

## Anatomical study of the paratendinous tissues and their role in the pathogenesis of the tendinopathy

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According with the recent Literature, the paratendineous tissues have an important role in the pathogenesis of the so-called tendinitis, but their anatomical and histological features are not clear. This research has the aim to analyze the paratendinous tissues from a macroscopic, histological and imaging point of view.

Samples were taken from the Achilles tendon and the tendon of the flexor hallucis longus muscle of thirteen fresh non-embalmed cadaver's feet. All samples were stained with hematoxylin-eosin, Azan-Mallory, van Gieson and Alcian Blue stains and antiS100 and PGP 9.5 antibodies. Measurement were also performed on 60 foot-RMN, both in healthy people and in patients with Achilles tendinopathy.

The paratendinous tissues are made of three different layers: the paratenon, the epitenon and the endotenon. The dissections have demonstrated that the paratenon is in continuity with the crural fascia. It is a layered sheath of collagen fibres densely packaged. It envelops the tendon and isolates it from the surrounding tissues, guarantying its free sliding. The elastic fibres are less than 1%. The epitenon is a dense connective tissue sheath covering the tendons over their entire length. It is rich in elastic fibers, distribute fairly uniformly in the whole thickness. Both paratenon and epitenon contain blood and lymphatic vessels and many free nerve endings. Between the two structures, loose connective tissue rich in hyaluronic acid is present. In some samples, some fibroblast-like cells that stained very well at the Alcian Blue stain were observed. It was postulated that these were specialized cells for the biosynthesis of the HA-rich matrix, that we have called "fasciocytes". The innermost layer of the three is the endotenon, it surrounds the tertiary fascicles of the tendon. It is formed by collagen fibers and it is rich of elastic fibers. It reacts intensively to the Alcian Blu, having an important component of ialuronic acid.

At the RMN, the Achilles paratenon in the healthy patient appears as a homogenous line that surrounds the tendon and the loose tissue near the tendon; it presents a mean thickness of 1.04 mm. The crural fascia appears like a line with a signal slightly increase, localized laterally to the tendon that give the origin to the paratenon with a splitting, it has a mean thickness of 1.19 mm. In the patients affected by tendinopathy a statistically significant ( $p < 0,0001$ ) variation of the thickness of the paratenon is present. Besides, also an increased intensity of signal is evident.

Our findings support the idea that the paratendineous tissues could have a role in the etiology of the so-called tendinitis, in particular thanks to the rich vascularization and innervations. Consequently we suggest that the term "tendinitis" in some cases could be replaced with the term "paratendinitis".

Keywords: Tendon, tendinopathy, paratenon, epitenon, paratendinitis.