# Accuracy of Distal Femoral Condyle Osteochondral Allograft Transplantation Using Patient Specific Instrumentation

MIDWEST ORTHOPAEDICS AT RUSH

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## BACKGROUND

- Osteochondral allograft (OCA) transplantation reconstructs the area of the knee with an osteochondral defect with a fully formed articular hyaline cartilage/osseous unit.
- For this surgery to be successful, the graft needs to be chosen and harvested from the correct location on the donor femoral condyle, and then placed correctly on the recipient condyle minimizing step-off relative to the surrounding cartilage.
- Currently, donor and recipient graft matching is fairly rudimentary and requires significant experience from the treating surgeon.

## PURPOSE

To evaluate a novel topography matching technique for distal femoral condyle OCA transplantation using three-dimensional (3D) laser scanning to create 3D printed patient-specific instrumentation in a human cadaveric model.

## METHODS

- Twelve human cadaveric distal femoral condyles were 3D laser scanned.
- An 18-mm circular osteochondral recipient defect was virtually created on the medial femoral condyle (MFC) and the position and orientation of the best topography matched osteochondral graft from a paired donor lateral femoral condyle (LFC) was determined using an *in-silico* analysis algorithm minimizing articular step-off (**Figure 1**).
- Donor (LFC) and recipient (MFC) 3D-printed patient-specific guides were created based on 3D reconstructions of the scanned condyles.
- Using the guides, OCAs were harvested from the LFC and transplanted to the reamed recipient defect site (MFC). The post-OCA recipient condyles were laser scanned (**Figure 2**).
- The 360-degree articular step-off and cartilage topography mismatch were measured and compared to the *in-silico* result **(Figure 2).**

## METHODS

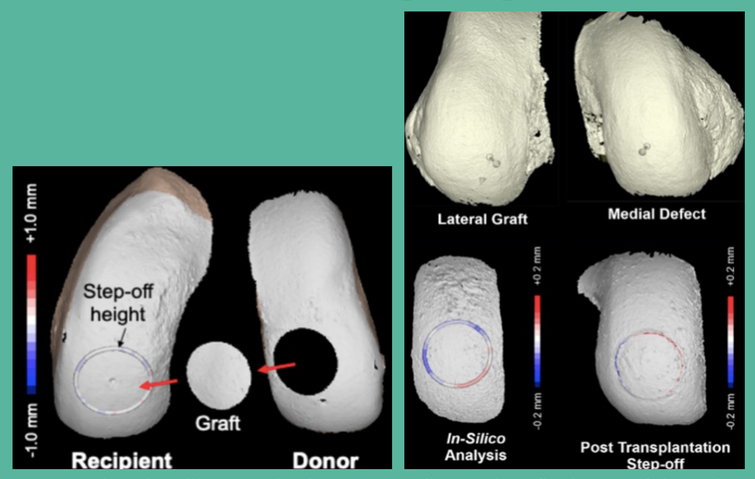


**Figure 1.** Pre-operative *in-silico* analysis was performed to find a graft location on the LFC with the mean least distance articular step-off between the graft perimeter and MFC for each specimen.

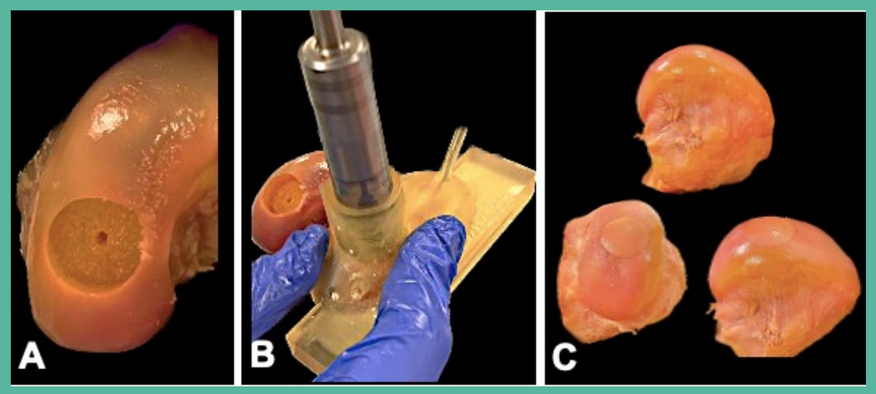


**Figure 2. (A)** First, the site of the MFC defect is reamed on the recipient MFC . (B) The patient-specific 3D-printed guide is used to harvest the osteochondral donor graft on the LFC with a coring reamer (C) The recipient MFC after the OCA graft is implanted. Excellent topography matching can be observed between the donor OCA and recipient site showing minimal articular step off.

