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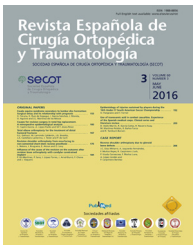

ORIGINAL ARTICLE

Cross-linked polyethylene does not reduce wear in total knee arthroplasty☆

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KEYWORDS
Total knee arthroplasty;
Polyethylene particles;
Synovial fluid

Abstract
Aim: To compare two different types of inserts: ultra-high molecular weight polyethylene (UHMWPE) and cross-linked polyethylene with a quantitative and qualitative study of polyethylene wear particles in synovial fluid 3 years after total knee arthroplasty.
Material and methods: A prospective, randomised, controlled cohort study with blinded evaluation was carried out on 25 patients undergoing staged bilateral total knee replacement, 6 months apart. Knee arthrocentesis was performed on 12 patients 3 years after surgery, and the polyethylene particles were analysed.
Results: No significant differences were found in the number of particles generated by the two different types of inserts at 3 years from total knee arthroplasty (3000×: $\bar{x}$ cross-linked = 849.7; $\bar{x}$ UHMWPE = 796.9; $p = .63$; 20,000×: $\bar{x}$ cross-linked = 66.3; $\bar{x}$ UHMWPE = 73.1; $p = .76$). Likewise, no differences in the probability of finding elongated ($\chi^2 = .19$; $p = .66$) or rounded ($\chi^2 = 1.44$; $p = .23$) particles in both types of inserts were observed. However, the probability of finding fibrillar particles is 3.08 times greater in UHMWPE.

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Conclusions: Cross-linked polyethylene does not significantly reduce the generation of polyethylene particles in patients with total knee arthroplasty, 3 years after the surgical procedure.

PALABRAS CLAVE
Artroplastia total de rodilla;
Partículas de polietileno;
Líquido sinovial

El polietileno de alto entrecruzamiento no reduce el desgaste en la artroplastia total de rodilla

Resumen
Objetivo: Comparar dos pares de fricción (metal/polietileno de ultra alto peso molecular [UHMWPE], metal/polietileno de alto entrecruzamiento) mediante análisis cuantitativo y cualitativo de partículas de polietileno en líquido sinovial a los 3 años postintervención en pacientes portadores de prótesis total de rodilla (PTR).
Material y métodos: Se llevó a cabo un estudio de cohortes prospectivo, aleatorizado, con evaluación ciega incluyendo 25 pacientes a quienes se intervino de PTR de manera bilateral, con 6 meses de diferencia. A los 3 años postintervención, se realizaron artrocentesis de rodilla a 12 pacientes y se analizaron las partículas de polietileno.
Resultados: No se hallaron diferencias significativas en el número de partículas generadas por los diferentes insertos de polietileno a los 3 años tras la implantación de una artroplastia total de rodilla (3.000×: $\bar{x}$ entrecruzado = 849,7; $\bar{x}$ UHMWPE = 796,9; p = 0,63; 20.000×: $\bar{x}$ entrecruzado = 66,3; $\bar{x}$ UHMWPE = 73,1; p = 0,76). Tampoco existen diferencias significativas entre los 2 tipos de inserto, entre la posibilidad de encontrar partículas de forma elongada (χ^2 = 0,19; p = 0,66) ni redonda (χ^2 = 1,44; p = 0,23). Sin embargo, la probabilidad de encontrar partículas de forma fibrilar es 3,08 veces mayor en el UHMWPE.
Conclusiones: El polietileno altamente entrecruzado no reduce significativamente la generación de partículas de polietileno en aquellos pacientes intervenidos mediante una artroplastia total de rodilla, con muestras a 3 años postintervención.

Introduction

The biological effects of wear are a limiting factor over the medium to long term for the survival of a total knee arthroplasty.[1]

Different prosthetic materials have been designed to reduce the production of polyethylene and minimise its biological effects.[2]

Ultra high molecular weight polyethylene (UHMWPE) is currently the material of choice for the load-supporting surface of total knee arthroplasties. Cross-linked polyethylene emerged as an alternative to UHMWPE based on the hypothesis that it would reduce wear.

Several studies have been performed in recent decades with the aim of finding a way to reduce polymer wear in total knee prostheses (TKP) using cross-linked polyethylene, thereby improving the mechanical properties of the load-supporting material.[3]

Although the results obtained using cross-linked polyethylene in total hip prostheses have been highly encouraging,[4,5] its benefits in comparison with UHMWPE in TKP are still controversial.[6–9]

Factors such as the number, size and shape of the wear particles of polyethylene seem to be critical in the development of osteolysis. A greater volume and sub-micrometre size of polyethylene wear particles stimulate a greater response by the macrophages.[8–11] Wear particles are generated in the joint and disperse in the synovial fluid. Some of them remain in the capsule, while other migrate towards the bone-implant interface, causing osteolysis and aseptic loosening.[11]

The most significant characteristics of the adverse biological reactions associated with failure of a total arthroplasty are the size, concentration, material and shape of wear particles. The size of the particles is significant as phagocytes play a key role in macrophage activation.[8] The critical size range for phagocytosis induction after the activation of the macrophages by wear particles has been estimated to stand at from .2 to 10 μm.[12]

The association between the rate of polyethylene wear and osteolysis or loosening has been described by several authors. Kobayashi et al. found that the morphological characteristics and concentration of polyethylene particles accumulating in the tissues were the most important factors in the pathogenesis of osteolysis.[10]

Objectives

The chief aim of this study is to compare the number and concentration of particles in the synovial fluid following