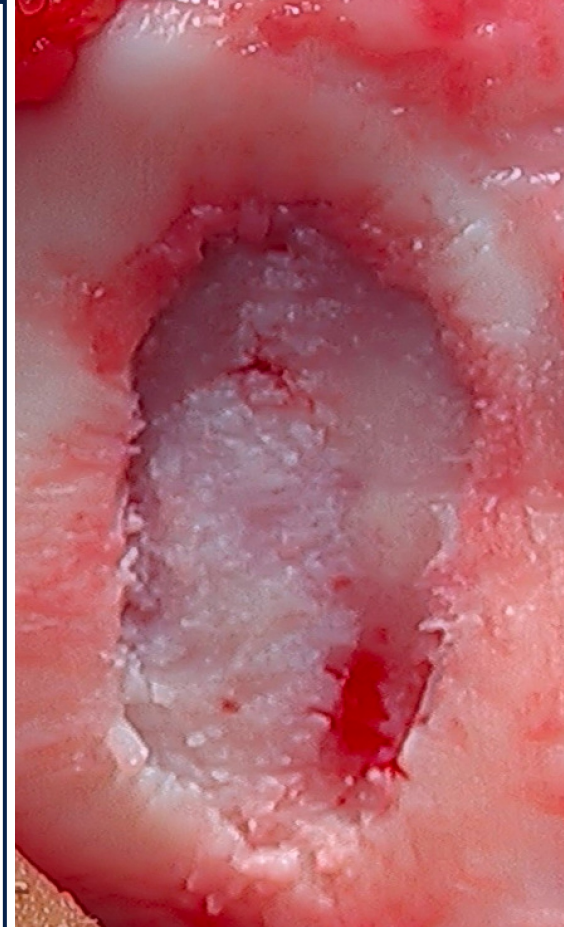
**I (and/or my co-authors) have something to disclose.  
All relevant financial relationships have been mitigated.**

Detailed disclosure information is available in the final program

Relevant Disclosure: Drew Lansdown – consulting work with Vericel, Inc

# Introduction

- Autologous chondrocyte implantation (ACI) is one option for treating symptomatic articular cartilage defects
- Matrix-induced autologous chondrocyte implantation (MACI):
  - Introduced in US after FDA approval in 2016
  - Simplified surgical process that avoids suturing collagen patch
- Most reports on reoperation are from single institutions
- Changes in utilization and reoperation rates after introduction of MACI not yet been defined





# Purpose & Hypothesis

## Purposes

- To assess utilization of autologous chondrocyte implantation over the past decade
- To determine re-operation rates and risk factors for re-operation after ACI

## Hypotheses

- ACI utilization will have increased significantly after introduction of MACI in 2017
- Increased reoperation rates in patients after 2017 due to utilization in patients with more comorbidities



