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The mechanical effect of extracorporeal irradiation on bone

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Extracorporeal irradiation and re-implantation of a bone segment is a technique employed in bone sarcoma surgery for limb salvage in the setting of reasonable bone stock. There is neither consensus nor rationale given for the dosage of irradiation used in previous studies, with values of up to 300Gy applied. We investigated the influence of extracorporeal irradiation on the elastic and viscoelastic properties of bone. Bone specimens were extracted from mature cattle and subdivided into thirteen groups; twelve groups exposed to increasing levels of irradiation and a control group. The specimens, once irradiated, underwent mechanical testing in saline at 37°C. Mechanical properties were calculated by experimental means which included Young's Modulus, Poisson's Ratio, Dissipation Factor, Storage Modulus, Loss Modulus and Dynamic Modulus. These were all obtained for comparison of the irradiated specimens to the control group. We found there to be a statistically significant increase in Poisson's ratio after increasing irradiation doses up to 300Gy were applied. However, here was negligible change in all other mechanical properties of bone that were assessed. Therefore, we conclude that the overall mechanical effect of high levels of extracorporeal irradiation (300Gy) is minute, and can be administered to reduce the risk of malignancy recurrence.