Chapter

# Introductory Chapter: Tendons

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## 1. Introduction

The tendons act as a mechanical bridge. Tendons allowing muscle strength to pass to the bones and joints, it also allows the muscle to contract and target movement. There are different types of tendons that reflect muscle morphology and specific functions. Tendon tissue includes all muscle tissue, not just the terminal or starting area of each muscle. The binding layers (epimysium, perimysium, and endomysium) combine in a single organization to contact one or more fixed bone points. There is a contraction fiber in the same tendon near the muscle. It affects the muscle-tendon, and thus the tendon affects the functional function of the muscle. In the context of manual therapy, rehabilitation or surgery, it is important to consider these close relationships between anatomy and function. Tendon tissue can adapt its cellular structure to pathological or physiological stimuli depending on the systemic hormonal environment and age [1]. The primary function of ligaments and tendons is to move from muscles to tendons or to assist movement to transfer force from the bone involved in the movement to the bone (ligaments). Foot and hand tendons net occur in relation to the ligament between them and this is called super-tendons. The concept of super-tendons has been proposed to explain that such networks exhibit a more functional range than their members [2].

In the organism, ligaments and tendons act as connective tissues that act as force-transmitting structures and provide musculoskeletal movement. Typical features of normal tendon tissue are parallel-aligned tenocytes and collagen I fibers. In addition, the extracellular matrix consists of proteoglycans, elastin, and glycoproteins. There is almost no vein in the tissue and nutrition is provided along with oxygen as well as nutrition at the osteotendinous junctions and vascularized myotendinous. Growth factors are vital for tendon homeostasis, development, and regeneration. The most important of these is growth factor-beta. Structural changes on tendinopathy and aging comprise the degree of vascularization (aging leads to less tendinopathy and more vascularization), extracellular matrix (age-related lower collagen content and tendinopathic collagen disorder), and proteoglycan tendon (small tendons, tendinopathic tendons) [3].

Tendons' basic structural properties situations are combined and shown in **Figure 1**. The main differences in morphology and organization of collagen fibers, has in terms of vascularization and cell density and morphology. In addition, extracellular matrix proteins in the normal aging and degenerative change the condition of the tendon and ligament [4]. Aging tendon tissue is different in terms of the tendon cells from healthy tissue morphology and finer turn into tenocytes have larger nuclei in older age. As for the vascularization is reduced and there are fat deposits in the connective tissue. Finally, tendinopathic tendon is more vascularized than normal tendon with irregular collagen fibers and the enriched with extracellular matrix proteoglycans (**Figure 2**).

According to the figure, healthy tendon tissue consists of densely packed collagen fibers in an amorphous ground material containing connective tissue of

