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Scanning Force Arthroscope

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INTRODUCTION: In severe knee injuries, the surface of the joint is often affected. Depending on the age of the patient and the severity of the damage, the surgeon try to repair the cartilage or, in the worst cases, the knee is replaced by prosthesis. After a cartilage replacement, it would be highly desirable to have a minimally invasive device that allows post-operative monitoring of the status of the repaired area. A recent study based on *ex-vivo* indentation of normal, diseased and enzymatically altered cartilage shows that the scanning force microscope (SFM) is a very sensitive tool that allows quantitative measurements of the bioechanical properties of cartilage tissue[1]. We design a robust, reliable and quantitative diagnostical tool, the scanning force arthroscope (SFA), for monitoring the long-term clinical outcomes of such surgical procedures for knee cartilage defects.

INSTRUMENT: The SFA (Fig. 1) has a diameter comparable with current arthroscopic operative instruments (roughly 5 mm). The stabilization of the SFA inside the knee-cavity relative to the surface to be inspected is perform by a pneumatic system: Two sets of balloons, similar to those used in angioplasty, wedge the instrument between the bones, ligaments and the fat pad. A standard four segmented piezoelectric tube is used as scanner. The deflection of the cantilever is detected by an integrated piezoresistor. During the insertion, under arthroscopic control, of the instrument inside the knee, the fragile tip needs a special mechanical protection, which is withdrawn once the instrument is in place.

Fig. 1: A complete SFM setup has been inserted into an arthroscopic cannula.

MEASUREMENTS: The stability of the pneumatic stage was checked in a series of tests, for which the knee cavity was modeled by a rubber tube. Load-displacement curves (Fig. 2) have been recorded, using a prototype of SFA in a knee phantom. Recently, this instrument has been inserted in a knee cadaver for testing stabilization in an anatomical environment. Further development and evaluation are in progress.

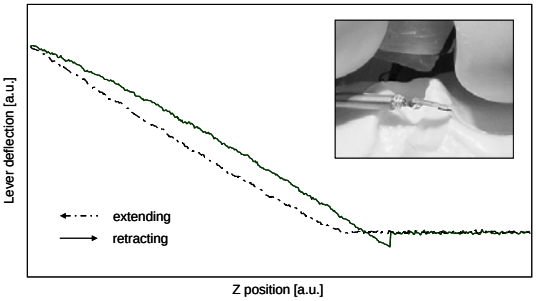

Fig. 2: Load-displacement curves have been recorded in a knee phantom, with the prototype of SFE shown in Fig. 1.

REFERENCE: [1]Stolz M, Raiteri R, Daniels AU, VanLandingham MR, Baschong W, Aebi U (2004) Dynamic elastic modulus of porcine articular cartilage determined at two different levels of tissue organization by indentation-type atomic force microscopy, Biophysical Journal 86:3269-3283.

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