

Electron-beam irradiation of polymer bracket materials.

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Source

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Abstract

INTRODUCTION:

Electron-beam irradiation can be used to influence the properties of polymers. Electron beams cause cross-linking that enhances the molecular mass of the polymer; this leads to branched chains until, ultimately, a 3-dimensional network is formed. The aim of this study was to evaluate the effect of electron-beam irradiation on polymer bracket materials.

METHODS:

Since polymers are commonly used materials for brackets, polyoxymethylene, polycarbonate, and polyurethane were chosen for this study. The acceleration voltage of the electron-beam device was 10 MeV, and the energy dose was 100 kGy with an electron accelerator (BGS beta gamma service, Rhodotron, Bruchsal, Germany). Three-medium wear, fracture toughness, and Vickers hardness tests were performed. The irradiated samples were compared with untreated control groups.

RESULTS:

Polycarbonate and polyurethane bracket materials have enhanced fracture toughness and Vickers hardness after electron-beam irradiation of 100 kGy and 10 MeV. Polyoxymethylene bracket materials showed significantly lower fracture toughness values after irradiation compared with the untreated control group. Polyoxymethylene had the best mechanical properties, followed by polycarbonate and polyurethane. Almost the same effects could be measured during the 3-medium wear test.

CONCLUSIONS:

Electron-beam postcuring improved Vickers hardness and fracture toughness of polymers with lower mechanical properties (polycarbonate and polyurethane). Polyoxymethylene, with sufficient hardness and fracture toughness, could not be improved with electron-beam postcuring.