# Methods

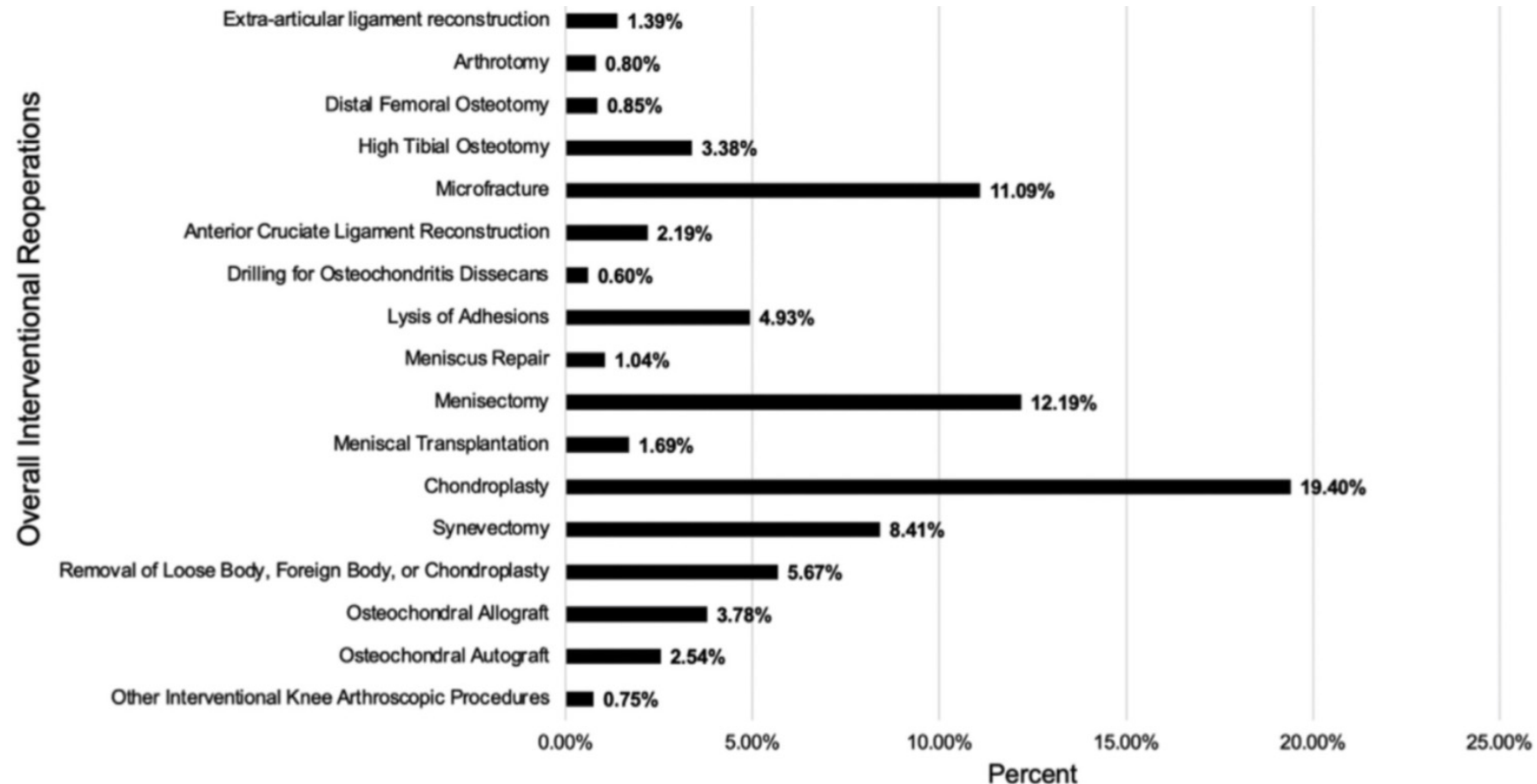
- Queried the MArthro dataset of Pearldiver Mariner Database (PearlDiver Technologies Inc, Colorado Springs, CO)
  - Insurance claims database with 91 million records between 2010 and 2020
  - MArthro dataset contains 4 million patient records
  - Includes Medicaid, Medicare, commercial insurers, and cash payors
- Identified patients undergoing ACI/MACI with CPT code 27412

# Statistical Analysis

- Demographic characteristics were collected
- Reoperations queried for all patients
- Chi-squared tests used to compare categorical variables and Welch's t-test used to compare continuous variables between groups
- Univariate and multivariate logistic regression performed
- Patients from 2014-2016 were compared to 2017-2019 as this represents three years before introduction of MACI and the first three years in use
- Significance defined as  $p < 0.05$

# Reoperation Rates after ACI

- Overall re-operation rate was 30.4%
- Conversion to total knee rate was 4.48%
- 90-day re-operation rate was 2.24%





