

Correlation of Traditional and Novel Outcome Measures for the Assessment of Regenerated Osteochondral Tissue in a Sheep Model

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Purpose: To demonstrate the ability of a non-destructive electromechanical method (Arthro-BST) in assessing the quality of regenerated osteochondral tissue in a sheep model.

Material & Methods: Fresh osteochondral defects (W=6, L=20, D=5 mm) in the weight-bearing area of left medial femoral condyles (L-MFC) were created in 10 female sheep (3-6 y-o, 62-84 kg). Animals were randomly assigned to one of two treatment groups: 1) a composite of Chondro-Gide® and Orthoss® and 2) a custom-designed bilayer implant made of a nanofibrous PCL electrospun on a macroporous PCL. Arthro-BST mappings (Biomomentum, Laval) were performed *ex vivo* on all L-MFC and contralateral FC. Its quantitative parameter (QP) is inversely related to electromechanical properties. Biopsies from all L-MFC and untreated surfaces were analyzed for histology, and sGAG and dsDNA content. All statistics were expressed as means \pm SE.

Results: For both treatments, QP values, dsDNA and sGAG contents measured at the repair sites were statistically lower than those obtained for the contralateral surface. For group 1, $QP - QP_{Ref}$ was -1.50 ± 0.39 (n=266) demonstrating better regeneration than group 2 (-2.62 ± 0.33 ; n=255). However, this regeneration was not significantly different ($p=0.14$). These findings were supported by higher dsDNA (247 ± 59 μ g/ml) and sGAG/weight (dw 1.41 ± 0.43 / ww 6.47 ± 2.79 ng/mg) levels in group 1 compared to dsDNA (179 ± 59 μ g/ml) and sGAG/weight (dw 0.46 ± 0.43 / ww 1.95 ± 2.79 ng/mg) in group 2, which lack significant difference ($p > 0.05$). For both treatments, Arthro-BST revealed early signs of degeneration of the cartilage bordering the repair site on the L-MFC (Fig.1), where $QP - QP_{Ref}$ was 1.55 ± 0.20 (n=922) for group 1 and 2.08 ± 0.20 (n=963) for group 2.

Conclusion: The performance of Arthro-BST for the assessment of cartilage repair techniques in an animal model was highlighted. Its findings were supported by traditional outcome measures. No statistical differences were observed in the quality of the regenerated cartilage among treatments and both resulted in an incomplete regeneration.

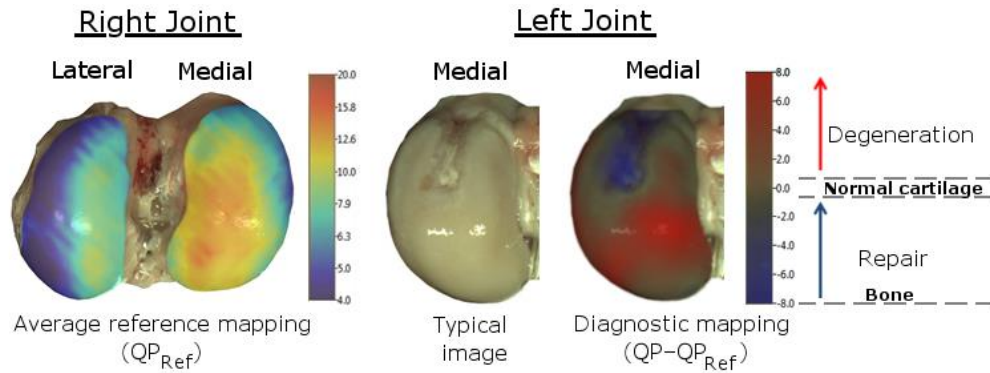


Figure 1. A) Averaged reference Arthro-BST map (QP_{Ref}) for the 10 untreated (contralateral) femoral condyles. B) Typical image and corresponding Arthro-BST diagnostic mapping ($QP-QP_{Ref}$) measured on a L-MFC (similar patterns for both treatments). A value close to zero corresponds to “normal” cartilage, negative values to abnormally thin or weak cartilage (uncompleted repair) and positive values to degeneration.

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