The Treatment of Tendon Pain with Traditional Chinese Medicine

By: Mark Kastner

Keywords: Acupuncture, Chinese medicine, musculoskeletal, tendinosis, tendinopathy, tendinitis, tendon pain, electro-acupuncture, collagen regeneration, lateral epicondylitis, tennis elbow, high hamstring pain.

Abstract

This article describes the treatment of tendon pain using acupuncture and adjunctive Chinese medicine techniques. The pathomechanism of tendon pain is discussed from the perspectives of biomedicine and Chinese medicine, and a comprehensive treatment protocol for the treatment of tendinosis is provided.

Introduction

In 1976 an Italian scientist named Giancarlo Puddu began examining a group of runners experiencing Achilles tendon pain.[1] Contrary to the accepted scientific doctrine at the time - that tendon pain was due to inflammation - his histological studies showed only a minimal amount of inflammatory cells in the injured tendons. In addition, Puddu found that the fibres within the tendon had become disorganised and degenerated, with signs of extensive micro-tearing. When this evidence was later confirmed by further research, scientists had to re-evaluate their understanding of tendonitis, which had been the accepted norm for describing the pathology involved in chronic tendon pain. The absence of inflammatory cells in many cases of tendon pain meant the diagnosis of tendonitis was incorrect, as by definition tendonitis entails inflammation of the tendon fibres. Scientists subsequently gave this discovery of degenerated and torn tendon fibres a new diagnostic label, 'tendinosis', which literally means 'tendon cellular injury'.[2] This pathology can also be referred to as a 'tendinopathy', which is defined more generally as 'tendon disease'.[2]

Tendon pain is one of the most commonly diagnosed chronic connective tissue disorders in sports medicine according to Center for Disease Control.[3] It can affect every major joint within the body and make even the most well conditioned athlete limp to the sidelines due to the overwhelming pain. Whether for the professional golfer or the weekend tennis player, tendon pain is a problem that can affect players of all sports. Tendon pain can also create problems for people in everyday life. According to statistics of the United States Department of Labor, tendon pain is one of the leading claims for job disability.[4] Up to now non-steroidal anti-inflammatory drugs (NSAIDs), ice, rest and cortisone therapy have been the typical treatments for chronic tendon pain, as doctors assumed the aetiology of the problem was inflammation. However, with the new diagnosis of tendinosis and the absence of any inflammatory cells, therapies that focus on reducing inflammation may be contraindicated as they may contribute to the further degeneration of the tendon fibres.[2] Recent studies point to the capacity of acupuncture and electro-stimulation to help tendon fibres to regenerate.[3] It is for these reasons that traditional Chinese medicine (TCM) is well positioned to play a major part in alleviating chronic tendon pain.

Biomedical background

A review of the basic anatomy and function of tendons can help in understanding the pathology of tendinosis. Tendons attach muscles to bones. There are two important areas in this connection: the myotendinous junction and the osteotendinous junction. The myotendinous junction is where muscle tissue morphs to become tendon fibres, whereas the osteotendinous junction is where the tendon fibres connect to the bone (called the condyle). The osteotendinous junction is where the majority of tendon injuries occur.[2]

All connective tissue is made out of collagen fibres. However, tendon fibres are specialised to be able to handle heavy loads. Biomechanical studies have shown tendons have the ability to handle up to 10 times human body weight during stress tests.[2] They are able to accomplish this because of a number of interesting characteristics. Tendon fibres are made up at the molecular level of collagen proteins. Tendon structure is based, as can be seen in Figure 1, on a hierarchical

"The osteotendinous junction is where the majority of tendon injuries occur."

pattern of fibres gathered together in progressively larger bundles, which are held together by a series of sheaths called the epitenon and paritenon (this feature of bundles within bundles is similar to that seen in support cables for suspension bridges - See Figure 2). This structure and linear alignment of the fibres give tendons their unusual tensile strength.