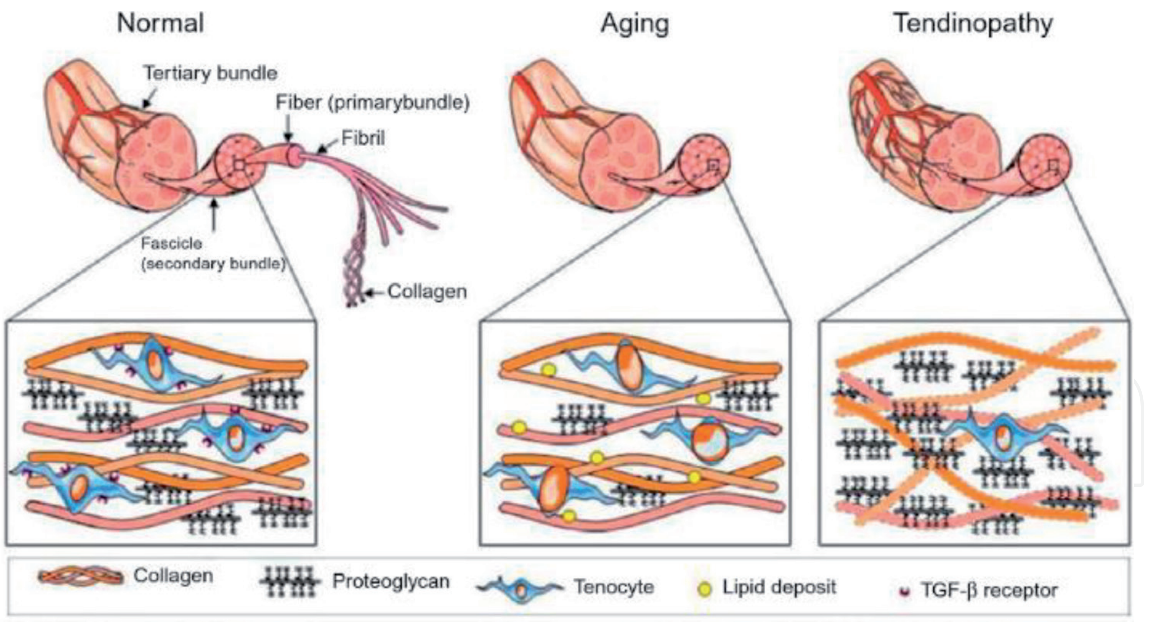


**Figure 1.**
*Structural changes of tendons [4].*

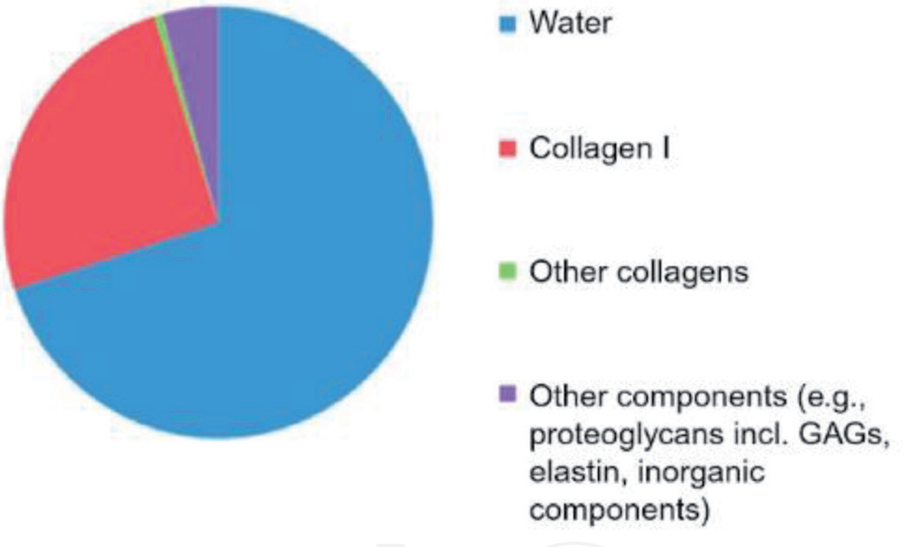


**Figure 2.**
*Composition of tendon tissue [3].*

water (60–80% of total wet weight), collagen (65–86% of dry weight, mostly type I collagen 95–98%) proteoglycans (1–5%), elastin (1–2%) and 0.2% inorganic components. In addition, tendon cells appear arranged in parallel lines [5].

The biomechanical behavior of a tendon is not only related to the magnitude of tension stress, but also to the shape of the tendon itself. The muscles used to perform precise and precise movements such as bending of the fingers have long and thin tendons, while those who perform strength and endurance actions such as quadriceps femoris and sural turaleps have shorter and more robust tendons. A short tendon has greater tensile strength than a long tendon because the load required to achieve fracture is much larger in the short tendon of the same diameter. A long tendon may undergo a greater deformation than a short tendon before it tears. The strength and resistance of a tendon are therefore two different entities and depend on the diameter and length of the tendon itself. The biomechanical properties of the tendon are related to the diameter and arrangement of collagen fibrils, tendons exposed to high stress are less flexible, large-diameter fibrils than small-diameter fibers [1].

The cells forming the tendons are generally thought to consist of tenocytes only for maintenance, repair, and regeneration. In scientific research, special cell types have been observed in tendons that can self-proliferate and differentiate into different cell types [6, 7]. In 2007, Bi et al. directly showed the presence of stem cells in tendons. Bi et al. showed that there is a small cell population carrying stem cell characters such as the ability to clone, self-proliferate and differentiate into other cells in human and mouse tendons [8]. After these developments, interest in tendon physiology, pathology, and tendon tissue engineering has increased. Tendon-derived stem cells, like other stem cells, play a role in tissue regeneration, maintenance, and repair within their local microenvironment. The in vivo niche environment of tendon-derived stem cells is still unknown. Although tendon stem cells are generally used to identify these cells, many names are used in the literature.

Muscles and tendons are the most commonly injured tissues in sports individuals. The limited number of studies on muscle-tendon injuries, especially in childhood and adolescence, has caused our knowledge to be quite limited compared to bone, growth cartilage, joint cartilage, and ligament injuries. Acute injuries such as muscle contusion or strain are seen in childhood and adolescence, mostly due to macro trauma. These injuries usually have a limited, benign course and allow the athlete to return to training and competitions in a short time. Overuse injuries resulting from repeated microtrauma and prolonged exposure to submaximal stress, although less common than acute injuries, require a more intensive treatment program. Overuse injuries cause individuals to stay away from sports for longer. Collagen connective tissue is an important part of a healthy tendon and in athletic performances, its robust function is a prerequisite for the smooth functioning of muscle-tendon units. An accurate understanding of the structure and metabolism of the tendon connective tissue is necessary to understand the etiology and pathogenesis of tendon injuries and athletic diseases and histopathological findings in each disease. In addition, this information is required to plan the treatment and rehabilitation protocol for a patient with a specific tendon problem. Future basic tendon science studies, not only in the field of rehabilitation and medicine but also in sports medicine, should explain where the pain after injury comes from chronic tendon disorders and how it can accelerate and accelerate tendon tissue healing after an injury [9].



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