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ORTHOPAEDICS  
AT RUSH

# Influence of Donor Demographics on Graft Survival following Osteochondral Allograft Transplantation

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# Disclosures:



**Kyle R. Wagner BS; Ryan A. Quigley, MD; Zachary D. Meeker, BS; Landon P. Frazier, BS; Joshua T Kaiser, BS; Nate Cohen, BS:** Nothing to disclose

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# The Problem



- **Articular cartilage defects** can be seen in up to **60%** of knee arthroscopies
- Osteochondral allograft transplantation
  - **MCID** for IKDC: **75%**
  - Survival: **86%** and **82%** at **5** and **10-years**
- Cartilage restoration **increasingly performed** as access to fresh allografts improves

AJSM, 2021

## Osteochondral Allograft Transplant for Focal Cartilage Defects of the Femoral Condyles: Clinically Significant Outcomes, Failures, and Survival at a Minimum 5-Year Follow-up

Ron Gilat <sup>1, 2</sup>, Eric D Haunschild <sup>1</sup>, Hailey P Huddleston <sup>1</sup>, Tracy M Tauro <sup>1</sup>, Sumit Patel <sup>3</sup>, Theodore S Wolfson <sup>1</sup>, Kevin C Parvareh <sup>1</sup>, Adam B Yanke <sup>1</sup>, Brian J Cole <sup>1</sup>

J Knee Surg, 2020

## Trends in the Surgical Treatment of Articular Cartilage Lesions in the United States from 2007 to 2016

Steven F DeFroda <sup>1</sup>, Steven L Bokshan <sup>1</sup>, Daniel S Yang <sup>1</sup>, Alan H Daniels <sup>1</sup>, Brett D Owens <sup>1</sup>

# The Problem



Do **donor** variables influence **recipient** outcomes?

AJSM, 2022

## Association of Sex Mismatch Between Donor and Recipient With Graft Survivorship at 5 Years After Osteochondral Allograft Transplantation

Gergo Merkely<sup>1</sup>, Evan M Farina<sup>1</sup>, Chilan B G Leite<sup>1,2</sup>, Jakob Ackermann<sup>3</sup>, Simon Görtz<sup>1</sup>, Christian Lattermann<sup>1</sup>, Andreas H Gomoll<sup>4</sup>

AJSM, 2020

## Shorter Storage Time Is Strongly Associated With Improved Graft Survivorship at 5 Years After Osteochondral Allograft Transplantation

Gergo Merkely<sup>1</sup>, Jakob Ackermann<sup>2</sup>, Evan M Farina<sup>1</sup>, Courtney VanArsdale<sup>1</sup>, Christian Lattermann<sup>1</sup>, Andreas H Gomoll<sup>3</sup>

J Knee Surg, 2017

## Patient Factors, Donor Age, and Graft Storage Duration Affect Osteochondral Allograft Outcomes in Knees with or without Comorbidities

Clayton W Nuelle<sup>1</sup>, Julia A V Nuelle<sup>1</sup>, James L Cook<sup>1</sup>, James P Stannard<sup>1</sup>

JBJS, 1989

## The fate of articular cartilage after transplantation of fresh and cryopreserved tissue-antigen-matched and mismatched osteochondral allografts in dogs

S Stevenson<sup>1</sup>, G A Dannucci, N A Sharkey, R R Pool



# Purpose

To evaluate whether **donor sex** and **age**, **donor-recipient sex mismatch**, and **duration of graft storage** affect **clinical outcomes** and **failure** rates following knee osteochondral allograft transplantation.

