

Crosslinking UHMWPE for use in total knee arthroplasties

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Abstract

Ultra-high molecular weight polyethylene (UHMWPE) is commonly used for tibial inserts in total knee arthroplasties. Being the softer of the articulating surfaces, UHMWPE sees a great deal of wear and the generation of wear particles [1]. UHMWPE wear particles are highly undesirable as they incite severe inflammatory responses through macrophage and foreign body giant cell activation. The immune response also triggers osteolysis which can lead to loosening and failure of the implant [2]. Crosslinking through irradiation has been introduced as an effective method of reducing wear by limiting plastic deformation and strain softening at the surface. The crosslinking process does have adverse effects on the mechanical properties of the implant including a decrease in fracture toughness and fatigue resistance, but methods are being developed to control this degradation performance [3-5]. The reduction in wear volume, and resulting reduction in osteolysis and implant failure, makes crosslinked UHMWPE a viable option for tibial inserts in total knee arthroplasties.

1. Introduction

The knee sees a great deal of wear and tear from everyday activities. Coupled with any injuries to the joint or degeneration due to osteoarthritis, the degradation of the natural structure can require surgical intervention to reduce pain and restore function. Often the entire joint needs to be replaced with a total knee arthroplasty procedure. As a testament to the abuse the knee joint encounters, over 200,000 people required a knee replacement in 2007 and this figure is expected to increase by up to 66% in the next 25 years due to an increase in older and high risk patients [7].

In total knee arthroplasties, UHMWPE is used for the tibial inserts (Figure 1). Most implants have a metal femoral component rubbing on a UHMWPE bearing surface, so the polymer becomes the primary wear surface [1]. UHMWPE wear becomes a serious issue *in vivo* because osteolysis induced by wear particles is the major reason for failures and revisions of total knee arthroplasties. Revision surgery is highly undesirable. The patient must be subjected to all the risks associated with major surgery again and must also go through a difficult recovery period. The revision surgery can also be more difficult because surgeons have to work with previously cut bones that may be further damaged by osteolysis [1,3,4,8,9].