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Research paper

Mobile or fixed unicompartmental knee prostheses? *In-vitro* wear assessments to solve this dilemma

P. Taddei[a], *E. Modena*[a], *Thomas M. Grupp*[b,c], *Saverio Affatato*[d,*]

[a] *Dipartimento di Biochimica "G. Moruzzi", Sezione di Chimica e Propedeutica Biochimica, Università di Bologna, Bologna, Italy*
[b] *Aesculap Ag Researcher & Development, Tuttlingen, Germany*
[c] *Ludwig Maximilian University, Clinic for Orthopaedic Surgery, Campus Grosshadern, Munich, Germany*
[d] *Laboratorio di Tecnologia Medica, Istituto Ortopedico Rizzoli, Via di Barbiano, 1/10, 40136, Bologna, Italy*

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ABSTRACT

The unicompartmental knee prosthesis is an attractive alternative to total knee arthroplasty. Current UKP devices can be subdivided into two groups based on different design principles: fixed bearing knees, where the ultra-high molecular weight polyethylene meniscal component snap or press fits into the tibial tray, and mobile bearing designs which facilitate movement of the insert relative to the tray. The present study was aimed at comparing the *in-vitro* wear behaviour of fixed and mobile unicompartmental knee menisci under two configurations: the femoral components were cemented into a custom-made metallic block or, as a novelty of the present study, into a synthetic femur (i.e. under conditions which should better reproduce the in-vivo behaviour). Analyses were performed using a displacement-control knee wear simulator with "three-plus-one" stations. All the kinematics tests were set in accordance with the ISO 14243-1,2,3.

Fixed and mobile polyethylene menisci showed a different wear behaviour: the fixation-frame influenced directional load transfer through each component in a qualitative and quantitative way. In fact, gravimetric results showed that under the metal block holder fixation, mobile components worn more than fixed components (weight losses of 8.7 ± 2.0 mg and 2.6 ± 1.09 mg, respectively); on the other hand, under the synthetic femur configuration, differences in wear behaviour were less pronounced and mobile menisci underwent a slightly lower weight loss than fixed components (4.5 ± 2.2 mg vs. 6.7 ± 1.4 mg). This different trend was explained in relation to the kinematic schemes of the two fixation methods.

Raman spectroscopy, used to evaluate the UHMWPE crystallinity changes induced by mechanical stress, showed that mobile menisci specimens were more affected than the fixed components in both their superior and inferior surfaces, independent of the fixation-frame.

In conclusion, if tested under conditions which should better reproduce the in-vivo behaviour, mobile UKPs did not show a worse wear behaviour than fixed components in terms of weight losses, although UHMWPE changes at the molecular scale could be detrimental.

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* *Corresponding author.* Tel.: +39 051 6366864; fax: +39 051 6366863.
E-mail address: affatato@tecno.ior.it (S. Affatato).

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