# Methods



- Prospectively collected, single-surgeon database from 2003-2018
- **Inclusion Criteria:** primary OCA, minimum 2-year follow-up, data on allograft donor sex, age, and date of allograft expiration
- **Exclusion Criteria:** <2-years follow-up or revision OCA
- **Failure** = revision cartilage procedure or conversion to UKA or TKA



# Results



- **N = 459** primary OCAs performed
  - **Included:** N = 360
  - **Age:** 31.2 ± 9.8 years
  - **BMI:** 26.6 ± 4.4 kg/m<sup>2</sup>
- **Mean f/u** 5.5 ± 2.6 years
  - Range: 2.0-16.3
- Donor-recipient mismatch present in **N = 149 (41%)**
  - More female recipients
  - 79% of donors were male
  - Smaller defect size

Demographics and Intraoperative Variables			
Characteristic	Non-mismatch, N = 211	Mismatch, N = 149	P-value
<b>Sex</b>			<b>&lt;0.001</b>
Female	58 (27%)	134 (90%)	
Male	153 (73%)	15 (10%)	
<b>Age (years)</b>	31.0 ± 9.7	31.6 ± 10.0	0.568
<b>BMI</b>			
Male	27.9 ± 4.4	27.8 ± 4.3	0.714
Female	25.7 ± 4.1	24.8 ± 3.8	0.149
<b>Laterality (right)</b>	124 (59%)	82 (55%)	0.481
<b>Smoking status</b>			0.861
Current	14 (6.6%)	12 (8.1%)	
Former	8 (3.8%)	5 (3.4%)	
Never	189 (90%)	132 (89%)	
<b>Prior surgeries</b>	2.62 ± 1.56	2.69 ± 1.40	0.373
<b>WC</b>	29 (14%)	17 (11%)	0.513
<b>Defect size (mm)</b>	19.8 ± 4.3	18.2 ± 3.7	<b>0.002</b>
Defect location			
<b>MFC</b>	112 (53%)	73 (49%)	0.445
<b>LFC</b>	91 (43%)	62 (42%)	0.816
<b>Trochlea</b>	25 (12%)	13 (8.7%)	0.342
<b>Patella</b>	23 (11%)	24 (16%)	<b>0.149</b>
Categorical variables listed as n (%); continuous variables listed as mean (SD). BMI, body mass index; LFC, lateral femoral condyle; MFC, medial femoral condyle; WC, worker's compensation status.			

# Results



- Isolated OCA in 45% cases
- **Graft storage time:**  $24.3 \pm 2.8$  days
  - Range: 14 - 28 days
- **Donor age:**  $22.9 \pm 6.2$  years
  - **Younger donor age** in those who received a **sex-mismatched** allograft

Demographics and Intraoperative Variables			
Characteristic	Non-mismatch, N = 211	Mismatch, N = 149	P-value
<b>Major concomitant</b>	119 (56%)	80 (54%)	0.611
<b>ACI</b>	0 (0%)	2 (1.3%)	0.171
<b>MFX</b>	16 (7.6%)	9 (6.0%)	0.571
<b>ACLR</b>	14 (6.6%)	5 (3.4%)	0.170
<b>DFO</b>	11 (5.2%)	5 (3.4%)	0.400
<b>HTO</b>	21 (10.0%)	8 (5.4%)	0.116
<b>LMAT</b>	54 (26%)	37 (25%)	0.870
<b>MMAT</b>	40 (19%)	19 (13%)	0.117
<b>BMAC</b>	20 (9.5%)	22 (15%)	0.124
<b>PRP</b>	4 (1.9%)	3 (2.0%)	>0.999
<b>Donor age</b>	$23.6 \pm 6.3$	$22.0 \pm 5.9$	<b>0.023</b>
<b>Days in storage</b>	$24.3 \pm 2.8$	$24.1 \pm 2.8$	0.467

Major concomitant procedure is defined as any of the listed procedures, apart from bone marrow aspirate concentrate (BMAC) or platelet-rich plasma (PRP). ACI, autologous chondrocyte implantation; ACLR, anterior cruciate ligament reconstruction; DFO, distal femoral osteotomy; HTO, high tibial osteotomy; LMAT, lateral meniscal transplantation; MFX, marrow stimulation; MMAT, medial meniscal transplantation.



