Anatomy of Tendon

A tendon is the end point of a muscle, the structure that attaches muscle to bone. A muscle is divided into 2 parts, each constructed of different material. The fleshy part of the structure is the muscle belly and on either end are tendons. The belly is made of cells called myofibers, cells that are shaped like drinking straws, long and thin. These cells are bundled together in groups called fascicles. Each fascicle is then "wrapped" in a connective tissue covering. Myofibers are the pliable and stretchy part of the muscle that has contractile properties. The belly is able to contract or shorten its overall length to pull bones closer together and create movement. The belly is well supplied with blood and nutrients which speeds healing of injured muscles.

Physiology of tendon

Tendons function to insert muscles onto bones in specific locations, in order to transmit the force of a muscle contraction across a joint. In addition, tendons may possess some ability to prevent trauma to muscle by absorbing the forces transmitted through them. Tendons contain 95% type I collagen with less than 5% type III collagen and they are sparsely populated by fibrocytes called tenocytes. The blood supply of tendons is sparse and arises from the myotendinous junction, the epitenon tissue and to a lesser extent from the bone at the tendon's insertion site. Significant nutrition is also obtained from synovial fluid in sheathed tendons

Type of Tendons

1. the extensor tendon runs down the front of your horse's leg and extends (straightens) it
2. the flexor tendons run down the back of your horse's legs and flex (bend) it. There are two – the superficial digital flexor tendon and the deep digital flexor tendon. They're easy to feel at the very back of your horse's lower leg, with the superficial digital flexor tendon the furthest back, just underneath the skin.

Tendon repair surgery

Tendon repair is surgery done to treat a torn or otherwise damaged tendon. Tendons are the soft, band-like tissues that connect muscles to bone. When the muscles contract, the tendons pull the bones and cause the joints to move.

When tendon damage occurs, movement may be seriously limited. The damaged area may feel weak or painful.

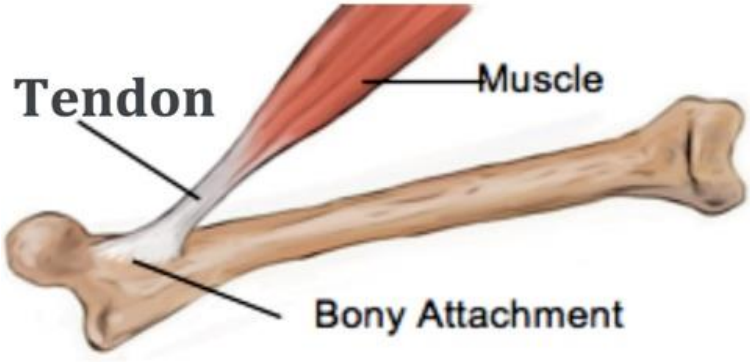
Tendon repair surgery may be helpful for animal who has tendon injuries that are making it difficult for them to move a joint or are very painful.

There are two main types of tendon:

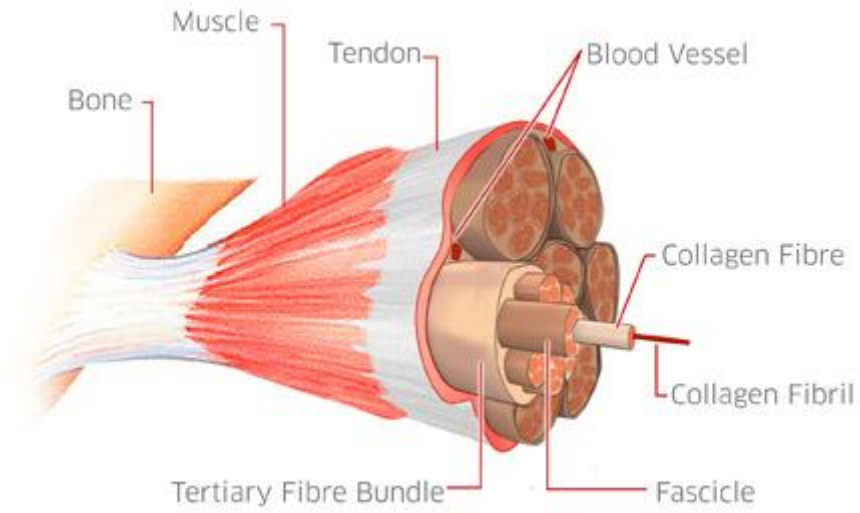
-**Flexor tendons,** which work by tightening to pull on the bones.

