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THE ROLE OF WATER IN TENDON BIOMECHANICS.

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Tendon transmits forces from muscle to bone to promote joint movements. Collagen, the main component of dried tendon, shows a hierarchical arrangement from a molecular to a supramolecular level (collagen, tropocollagen, microfibril, fibril and fibre) with an alternating handedness increasing the resistance of fibrils to tension.

Achilles tendons of rat were stretched in vivo and then observed at the transmission electron microscope to measure the fibril diameters and interfibril spaces. Fibril diameter and interfibril space showed a reduction of 18 % and 50 % respectively when compared to relaxed tendons. From a mechanical point of view each fibril resembles a right handed rope that undergoes to a shrinkage when it is stretched.

However the 60-70 % of the total weight of tendon is represented by water. Collagen fibres and hydrophilic proteoglycan aggregates (such as decorin, biglycan, aggrecan and versican) retain the main part of bound and free water, respectively. Free water shows a radial extrusion along the outside surface of the tendon when tendon is stretched.

Tendon sheaths like epitenon and paratenon have been described at the outside surface of Achilles tendon. However between these two collagen sheaths a mesotenon connecting and separating epitenon from paratenon was observable at the scanning electron microscope. Spaces delimited by mesotenon between epitenon and paratenon could represents spaces for water radial extrusion during tendon stretching. A hydrodynamic mechanical model is suggested to explain the mechanical role of water in tendon.

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