# Risk Factors For Reoperation After ACI

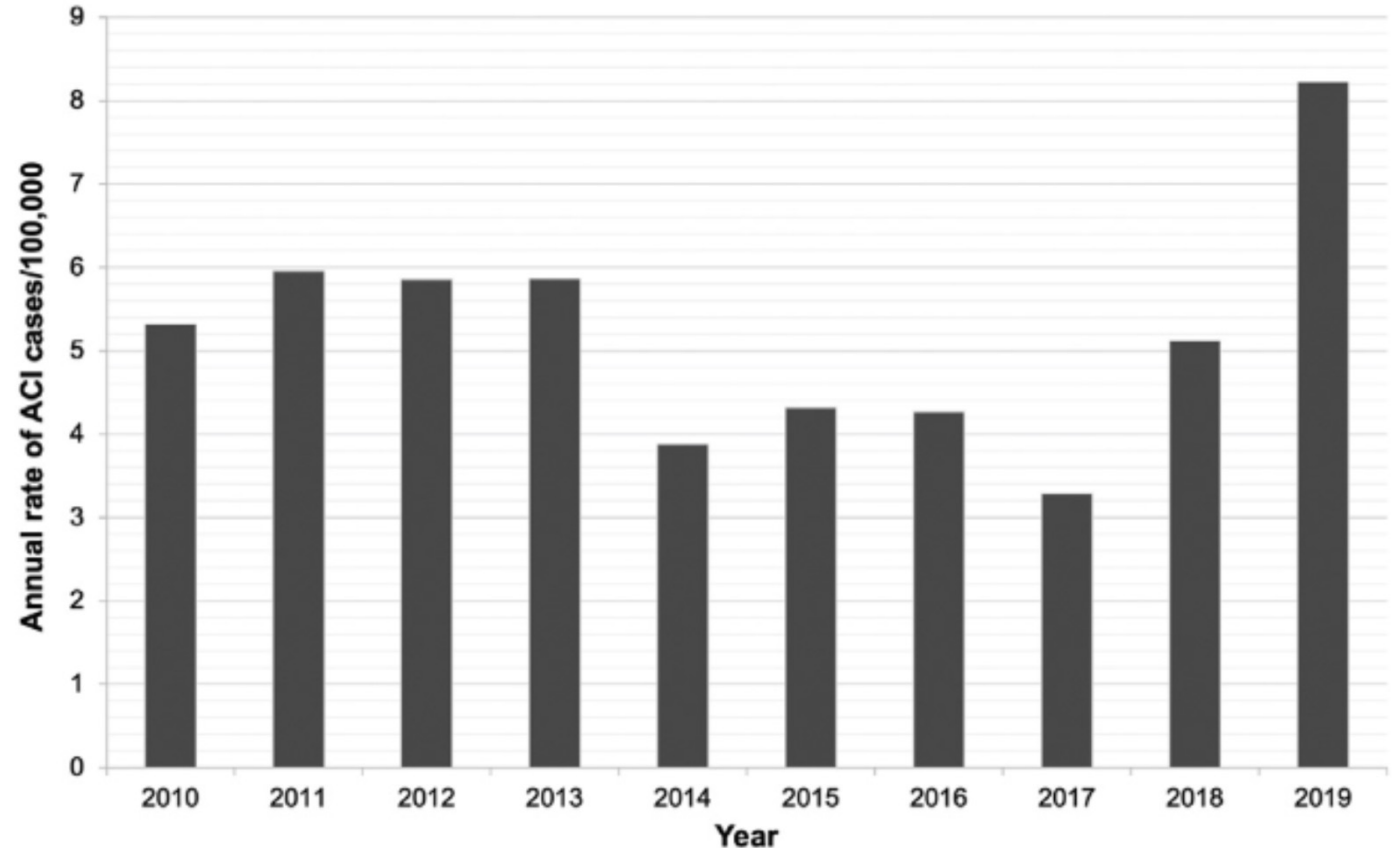
- Female patients had increased rates of re-operation at both 90-days and overall after ACI
- Mean age of patients undergoing reoperation was significantly higher than patients without re-operation (35.0 years vs 33.8 years;  $p=0.037$ ).

|             | Within 90 Days            |                      |          | Overall                   |                       |          |
|-------------|---------------------------|----------------------|----------|---------------------------|-----------------------|----------|
|             | No Reoperation (N = 1965) | Reoperation (N = 45) | <i>P</i> | No Reoperation (N = 1398) | Reoperation (N = 612) | <i>P</i> |
| Age         | 34.1 ± 11.8               | 36.6 ± 11.6          | .154     | 33.8 ± 12.1               | 35.0 ± 11.1           | .037     |
| CCI         | 0.45 ± 0.95               | 0.84 ± 1.57          | .101     | 0.46 ± 0.95               | 0.47 ± 1.00           | .830     |
| Male Sex    | 870 (44.3%)               | 12 (26.7%)           | .028     | 647 (46.3%)               | 235 (38.4%)           | .001     |
| Tobacco Use | 132 (6.72%)               | <11                  | .370     | 84 (6.01%)                | 49 (8.01%)            | .119     |
| Diabetes    | 89 (4.53%)                | <11                  | .707     | 67 (4.79%)                | 23 (3.76%)            | .360     |
| Obesity     | 205 (10.4%)               | <11                  | .930     | 142 (10.2%)               | 67 (10.9%)            | .649     |

