Tendons and Ligaments

Thesis

Submitted for Partial Fulfillment of Master Degree of Orthopaedics

By

Ashraf Mohamed Abdallah Elseddawy

M.B; B. Ch. - Ain Shams University

Supervised by

Prof. Dr. Rafeek Ahmed Sadek

Professor of Orthopaedics

Faculty of Medicine - Ain Shams University

Prof. Dr. Mohamed Sadek Elsokkary

Assisstant Professor of Orthopaedics

Faculty of Medicine - Ain Shams University

Faculty of Medicine

Ain Shams University

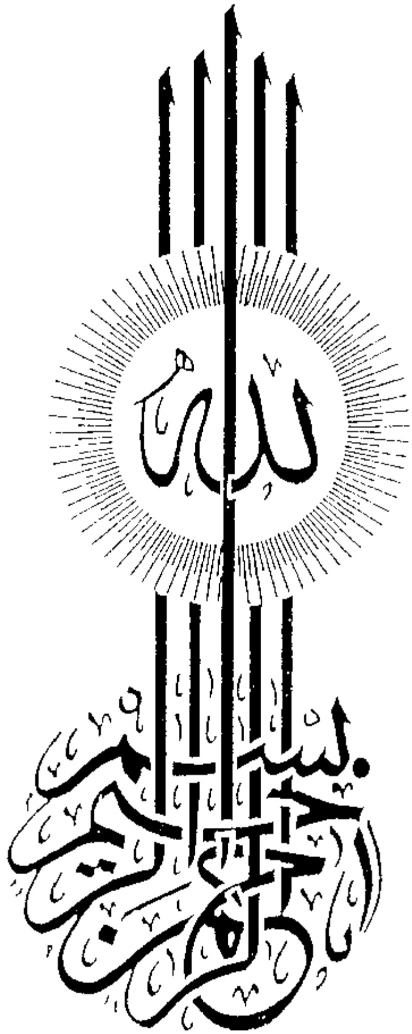
1995

ACKNOWLEDGMENTS

First of All thanks to God

I wish to express my deepest gratitude and thanks to Professor Dr. Rafeek Ahmed Sadek, Professor of Orthopaedics, Ain Shams University, for giving me the privilage of being under his supervision in this essay. His constant encouragement and constructive guidance were of paramount importance for the initiation and progress of this work.

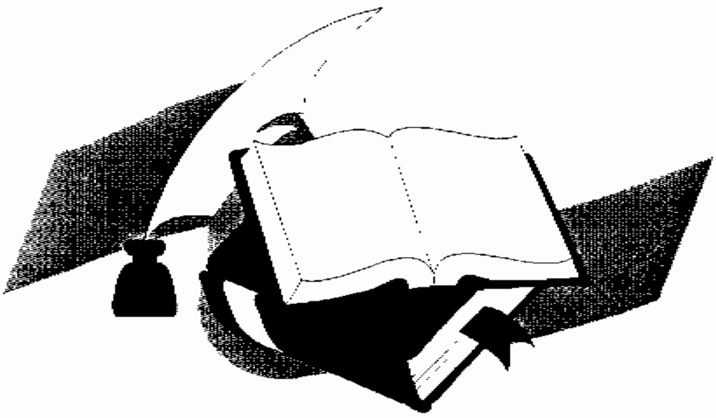
I would like to express my sincere thanks to Professor Dr. Mohamed Sadek Elsokkary, Assisstant Professor of Orthopaedics, Ain Shams University for his remarkable effort, considerable help, and continuous supervision and guidance, which were the major factors behind the completion of this essay.


بسم الله الرحمن الرحيم

Also, I wish to thank all my professors and colleagues for the continuous cooperation and help they offered me all through.

I would like to express my heartly thanks and deepest gratitude to all the members of my family, my parents and my wife, for their support, understanding and tolerance all the time till this essay is completed and always.

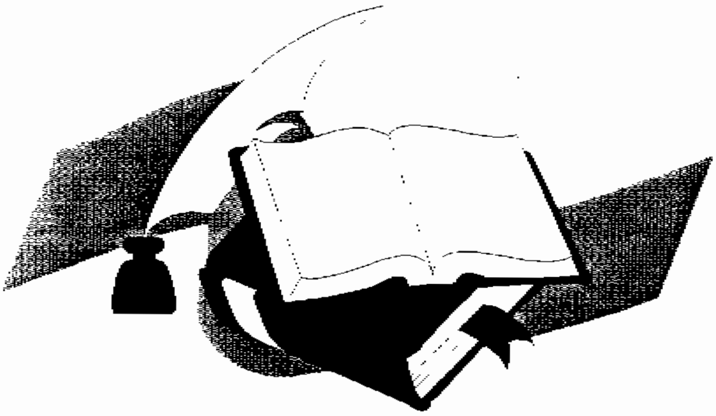
Ashraf Elseddawy



INTRODUCTION AND AIM OF THE WORK

articular surfaces, are integral factors in producing close packing, limiting most habitual movement[3].