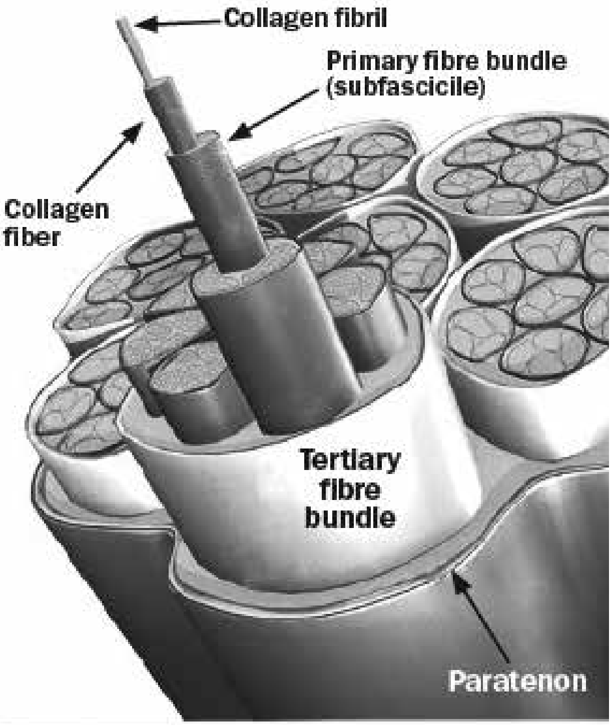

FIgure 1: Tendon structure

Figure 2: Bridge cables and tendon structure

The sheaths that hold the bundles together also contain synovial cells that help lubricate the tendon as it moves to and fro within the sheath. These sheaths also carry both the primary blood supply and nerve network of individual tendons. This structure leads to reduced vascularity and nerve supply within the tendon itself, causing reduced oxygen consumption in the tendon tissue. This reduction in oxygen is offset by anaerobic generation of energy among specialised cells surrounding the tendon fibres, which allows the tendon to handle heavy loads over long periods of time without creating ischaemia in the tendon fibres. Unfortunately, these lower levels of oxygen and blood also inhibit the tendons' ability to heal over time.[1]

Tendon injury

When a tendon undergoes repetitive motion or unusual stress, a series of biochemical reactions begins to occur. The tension caused by muscle contraction stimulates proprioceptive sensory receptors called Golgi tendon organs, which are located at the myotendinous junction, to communicate to the collagen fibres to arrange themselves in a more linear formation. Increased tension also stimulates the proteins that surround the collagen fibres, called the extracellular matrix (also known as 'ground substance'), to begin to multiply – a process called hypercellularity. Many of these cells in the extracellur matrix are hydrophilic, which allows them to take on interstitial fluids and swell, causing oedema. As these cells multiply and swell, they impair the structure of the collagen, which weakens the linear formation of the tendon fibres. The migration of numerous proteins associated with hypercellularity can cause additional problems within the tendons such as a reduction the ability of new collagen to reproduce and an increase in glycoproteins that have an adhesive effect on the surrounding tissue. Another interesting phenomena called neovascularisation also occurs, where small blood vessels begin to grow perpendicular to the collagen (though these vessels do not provide any nourishment to the collagen itself).[1]

The above description gives a basic overview of the intricate biochemical processes that occur within tendons when they are put under stress. There is actually a very pronounced balancing act taking place. On the one hand, the tendon fibres, stimulated by the Golgi apparatus, try to align themselves to better handle increased stress. On the other, if this stress continues (as is the case with repetitive motion disorders), the extracellular matrix thickens, causing disorganisation and weakening of the fibres. In this ongoing tug-of-war, the collagen fibres at some point become incapable of repairing themselves fast enough, and degeneration occurs (see Figure 3). This can be observed microscopically as micro-tearing. If this process continues, the tendon can reach the point of pain response, manifesting as extremely sharp pain, and loses its functional capabilities, rendering it incapable of sustaining load and limiting the range of motion of its associated joint.[1]