# Results



No donor variables predicted CSOs for **subjective IKDC** as well as **KOOS subscales**

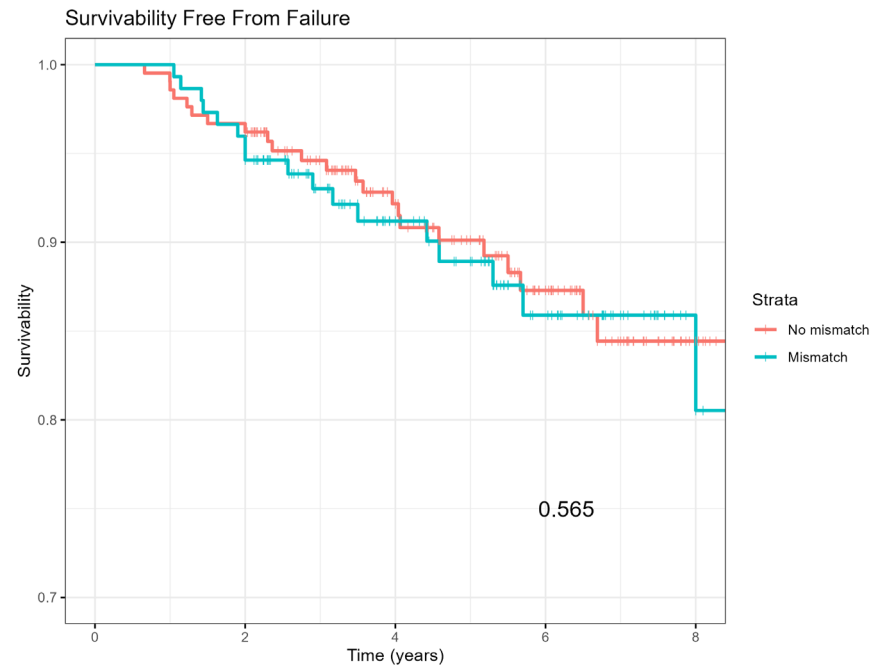
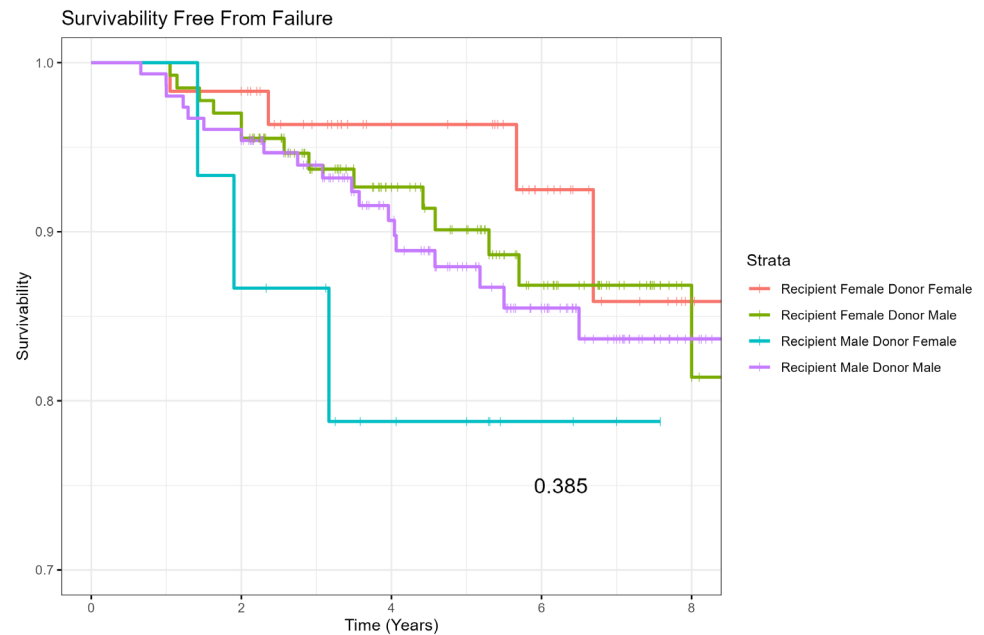
Clinically Significant Outcomes for IKDC Subjective Form			
Variables included in model	Univariable P-value	Multivariable P-value	Odds Ratio
<b>MCID</b>			
Days in storage (linear)	0.645	0.768	1.026 (0.867 - 1.230)
Donor Age	0.112	0.061	0.922 (0.845 - 1.002)
Donor Sex (female)	0.468	0.905	1.085 (0.292 - 4.634)
Donor-Recipient Sex Mismatch	0.289	0.917	0.931 (0.247 - 3.742)
<b>PASS</b>			
Days in storage (linear)	0.545	0.483	0.958 (0.852 - 1.079)
Donor Age	0.352	0.687	0.988 (0.936 - 1.044)
Donor Sex (female)	0.797	0.599	0.820 (0.395 - 1.754)
Donor-Recipient Sex Mismatch	0.568	0.338	1.395 (0.713 - 2.812)
<b>SCB</b>			
Days in storage (linear)	0.106	0.099	0.886 (0.764 - 1.019)
Donor Age	0.256	0.237	0.962 (0.902 - 1.025)
Donor Sex (female)	0.746	0.578	0.758 (0.282 - 2.015)
Donor-Recipient Sex Mismatch	0.122	0.724	0.838 (0.307 - 2.216)

