

WATER-JET CUTTING OF ARTICULAR CARTILAGE TO IMPROVE CELL VIABILITY IN CARTILAGE REPAIR

[M. Wimmer](#)¹, PhD; [T. K. Pylawka](#)^{1,2}, [J. M. Williams](#)², PhD, [M. Honl](#)¹ MD, PhD

¹[Department of Orthopedic Surgery](#), ²[Department of Anatomy and Cell Biology](#)

Rush University Medical Center, Chicago, US

INTRODUCTION: Osteochondral grafting is a standard procedure in the surgery of cartilage defects. It involves the retrieval of osteochondral plugs from the donor site, typically with a punch device and the similar preparation of a recipient bed. Conventional punch sets cause chondrocyte death at the edge of either the transplant or the recipient bed¹⁻². Water Jets (WJ) are a group of “cold” cutting methods, where the loads applied to the target material are minimized when compared to conventional tools. The cut is performed using water under high pressure (potential energy) by transforming it into water with high velocity (kinetic energy) using a nozzle, as seen in Fig. 1.



Fig. 1: WJ.

Aim of the study was to compare cell viability of a conventionally prepared cartilage to the WJ.

METHODS: 24 full-thickness patellar articular cartilage slices (20mm x14mm) were obtained from 22 month-old cattle under sterile conditions. The recipient tool of an 8 mm osteo-articular transfer system (OATS, Arthrex) was used to remove a cartilage cylinder from the center of each sample. Then the WJ was used to cut the sample in half. The nozzle ($\varnothing=0.2\text{mm}$) was positioned with a stand off distance of 5mm and cutting was performed at a traverse speed of 1mm/s using saline solution and a pressure of 50MPa. The samples were cultured up to 8 days with live dead staining and confocal microscopy completed at days zero, four and eight.

One-way analyses of variance were computed with the depth of cell death as dependent variable.

RESULTS: The resulting area of dead cells was significantly smaller for the WJ cut samples if compared to the OATS- punched samples (Fig.2) at any time point of the tissue cultivation ($p<0.001$, Fig.3).

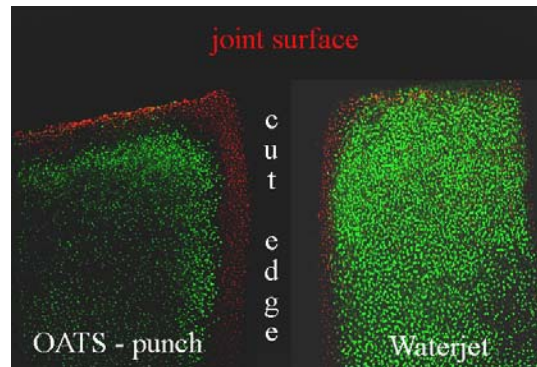


Fig.2: Cut edge using OATS (left) and WJ (right) in a day 4 sample.

There was a slight but not significant increase of the necrotic zone during the 8 days of cultivation in the WJ group (Fig.3).

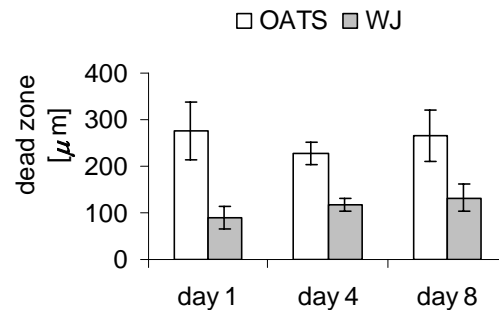


Fig.3: Cell death vs. cut group and time.

DISCUSSION & CONCLUSIONS: The results suggest that WJ have great potential for cartilage surgery. The tremendous reduced cell death could hypothetically be traced back to minor mechanical stress applied to the chondrocytes during cutting. An additional advantage is the potential to cut varying geometrical shapes and sizes as need to machine the individual defect fitting geometry as per the surgeon’s requirements.

REFERENCES: ¹ Redman et.al.: The cellular responses to articular cartilage to sharp and blunt trauma. *Osteoarthritis and Cartilage* 2004; 12: 106-116. ² Evans et al.: Manual punch versus power harvesting of osteochondral grafts. *Arthroscopy* 2004; 20(3): 306-310.