-**Extensor tendons,** which work by stretching when a part of the body needs to move outward, such as when standing on the toes or straightening the fingers.

Tendons have different shapes and sizes depending on the role of the muscle. Muscles that generate a lot of power and force tend to have shorter and wider. tendons that perform more fine delicate movements these tendon long and thin



A cross section of a tendon shows a highly organized pattern of structures which reflect the function of the tendon. The network of nerve fibers, blood and lymph vessels communicate with each other to detect and respond to loads applied to the tendon.



Tendon injuries often require surgical treatment, the aims of tendon repair surgery are:

-to bring back normal range of motion and function to an injured tendon

-to provide pain relief

blood supply.

The blood vessels originate from vessels in the perimysium, periosteum, and via theparatenon and mesotendon.

Nerve supply

The innervation of tendons start from cutaneous, peritendinous and muscular nerves.

Achilles tendon

The Achilles tendon or heel cord, also known as the calcaneal tendon, is a tendon of the back of the leg, and the thickest in the body

The Achilles tendon connects muscle to bone, like other tendons, and is located at the back of the lower leg.

Diagnostic

-The physical exam is very important to diagnosing and localizing the injury as well as identifying what therapies might be needed

-other tests that your veterinarian may recommend to diagnose the problem are x-rays and ultrasound.

Procedure

The following steps occur during most tendon repair operations:

-The surgeon make at least one cut through the skin in the area above the injured tendon so they can see it and look for injuries.

- they remove any damaged tendon tissue.

-they carefully sew any torn ends of the tendon back together.

-Once this is complete, the surgeon will sew the cut skin back together with medical stitches.

- cover the wound and stitches with fresh medical dressings.

-A splint or similar dressing can reduce tension while the tendon heals. If there is too much tension on the tendon, the repair will fail and re-tear.

Suture techniques

Bunnuell stitch-

Modified Bunnuell stitch-

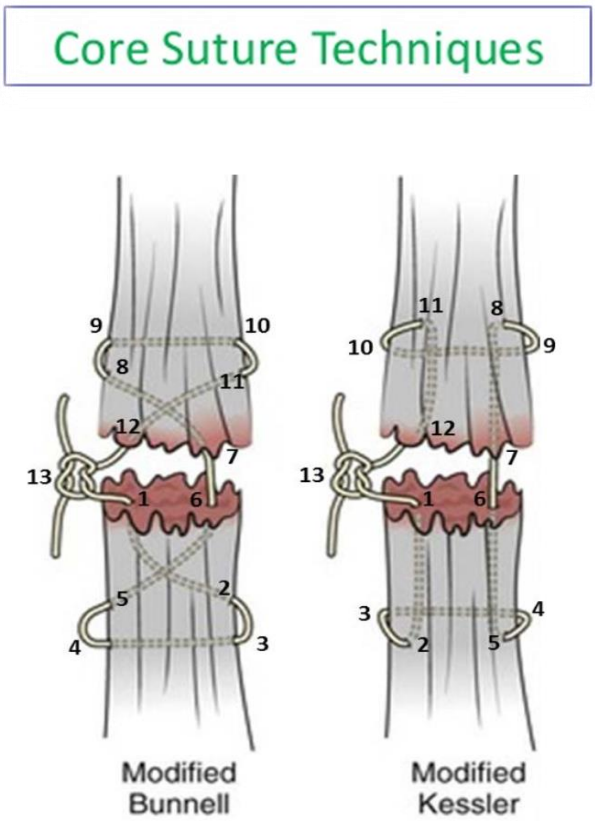
Crisscross stitch-

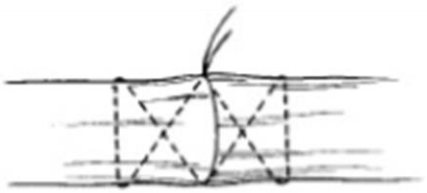
Robertson and Al-qattan interlock stitch-

