OSTEOCHONDRAL MOSAICPLASTY: CHARACTERIZATION OF IMPLANTED GRAFT HEIGHT BY DISSIPATED ENERGY

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Introduction

Osteochondral autologous transplantation is frequently used to repair small cartilage defects. Incongruence between the osteochondral graft surface and the adjacent cartilage results in increased contact pressures [Latt 2011]. On the other hand the cartilage surface plays very important role in the low-friction movement of a healthy joint. The purpose of our study was to characterize different states of the mosaicplasty by the dissipated energy dynamically measured in an in vitro joint model [Walter 2013].

Methods

Six ovine carpometacarpal joints were used to perform experiments. During different joint cartilage states (intact, cartilage defect of 8 mm diameter, 1 mm deep-, flush-, 1 mm high-implanted osteochondral graft and cartilage damage on a high-implanted graft) the dissipated energy were measured (hysteresis area of a torque versus torsion angle curve). The measurement sequence of the deep-, flush- and high-implanted grafts was permutated. The torsion motion of 10° was applied with a triangular shaped target value and a frequency of 0.1 Hz under constant axial preload of 200 N for 9 cycles (Fig. 1). Control measurements on two specimens were performed under same conditions but without surgical treatments.

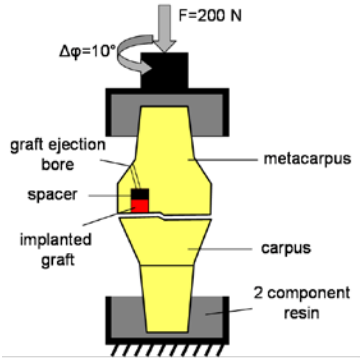

Figure 1: Schematic diagram of the measurement set up on the material testing machine

Results

Friedman's test with bonferroni correction for multiple comparisons didn't reveal significant differences between the six states in the control measurement. The dissipated energy of the defected high-implanted graft was significant different ($P=7x10^{-33}$) from the values in the intact joint and when the graft was implanted high. Moreover the Wilcoxon test of the normalized dissipated energy data identified that all treated states had significantly higher dissipated energy than in the intact joint ($P<2.55x10^{-8}$) except when the graft was implanted high (P=0.23, Figure 2).

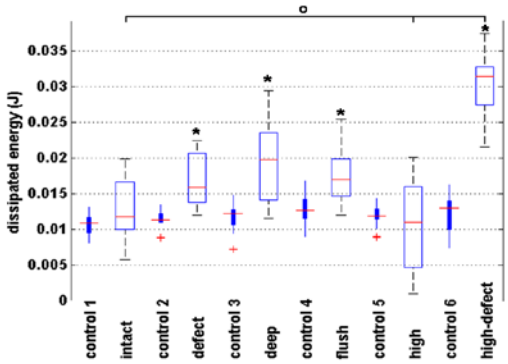

*Figure 2: Boxplot of the dissipated energy during control 1-6 states ("filled" style) and after surgical treatments. ○ denotes the significant difference (P<0.05) of Friedman's group test. * denotes the significant difference to the intact state after Wilcoxon test.*

Discussion

The measurements didn't reveal an advantage of the flush-implanted osteochondral graft in comparison to the defect and deep-implanted graft states. In contrast the dissipated energy level of the high-implanted graft was similar to that of the intact cartilage. Therefore it can be advantageous to implant a slightly elevated osteochondral graft when the mechanical stimulation of the graft is required. However an appropriate level of the implantation has to be found (<1mm) because of the graft cartilage damage risk and subsequent increase of the dissipated energy.

References

Latt et al, Am J Sports Med, 39(12):2662-2669, 2011.
Walter, C., et al., Med Eng Phys, 2013, In Press