The injury and repair of soft tissues (tendons, ligaments and joint capsules), in and about diarthroidal joints remain significant problems in the practice of orthopaedics. With an increased interest in athletic activities and an increased use of high speed, energy efficient transportation, soft tissue injuries are playing an increasingly important role in clinical practice. Such injuries produce both acute and chronic disability and, although once thought to be of minor consequences have been shown to lead to joint degeneration. Given the increasing span of human life, together with the increase in frequency of such soft tissue injury, prevention of its sequelae and consequent chronic disability is likely to be more significant in the future[2].



GROSS ANATOMY OF TENDONS AND LIGAMENTS

Gross Anatomy of Tendons and Ligaments

Gross Anatomy of Tendons

Tendons vary in shape and size from the small fibrous strings that form the tendons of the lumbrical muscles to the large fibrous cords that form the Achilles tendon. In any shape or size, however, they join muscle to bone. They transmit the force of muscle contraction to bone. They consist of three parts, the substance of the tendon itself, the muscle tendon junction, and the bone insertion. Connective tissues surrounding tendons allow low friction gliding and access for blood vessels to the tendon substance[1].

Since tendons are composed of collagen and their vascular supply is sparce, they appear white. Taking the form of cords or straps, they are round, oval, or elongate in section. Some tendons are commonly double and some have minor strands connecting with adjacent tendons. Their surface are smooth but longitudinal ridging by coarse fasciculi is common in large tendons e.g., the osseous aspect of the angulated tendon of obturator internus[3].

Many tendons have a well developed mesotenon, a structure that attaches the tendon to the surrounding elastic connective tissue that can stretch and recoil with the tendon and provide a blood supply to the tendon substance. In certain locations, the surrounding connective tissue forms sheaths that enclose the tendon and specialized pulleys of dense fibrous tissue that influence the line of tendon action.

Peritendinous structures: Normal tendon gliding, efficient transmission of muscle forces to move joints, and tendon nutrition and nerve supply depend on the peritendinous connective tissue structures, sometimes called peritenon. These structures range from loose connective tissue to elaborate well defined mesotenons, sheaths and pulleys.

Where tendons follow a straight course, the surrounding tissue usually consists of loose areolar tissue. In some locations, this tissue must stretch several centimeters and then recoil without tearing or disrupting the tendon blood supply.

Where tendons change course between their muscle attachment and their bone insertion, often as they cross or near a joint, the surrounding connective tissue may form a discrete tendon sheath or a bursa. These structures allow low friction movement between the tendon and adjacent bone, joint capsule, tendon, ligament, fibrous tissue retinacula, or fibrous tissue pulley. Tendon sheaths and bursae resemble synovial joints in that they consist of cavities lined with synovial like cells, they contain synovial like fluid, and they facilitate low friction gliding between two surfaces. Mesotenons generally attach to one surface of a tendon within a tendon sheath and provide the blood supply to this portion of the tendon[1].

Tendons are strongly attached to bones, not only via their periostea but also often by tendon fasciculi which may penetrate deeply into cortical asseous tissue. Sections of fresh bone show that at the sites of tendonal attachment there is often a plate of fibrocartilage, where this is thin or absent the bone surface is rough, but, when fibrocartilage is present, the bone surface is quite smooth in cleaned skeletal material[4].

The functions of such layers of fibrocartilage are not clear; where tendons insert into bones which replace a cartilage precursor relatively late in development e.g., as epiphysis, fibrocartilage may be particularly thick and may represent a remnant of the earlier state; however, cartilage is also found at other sites and may therefore have a continuing functional importance, as yet unknown[3].

Blood and Lymphatic Supply

The blood supply of tendon is relatively scant; small arterioles from adjacent muscle ramify longitudinally between their fascicles, anastomosing freely, accompanied by venae comitantes and lymphatic vessels. Lymphatics pass along blood vessels and drain into regional lymph nodes.

This longitudinal plexus is augmented by small vessels from adjacent loose connective tissue or synovial sheaths[5].

At osseous attachments, vessels are restricted to transverse capillaries and no vessels pass between bone and tendon at these sites; such osseous surfaces are usually devoid of foramina[3]. The metabolic rate of tendon is very low, but increases in reaction to infection or injury. Repair involves the initial proliferation of connective tissue cells associated with collagen fibers, followed by interstitial deposition of new fibers[6].