Kessler stitch-

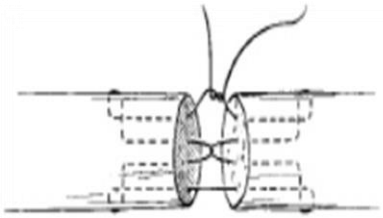
Modified Kessler stitch-

Tajima modification of Kessler-





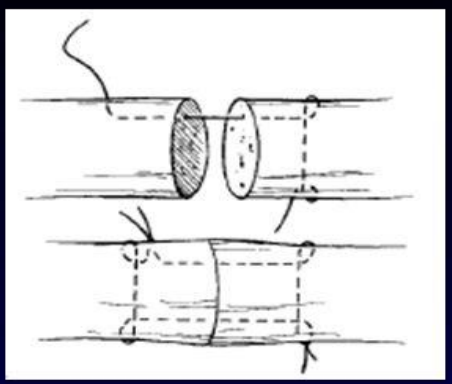
Crisscross stitch



Robertson and Al-Qattan
Interlock stitch

Bunnell stitch

Tajima modification Of kessler stitch with double loop at repair site



Kessler stitch

Tendon Healing:

The three Phases of Tendon Healing

-The inflammatory phase: which occurs during the first 7 days. Even a small amount of bleeding occurs after the surgery.

-The proliferative (new cell formation) phase: which occurs 2 to 3 weeks after surgery, new cells replace the inflammatory cells to produce scar tissue (collagen) and new blood vessels which replace the original clot.

-The maturation and remodeling phase: This begins around week 3 after surgery , scar tissue (collagen) matures. Immature scar tissues are replaced by mature tissues. The collagen is continually remodeled until permanent repair tissue is formed.

Tendon healing takes at least 12 to 16 weeks, but may indeed take up to 26 weeks to reach its final strength.

Aggressive early movements following surgery, which overly stresses the repair and exceeds the mechanical strength of the repair construct, must be avoided.

Modern technique fast heal tendon injury

1- Autologous conditioned serum (ACS) : Autologous blood-derived biologicals, including autologous conditioned serum (ACS), are frequently used to treat tendinopathies in horses despite limited evidence for their efficacy. The purpose of this study was to describe the effect of a single intralesional injection of ACS in naturally occurring tendin.

2- Laser: The effects of laser therapy on tendon healing have also been studied. Laser phototherapy increased collagen production in rabbits subjected to tenotomy and surgical repair. In a placebo-controlled, double-blind, prospective study of twenty-five patients with a total of forty-one digital flexor tendon repairs, laser therapy

reduced postoperative edema but provided no improvement with regard to pain relief, grip strength, or functional results compared with controls.

3- PEDF-derived: Tendon stem/progenitor cells (TSPC) exhibit a low proliferative response to heal tendon injury, leading to limited regeneration outcomes. Exogenous growth factors that activate TSPC proliferation have emerged as a promising approach for treatment. Here, we evaluated the pigment epithelial-derived factor (PEDF)-derived short peptide for treating acute tendon injury and to determine the timing and necleostemin-positive TSPC in the tendon healing process

4- Magnetic fields: It also demonstrated that magnetic fields can induce a faster healing rate of injured tendons and is a good noninvasive therapy for tendon injury. magnet could be explained through wound closure, histological changes, reduction of proinflammatory cytokine levels, proapoptotic cell death, increased angiogenesis and mast maturation.

5- Platelet-Rich Plasma (PRP) has been widely used in orthopaedic surgery and sport medicine to treat tendon injuries. However, the efficacy of PRP treatment for tendinopathy is controversial. numerous basic science studies have shown the beneficial effects of PRP in healing tendon injuries. Specifically, growth factors in PRP have significantly enhanced the healing of tendon injuries such as tendinopathy [21–24]. These include PDGF, TGF-β, VEGF, EGF, IGF-I, FGF, and HGF

6- Heat : Heat can increase blood flow to an injury, which may help promote healing. Heat also relaxes muscles, which promotes pain relief. Tendons are bands of fibrous tissue that connect muscles to bones. Tendons help muscles initiate and control movement in your joints.

7- Bioscaffold: to support and enhance repair have included autogenous, allogenous and synthetic materials. One described method involves application of a bone plate to the tendon repair, however, a second surgery must be performed to remove the plate 8 to 10 weeks postoperatively.

