# THE EFFECTS OF GAMMA IRRADIATION ON THE BIOLOGICAL CAPACITIES OF ALLOGRAFT BONE

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Whilst osseous allograft materials have no true osteogenic capacity, they can be of considerable biological assistance with osteoinductive capacity.

The ever-present risk of transmission of disease with allograft materials renders some form of secondary sterilisation desirable. This study explores the effects of gamma irradiation from a Cobalt 60 source on the osteoconductive and osteoinductive capacities of morsellised allograft bone.

Seven femoral heads were morsellised and divided into three equal portions. One portion was not irradiated, the second portion was exposed to 15kGray of gamma irradiation, and the remaining portion was exposed to 25kGray. Bilateral tibial windows were created in male nude rats. Five subgroups were created. The first was a negative control in which the tibial window was left empty. The second was a positive control where autograft was inserted into the tibial window. The remaining three were xenograft specimens with the 0, 15 or 25 kGray morsellised bone inserted. End points at three weeks and six weeks were created. Materials were assessed by Faxitron x-ray for bone density. Samples were fixed and decalcified for tissue processing, and were stained with H and E for osteoconductivity, osteoinductivity, osteoclast activity and vascularisation. Whilst there was a difference in osteoinductivity when the autograft was compared with the allograft specimens, the three allograft (or xenograft) specimens demonstrated no difference regardless of gamma irradiation dose.

The osteoconductivity tests (Scheffe's test) demonstrated identical osteoconductivity at 0 and 15 kGray, with a marginal reduction in osteoconductivity at the 25kGray level. It appeared therefore that biological incorporation and consolidation was not affected by 15kGray of gamma irradiation. There may be a theoretical and mild reduction in osteoconduction at 25kGray, but osteoinduction did not appear to be adversely affected.

It may be difficult to justify the risks associated with the use of non irradiated morsellised allograft products in orthopaedic surgery.

# THE EFFECTS OF GAMMA IRRADIATION ON THE MECHANICAL PROPERTIES OF MORSELLISED ALLOGRAFT BONE

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Given the ever-present risk of transmission of disease with allograft materials, various efforts have been directed towards safety and efficacy with terminal sterilisation methodologies. The use of ethylene oxide, hydrogen peroxide, ethanol and pasteurisation all have their inherent difficulties. Gamma irradiation has been favoured by many tissue banks. There have been suggestions that the biomechanical properties including impaction and stiffness are adversely affected by gamma irradiation.

Twelve morsellised femoral heads were each subdivided into three groups. One third of each head was not irradiated, the second third was irradiated with 15kGray of gamma irradiation from a Cobalt 60 source, and the remaining third from each head was irradiated to a 25kGray level. Samples of each allograft specimen were tested using an MTS 858 Bionix testing machine. Each sample was sequentially loaded with rest periods, reproducing an allograft impaction methodology used per operatively. A typical force/displacement curve for each sample was analysed.

The average maximum force for the 0 and 15kGray groups did not change. There was a very minor increase in the average maximum force in the 25kGray group. Similar results were obtained for the slope of the compaction curve.

The force displacement curves were typical of a porous substance with obvious linear and plateau regions. There was no statistical difference between the control and the 15kGray groups. The 25kGray group resulted in a slightly higher stiffness at maximum loads, but there was no statistical difference. Values were not affected by age and sex of femoral head donors. Independent research has demonstrated (Karrholm et al 1999) that stiffness is of prime importance in subsequent prosthetic implant stability. With impaction allografting, it may actually be better to have a stiffer material. It is therefore possible that gamma irradiation improves the biomechanical properties of morsellised allograft bone.

We could not detect any deleterious effects of gamma irradiation on the key biomechanical properties of morsellised bone, and it may therefore be difficult to justify the risks associated with the use of non irradiated morsellised allograft products in orthopaedic surgery.