**P > 0.05**

\*Covariates were included if P < .15 on univariable analysis

# Results

- **12% (N = 44/360) failed**
  - **TKA or UKA:** N = 22
  - **Revision cartilage:** N = 22
- **Mean time to fail:**  $3.8 \pm 2.9$  years
  - 0.6-12.8 years
- **No difference** in survivability free from **failure** on log-rank testing
- **5-year survivability**
  - Sex match: 90.1%
  - Sex mismatch: 88.9%



# Results



- Variables associated with **failure**:
  - Diabetes mellitus
  - Higher number of previous surgeries
  - Longer symptom duration
- **No** donor variables associated with failure
  - **Storage time  $\geq 25$  days** trended toward significance ( $P = 0.065$ )

Cox Regression Analysis for Variables Associated with Failure			
Variable	P-value		Hazard Ratio (95% CI)
	Univariable	Multivariable	
Donor age	0.773	0.491	1.018 (0.967 - 1.071)
Donor sex (female)	0.615	0.941	0.969 (0.425 - 2.211)
Donor-recipient Sex Mismatch	0.569	0.752	1.106 (0.589 - 2.077)
Days in storage (linear)	0.684	0.542	1.034 (0.927 - 1.153)
Days in storage (binomial $\geq 25$ days)	0.121	0.065	0.523 (0.263 - 1.043)

\*Covariates were included if  $P < .15$  on univariate

# Discussion



- **Optimal donor variables** and **matching requirements** remain debated
  - **Merkely et al.** found **inferior** cumulative 5-year survivorship among **female patients** who received an **allograft from a male**
  - **Nuelle et al.** found **inferior visual analogue scale scores** among patients who received grafts that had **longer storage times**
  - **Wang et al.** did not appreciate PRO, reoperation, or failure differences in those with non-orthotopic OCA transplantation (e.g., medial to lateral condyle)
- **Further study** is needed to assess whether there are **clinically-relevant** immune responses in **unmatched osteochondral allografts**

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# Conclusions



- The primary finding from this investigation was that there is **no** substantial difference in terms of **clinically significant outcomes or failures** following OCA transplantation for patients who received a graft from a donor of the opposite sex.
- These data can help inform graft selection, expedient recipient selection, and outcome optimization following OCA transplantation.



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# Thank you.

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