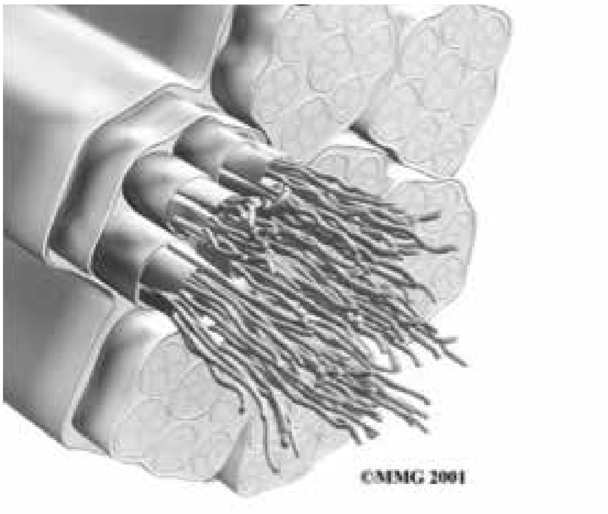

Figure 3: Abnomal arrangement of collagen fibres in tendinosis

Tendon healing

Microscopic observation has shown that tendon fibres go through three very distinct phases during their healing process. In the first 24 to 48 hours - corresponding to the initial tearing of the fibres - an inflammatory phase occurs. During this period immune cells flood the area, a process that involved in all cellular healing in the body. This short period is when the limited inflammatory cells are most prolific. These cells perform many functions, the most important of which is phagocytosis, which involves cleaning the area of necrotic material (i.e. degenerated collagen fibres). The next stage, called the 'repair phase', begins when immune growth factors and fibroblasts migrate to the site to begin collagen repair. This stage can last up to six weeks, and during this time new collagen fibres are formed. The last stage is called the 'remodeling phase', and is characterised by the repaired collagen becoming more fibrous and linear. During this stage the oedema and extra blood vessels (neovascularisation) disappear and the tendon is again ready to handle its normal load. This phase can take up to 12 weeks.[2]

In extreme chronic cases the tendon can become calcified, or proliferated by an abundance of scar tissue (adhesions), in which case the label 'tendinopathy' becomes the appropriate description.[2] With treatment, these cases can take up to one year for tendon fibre healing to occur. The importance for medical practitioners to understand this timeline for tendon healing cannot be underestimated, as patients will need to limit their repetitive activities to allow for complete healing of the tendon fibres. However, complete rest is not a solution, as immobilisation has been shown to be detrimental to collagen formation. Research has shown that eccentric exercise (lengthening the muscle while simultaneously putting it under strain, such as slowly lowering a dumbbell during a biceps curl) to be very beneficial to collagen regeneration when used as a rehabilitative exercise.[2]

TCM background

The ancient Chinese did not know about the microscopic thickening, disorganisation, neovascularisation, oedema and degeneration that are now known to be involved in tendinosis. However, if one palpates hardened, painful and oedemic tendons and observes the diminished motion of the associated joint, it becomes easy to understand how traditional Chinese doctors came to the conclusion that qi and blood have become stagnated in this condition.

The TCM perspective of tendon pathology stands up well against the modern microscopic knowledge presented above. This is logically apparent if we accept that the Chinese concept of blood stasis includes the accumulation of lymphatic and interstitial fluids with localised swelling (seen in acute ankle sprain, for example). In TCM terms this would be looked upon as a localised excess. In addition, although scientists do not yet fully understand the phenomenon of neovascularisation, the sharp localised pain associated with it also seems to correspond to the TCM diagnosis of blood stasis.

Modern research is relevant in terms of looking at the effects of acupuncture therapy on the pathological processes involved in tendinosis. A study from the University of Sao Paulo in Brazil compared the effects of electro-stimulation, laser therapy and ultrasound therapy on tendon repair. Electro-stimulation clearly increased collagen repair faster than the other two modalities, although all three showed improvement over the control group (in which the tendons were allowed to heal through rest alone).[5] Another study, in which acupuncture needles immersed in a solution of collagen proteins and connected to a machine that twisted them regularly, caused collagen to form into linear strands more effectively than controls.6 In another study, not only did electro-stimulation contribute to collagen formation, it also reduced the amount of adhesions in healed tendon tissue.[2] From a TCM perspective, the reduction of hardened tissue upon palpation constitutes an improvement in the movement of qi and blood in the channels.

