

The Effect of Storage at -70°C and -150°C on the Torsion Properties of the Canine Femur

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Abstract

This study investigates the effect of storage at -150°C in the vapour phase of liquid nitrogen on the torsion properties of whole intact femurs to be used as allografts. Twenty-five adult dog femurs, stripped of all soft tissue, were used. It has been established that storage at -70°C does not significantly affect the torsion properties of bone. In this study we found no significant difference in structural properties in torsion between the allografts stored at -150°C and -70°C . However, cortical hairline cracks, which were not present before storage, after the bones were stored for 3 months and thawed at $1^{\circ}\text{C}/\text{min}$ rate were observed. These cracks fractured longitudinally, and not spirally, when tested to failure and were noted to originate from the vessel foramen. The mean torsion strength of these "damaged" bones was reduced by 48%. We also determined that these hairline cracks occurred during the thawing process at about -42°C . This may suggest an effect of recrystallisation of fluids or water crystals within the "closed" medullary cavity and the foramen, thus increasing the pressure and paying for hairline cracks to propagate from stress risers. No incidence of cortical hairline cracks were observed if the medullary canal was decompressed and the medullary canals washed-out.

In tissue banking whole intact bones as allografts, caution should be taken when selecting the freezing and thawing rates for storage as cortical hairline cracks could result and eventually weaken the strength of the allograft.

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