CAN BIOMECHANICAL PROPERTIES OF LONG BONE ALLOGRAFTS BE PRESERVED DESPITE UNDERGOING GAMMA RADIATION? A SECRET SHARED

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Introduction: Frozen long bone allografts from UMMC Bone Bank are sterilized by gamma irradiation at 25kGy to minimize infectious disease transmissions. The bones must be maintained below -40oC throughout the process to avoid undesired adverse effects on the biomechanical properties. Deep freezing temperatures during irradiation were analyzed based on radiation data retrieved from 2015-2020.

Methodology: Bones were procured from cadaveric donors coordinated by Tissue and Organ Procurement (TOP) team. Donors' medical history and behavioral risk assessment were thoroughly screened. Virology and bacteriology tests were done, only negative results were accepted. Linen and polyethylene bags were used to pack each bone in triple layer and stored in -80oC freezer. Dry ice (DI) and gel ice (GI) were used to pack the bones in a polystyrene box (50cm x 38cm x 36cm) before sending to irradiation facility. Initial and final temperatures were recorded. Minimum (Dmin) and maximum (Dmax) doses absorbed by the bones were obtained from dosimetry analysis. Dose uniformity ratio (DUR = Dmax/Dmin) values were calculated. Surgeons' feedbacks on quality of the despatched bones were obtained via feedback forms.

Discussion: 60 batches were sent for irradiation but only 24 were contained long bones (40.0%). Radiation sterilization process took less than 24 hours. Packed bones from all batches were still frozen after completing the process. This confirms that the bones were irradiated in deep-freezing state (below -40oC). DUR values were close 1, indicating dose distribution was uniform and the minimum doses were not lower than 25kGy. Besides, no allograft-associated complications were reported and surgeons were satisfied with quality of the bone allografts.

Conclusion: Strict adherence to deep freezing temperature during irradiation is paramount to produce safe long bone allografts. This provides protection to biomechanical properties and safe to use for clinical transplantations.