Nerve Supply

The nerve supply is largely or perhaps solely sensory; evidence of any vasomotor control is lacking. Specialized mesotendinous sensory endings (Golgi tendon organs), exist near musculotendinous junctions; their large myelinated afferent fibers course centrally within branches of muscular nerves or in small rami of adjacent peripheral nerves[7]. Postnatally, tendons grow interstitially particularly at musculotendinous junctions, where high concentration of fibroblasts occur performing rapid elaboration of collagen, there is a decreasing growth gradient towards osseous attachments[3].

Gross Anatomy of Ligament and Joint Capsule

Ligaments and joint capsules have similar structures and functions, and in some regions ligaments and capsules form a continuous structure. Unlike tendons; ligaments and joint capsules more often assume the form of layered sheets or lamellae. Both ligament and capsule attach to adjacent bones and cross synovial joints, yet allow at least some motion between the bones. Ligaments have the primary function of restraining abnormal motion between adjacent bones. Joint capsules also restrain abnormal joint motion or displacement of articular surfaces, but usually to a lesser extent. Both ligament and capsule consist of a proximal bone insertion, ligament or capsular substance, and a distal bone insertion.

Ligament

Surgeons and anatomists have named ligaments by their location and bony attachments (e.g., the anterior glenohumeral ligament or the anterior talofibular ligament), or by their site (e.g., the medial collateral ligament of the knee or the posterior cruciate ligament of the knee). Unlike joint capsules, ligaments vary in their anatomic relation to synovial joints. This variability separates ligaments into three types. Intraarticular or intracapsular, articular or capsular, and extraarticular or extracapsular. Intraarticular ligaments including the cruciate ligaments of the knee, have the form of distinct separate structures. In contrast, capsular ligaments, like the glenohumeral ligaments, appear as thickening of joint capsule.

Extraarticular ligaments, like the coracoacramial ligament, lie at a distance from a synovial joint. Despite these differences in relation to joints, the function of the three ligament types remains that of stabilizing adjacent bones or restraining abnormal joint motion[1].

Joint Capsule

Joint capsule forms a fibrous cuff around the joint. The ends of the capsule are attached around the articular ends of the bones concerned in the joint, usually in small bones near the peripheries of articular surfaces, but this varies considerably in long bones, in which the attachment may be at a significant distance from the articular surface[3].

A synovial membrane lines the interior of the joint capsule, and loose areolar connective tissue covers the exterior. This loose tissue often contains networks of small blood vessels that supply the capsule. Nerves and blood vessels from this loose connective tissue penetrate the fibrous capsule to supply the capsule and outer layer of synovium.

Tendons and ligaments reinforce some regions of joint capsules. For example, the glenohumeral ligaments form part of the glenohumeral joint capsule, and the expansion of semimembranosus tendon contributes to the posterior oblique ligament of the knee and part of the knee joint capsule[1].

Blood and Lymphatic Supply

Ligaments and joint capsules receive blood supply from periarticular arterial plexuses whose numerous rami pierce capsules to form subsynovial vascular plexuses. Some synovial vessels end near articular margins in an anastomotic fringe (the circulus articularis vasculosus). A lymphatic plexus in the synovial subintima drains along blood vessels to the regional deep lymph noes.

Nerve Supply

Movable joints are innervated in general by nerves supplying their muscles, probably establishing local reflex loops involved in movement and posture. Although the branches concerned vary, each innervate a specific capsular region but their territories freely overlap.

The regions tautened by muscular contractions is usually innervated by nerves supplying antagonists. For example, the hip joint's capsule, on stretch inferiorly in abduction, is here supplied by the obturator nerve, tension in it thus producing reflex contraction of adductors, usually enough to prevent damage. However, this is not so at the shoulder, where the axillary nerve innervates the anteroinferior capsular region[8].

Myelinated fibers in articular nerves have Ruffini endings, lamellated articular corpuscles, and some like the neurotendinous organs of Golgi. Simple endings are numerous at attachment of ligaments and capsules;

they are terminals of non myelinated and finely myelinated fibers believed to mediate pain. Ruffini end organs are variably orientated in the knee joint's capsule, principally in its flexor region, they respond to stretch and adapt slowly. Lamellated corpuscles, less numerous than Ruffini endings are sited laterally and adapt rapidly, they respond to rapid movement and vibration; both register speed and direction of movement. Golgi end organs, with the largest mylinated nerve fibers (10 - 15 μm diameter), are like those at neuromuscular junctions and adapt slowly, they mediate sense of position[9].