## RESULTS

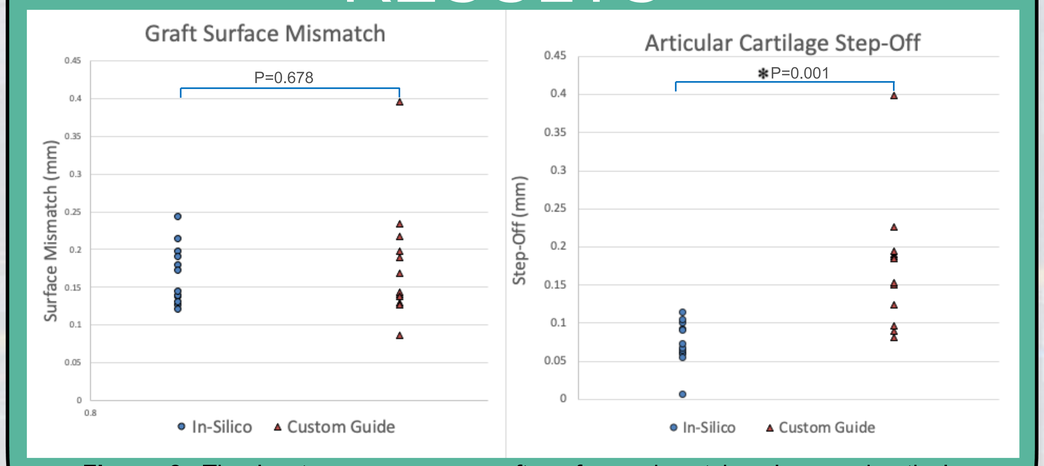


**Figure 3.** The least mean square graft surface mismatch values and articular cartilage step-off distances (in mm) for each test of the *in-silico* grafts compared to those performed with a custom-printed guide. *Denotes significance.

Notably, the difference in step-off distance between the two groups retains significance even with eliminating the test responsible for the outlier result in the Custom Guide group (P = 0.003).

## RESULTS

*In-Silico Analysis:*

- Mean cartilage step-off = 0.073 ± 0.029 mm (range: 0.005-0.113 mm)
- Mean graft surface area mismatch = 0.166 ± 0.039 mm (range: 0.120-0.243 mm),

Custom-Guide Specimens Post-Implant:

- Mean cartilage step-off = 0.173 ± 0.085 mm, (range: 0.082-0.399 mm)

*P = 0.001

- Mean graft surface area mismatch = 0.181 ± 0.080 mm, range: 0.087-0.396 mm

P = 0.678

## CONCLUSION

- This novel technique for patient-specific OCA instrumentation demonstrated the ability to optimize cartilage topography matching for LFC to MFC transplantation.
- Our study demonstrated substantially lower mismatch values compared to previous orthopedic literature reporting means of 0.48 mm for step-off (range: 0.335-0.738 mm) and 0.63 mm for surface area mismatch (range: 0.349-1.461 mm) when also evaluating LFC to MFC transplantation[1].
- Using this novel technique in a model performing MFC to MFC transplantation would likely yield further enhanced results due to improved radii of curvature matching.

## Clinical Relevance

- Topography matched graft implantation for focal chondral defects of the knee in the young patients would improve surface matching and associated long-term outcomes
- Efficient selection of the allograft would also improve availability of the limited allograft sources and reduce surgical time.

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NIH National Institute of Arthritis and Musculoskeletal and Skin Diseases

## References

1. Mologne TS, *et al*. Osteochondral allograft transplant to the medial femoral condyle using a medial or lateral femoral condyle allograft: is there a difference in graft sources? *Am J Sports Med*. 2014;42(9):2205-2213.