THE EFFECT OF THIEL EMBALMING OR DEHYDRATION ON BIOMECHANICAL PROPERTIES OF TENDONS, AS COMPARED TO FRESH FROZEN TENDONS.

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Background: Biomechanical research and orthopaedic training is often carried out on human cadavers. Because of rapid post-mortem decay, these cadavers are usually frozen or embalmed. The embalming method according to dr. Thiel is often praised for the preservation of natural colour and texture. However, the normal in-vivo biomechanical properties could be influenced by Thiel embalming.

Furthermore, in most studies which examine the biomechanical properties of tendons and other tissue, care is taken to preclude dehydration resulting from exposure to room conditions. However, the precise effect of dehydration of tendon tissue on the biomechanical properties, has not yet been quantified.

Aims: The primary objective of this study is to examine whether Thiel embalming alters the biomechanical properties of Achilles tendons compared with thawed fresh frozen specimens. The secondary objective of this study is the investigation of the influence of dehydration on biomechanical properties of both thawed fresh frozen tendons and Thiel embalmed tendons.

Materials & methods: Both Achilles tendons from seven human cadavers were used in this study. Each time one of the Achilles tendons was frozen and the other was Thiel embalmed, in order to enable a paired comparison of the biomechanical properties. The tendons were loaded gradually and elongation of each tendon was measured with ‘differential variable reluctance transducers’ (DVRTs) and ‘Digital Image Correlation’ (DIC). The modulus of the toe-region and the linear region (Young’s modulus) of each tendon was calculated via the stress-strain curve. The primary study objective (1) was investigated by comparing the moduli of the fresh frozen group with the Thiel embalmed group. The secondary objective (2) was examined by pair wise comparison of the moduli of the fresh frozen and Thiel embalmed non-dehydrated tendons with the moduli of fresh frozen and Thiel embalmed tendons after two hours of exposure to room conditions.

Results: (1) The Young’s modulus of Thiel embalmed Achilles tendons was significantly higher than the Young’s modulus of fresh frozen tendons (P=0,046).

(2) The Young’s modulus of the dehydrated fresh frozen tendons was significantly higher than the Young’s modulus of fresh frozen tendons (P=0,046).

The Young’s modulus of the dehydrated Thiel embalmed tendons was not significantly different from the Young’s modulus of non-dehydrated Thiel embalmed tendons (P=0,225).

Conclusion: Thiel embalming significantly alters the biomechanical properties of tendons and is thus not suitable for biomechanical testing. The results of this study are in contrast with some other studies that mention a decrease of the modulus of several tissues after Thiel embalming.

Furthermore it was demonstrated that exposure to room conditions of thawed fresh frozen tendons causes a significant increase of the Young’s modulus. It can thus be stated that in studies where moistening of tendons is impossible for longer than two hours, results should be interpreted with caution. A significant alteration of biomechanical properties of Thiel embalmed tendons when exposed to room conditions could not be demonstrated.