PROCEDURES

The study was approved by Community Tissue Services, an AATB accredited tissue bank. Permission was granted to use four research donors. Male research donors were determined using low-dose gamma irradiation during processing would affect the load bearing capacity and material properties of dense cancellous bone.

**METHODOLOGY & HYPOTHESIS**

The specimens were prepared by removing any remaining muscle tissue and other soft tissue from the lower extremity. A two mm saw was used to remove cartilage and cortical bone (Fig. 1). The initial two donors were not cut according to the anisotrophic orientation of bone. The anisotropic orientation of bone was considered in cutting the second two donors along the long axis of the bone. An 8 mm hole saw was used to create dowels for each of the bone cylinders. Dowels were then cut to a length of 8 mm (Fig. 2). Processing steps consisted of a series of static soaks (saline, antibiotics, isopropyl alcohol) and freeze drying all specimens.

All samples were re-hydrated in sterile saline for a minimum of 5 minutes. Measurements including sample height, weight, and diameter were taken for all samples prior to testing. Volume and density were calculated for each sample from the height, weight and diameter measurements. Ramp displacement on the Instron E3000 was set to a mm/min until maximum displacement of 3 mm was reached (Fig. 3). Ultimate Failure was defined at 10% strain based on similarly designed studies.

All samples were re-hydrated in sterile saline for a minimum of 3 minutes. Measurements including sample height, weight and diameter were taken for all samples prior to testing. Volume and density were calculated for each sample from the height, weight and diameter measurements. Ramp displacement on the Instron E3000 was set to a mm/min until maximum displacement of 3 mm was reached (Fig. 3). Ultimate Failure was defined at 10% strain based on similarly designed studies.

Energy – Toughness

Area under the stress strain curve is a measure of energy and toughness. It represents the ability of a material to plastically (permanently deform) without fracturing or failing. To be tough, a material must withstand both high stress and high strains. A measure of impact resistance.

**DISCUSSION**

The study reflects the results of previous studies using cortical bone that gamma irradiation degrades the structural properties of cancellous allograft bone. The irradiated treatment group showed less ability to absorb energy in dynamic testing. Although statistical significance was reached during fatigue testing, an an order and percentage reduction in cumulative energy was observed. Six (6) of the irradiated samples could not complete dynamic testing, which trends toward increased impact loading and fatigue crack resistance as opposed to an outlier with poor density.

This study is not without limitation. The nature of cancellous bone and variability of bone between donors increases standard deviation, as the material properties of cancellous bone are dependent on the architecture of trabecular bone. The inconsistency in specimen harvest with respect to anisotropy introduced additional variability in results that could be avoided in future studies.

**REFERENCES**

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**COMPARISON OF THE BIOMECHANICAL PROPERTIES OF NON-GAMMA IRRADIATED AND GAMMA IRRADIATED DENSE CANCELLOUS BONE**

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