All values represent mean ± standard deviation or n (percentage).

# Utilization of Autologous Chondrocyte Implantation

- Utilization of ACI was significantly higher in 2017-2019 compared to 2014-2016
  - 5.53/100,000 in 2017-2019 vs 4.16/100,000 in 2014-2016
  - 2017 represents the year that newest generation of MACI was introduced in the US



# Patient Demographics Undergoing ACI Surgery Before and After 2017

■ After introduction of MACI in 2017, patients have had:

- Higher CCI
- More obese patients
- Lower rates of tobacco use

|             | ACI Performed in<br>2014–2016 (N = 447) | ACI Performed in<br>2017–2019 (N = 584) | <i>P</i> |
|-------------|---|---|----------|
| Age         | 34.1 ± 11.5                             | 32.9 ± 11.2                             | .085     |
| CCI         | 0.38 ± 0.82                             | 0.57 ± 0.93                             | <.001    |
| Male Sex    | 199 (44.5%)                             | 240 (41.1%)                             | .299     |
| Tobacco Use | 37 (8.28%)                              | 15 (2.57%)                              | <.001    |
| Diabetes    | 19 (4.25%)                              | 23 (3.94%)                              | .926     |
| Obesity     | 33 (7.38%)                              | 75 (12.8%)                              | .006     |

All values represent mean ± standard deviation or n (percentage).



# Reoperation Rates Are Lower for Patients Undergoing ACI After 2017

- 90-day re-operation rate was significantly lower ( $p = 0.0004$ ) after 2017 relative to 2014-2016:
  - 3.80% for 2014-2016 (17/447)
  - 0.68% for 2017-2019 (4/584)
- Two-year reoperation rate was significantly lower ( $p=0.024$ ) in 2017-2019 group:
  - 26.2% for 2014-2016
  - 20.2% for 2017-2019

## Multivariate Analysis:

**ACI Performed in 2017-2019 is significant independent predictor of lower re-operation risk**

|                            | Univariate Analysis |       | Multivariate Analysis |       |
|----------------------------|---------------------|-------|-----------------------|-------|
|                            | OR [95% CI]         | P     | AOR [95% CI]          | P     |
| ACI Performed in 2017-2019 | 0.72 [0.54-0.97]    | .028  | 0.70 [0.52-0.94]      | .019  |
| Age                        | 1.01 [1.00-1.02]    | .306  | —                     | —     |
| CCI                        | 1.10 [0.94-1.28]    | .235  | —                     | —     |
| Male sex                   | 0.52 [0.38-0.71]    | <.001 | 0.52 [0.38-0.70]      | <.001 |
| Tobacco use                | 1.26 [0.65-2.31]    | .478  | —                     | —     |
| Diabetes                   | 0.55 [0.21-1.23]    | .181  | —                     | —     |
| Obesity                    | 1.14 [0.71-1.79]    | .581  | —                     | —     |

AOR, adjusted odds ratio.

# Discussion

- Overall reoperation for ACI in this cohort was 30.4%
  - Recent systematic review reported 33% reoperation rate in 5276 subjects
- ACI utilization increased significantly after introduction of new MACI technology in 2017
  - 90-day and overall reoperation rates decreased significantly
  - Patients after 2017 were more likely to be obese and have higher comorbidity scores
- Female patients had significantly higher rates of undergoing reoperation

# Conclusions

- Utilization of autologous chondrocyte implantation has increased since 2017 with introduction of newer MACI technology
- Male sex and surgery after 2017 both decreased the chance of reoperation in this large database study



# Thank you!

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