8- Carbon fiber and polypropylene mesh, however these implants may incite foreign body reactions to the materials postoperatively.

9- The positive effects of ultrasound on tendon healing. In vitro studies have also demonstrated that ultrasound can stimulate cell migration, proliferation, and collagen synthesis of tendon cells that may benefit tendon healing.

Ligaments in horses

Horses ligaments are elastic soft tissues which attach their bones to their joints and provide support to the joint.
The main purpose of a horses ligament is to maintain their bones in alignment and to support and stabilise the horses joints, as our ligaments do for us. Some joints have one ligament supporting them on both sides so there are many ligaments within a horses anatomy.
Collateral ligaments are found in the coffin, fetlock and hock joints. Palmar annular ligaments are only found in the fetlock. Whilst the accessory (check) ligament is next to the deep flexor tendon and the meniscal and cruciate ligaments support the stifle .
Common injuries to horses ligaments
One of the most commonly reported ligament conditions found in a horse is Suspensory Desmitis but as with fans your horse can experience issues with many of its ligaments, often dependant on the exercise. Jumping horses will put stress on ligaments different to those who compete in barrel racing or dressage, as an example.
The most commonly reported cause of a ligament injury to horses is 'trauma through exercise .'
The more active the horse, the more at risk they are from injuring a ligament .
Horses in active work such as sports horses competing in barrel racing, polo, dressage, eventing, showjumping are at much higher risk to ligament strains than a pet horse turned out at home.
Although ligament injuries are widely found it is with great interest how few ligament injuries are seen in the sports horse community at the highest level; often associated to the horse being trained to stretch the ligament on an ongoing basis. As an example, a professional

showjumping horse will stretch its ligaments and tendons to almost impossible levels and show no signs of pain or discomfort. As with someone beginning to work out a home, aches and pain and strains are more frequent as the body begins to adjust to the new activities it is being subjected to - as this is the same for horses.

Retiring sport horses however have higher-risk with issues with their ligaments (and tendons) and as such many are treated accordingly throughout their career and into their retirement .
The most widely diagnosed ligament injuries in horses are suspensory ligament injuries, annular ligament injuries and collateral ligament injuries.

Suspensory Ligament Injuries in horses

The suspensory ligament in a horse is there to support the fetlock and prevent it from hyperextending within exercise. The ligament itself starts behind the cannon bone in both the front and back legs and runs down the back of the cannon bone before branching into two and attaching to the sesamoid bones at the back of the fetlock. Although the ligament is strong it is only slightly elastic.
Due to the location and purpose of the suspensory ligaments, unfortunately injuries to the suspensory ligaments are common and particularly in sports horses or animals leading an active lifestyle.
The suspensory ligament goes through excessive stress when a horse is travelling at speed and when landing from a jump. In essence a suspensory ligament strain is through over stretching the ligament (hyperextending) which creates trauma within the ligament itself.
Although a suspensory ligament injury can occur through a single movement many suspensory ligament issues are actually caused through repetitive strain and over a period of time. More serious suspensory ligament injuries will often show a complete tear (or hole) in the ruptured fibres of the ligament.

Treating suspensory ligament injuries in horses can be a long process. A period of immobilisation (box rest and recuperation) will be required, sometimes for as log as 12 months, and in some cases painkillers and anti-inflammatories will be administered. Surgical intervention may be required if the injury to the ligament is severe. High hind suspensory ligament injuries are notoriously difficult to recover from without exacerbating the injury - because of this many owners now look to diagnosis tools to establish how the ligament has healed prior to returning

to light exercise. Thermal imaging is relatively low cost technique now used within the equine community .

Annular Ligament injuries in horses

The annular ligament, similarly to the suspensory ligament, is located at the back of the fetlock and is found within the tendon sheath of the horse. When the ligament is injured and begins to become inflamed or swollen the the annular ligament will begin to constrict the tendon sheath. This puts additional pressure on the surrounding tendons and can lead to various levels of pain and lameness.
Damage to the palmar or plantar annular ligament (PAL), created through either direct or indirect trauma can lead to primary desmitis. Secondary desmitis is created through septic tenosynovitis and non infectious tenosynovitis.