Based on this information, acupuncture with electro-stimulation[7] or needle-twisting to elicit deqi (needle sensation) appear to be excellent modalities to help facilitate the healing of tendon fibres. The fact that needles can be inserted into and around tendons is extremely advantageous, as it allows the practitioner to apply electro-stimulation directly to the tendon itself. Most tendons in the body are reasonably superficial to the skin and so are readily accessible.

Acupuncture treatment

Two specific needle patterns have traditionally been used to treat the local excess of qi and blood stagnation involved in tendinosis. They are the 'surround the dragon' and 'local, distal and adjacent' point protocols. The following is a description of a simple four-needle modification of these ancient techniques for the treatment of tendon pain.

Since it is not easy to describe needling techniques, readers should refer to the associated images to grasp the precise positioning of the needles.

In most cases of tendinosis, the pain is likely to be on or near the osteotendinous junction. Patients will generally be able to put their finger directly on the most painful point. This is by definition an 'ahshi' point and where the first needle should be inserted. For example, in the treatment of lateral epicondylitis of the elbow (tennis elbow), the ahshi point is usually where the tendon inserts into the lateral condyle, close to Quchi L.I.-11. The angle of insertion of this first needle is usually perpendicular, with a moderate depth into or just above, the tendon insertion. In patients with long-term chronic cases, it may be necessary to needle directly into the tendon to achieve strong dispersal of qi and blood, however caution must be taken as this can be very sensitive. Given that electro-stimulation can be used to effectively move qi and blood, eliciting the strong sensation of deqi is often unnecessary. However, if the patient is uncomfortable with electro-stimulation, eliciting deqi using needle technique is recommended. The next two needles should be placed using an oblique to horizontal insertion and threaded along each side of the tendon. The direction of these needles can vary depending on the anatomy (see Figure 4). Use the first needle as a location guide to place these needles in a pattern that will 'surround' the osteotendinous junction on three sides. The fourth needle is then inserted at the myotendinous junction, which is usually a few inches from the first needle where the soft muscle tissue becomes taut tendon tissue. A perpendicular insertion should be used at the most sensitive point (the myotendinous junction is often very tender to the touch). If you can't find this junction, or the area is not sensitive, find the closest ahshi point or acupuncture point along the associated channel and use this instead. Electro-stimulation is then used, connecting the two distal-proximal needles, and the two needles positioned on either side of the tendon. This creating a 'crossing' pattern, and the osteotendinous junction is surrounded with electro stimulation flowing from two directions. This combination is excellent at moving qi and blood, and thus reduces swelling and increases blood supply while stimulating the degenerated collagen fibers.[8]

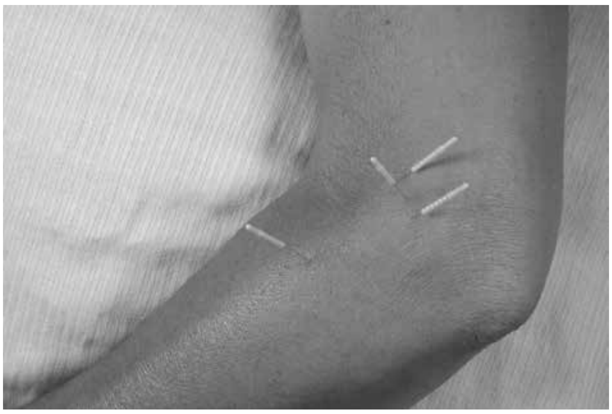

Figure 4: Treatment of lateral epicondylitis (tennis elbow).

Treating the shoulder

The shoulder has the greatest range of motion of any joint in the body, and because of its complexity requires a slightly different approach to that described above. The increased motion of the shoulder contributes to stress on the rotator cuff muscles, which include the teres minor, infraspinatus, subscapularus and supraspinatus. The supraspinatus is involved in overhead motion, and its tendon is involved in the greatest percentage of rotator cuff pain.[8] Supraspinatus pain, sometimes referred to as impingement syndrome, has a number of aetiologies. Muscle imbalance of the other rotator cuff muscles can lead to subacromial loading (the forward movement of the humeral head), causing the supraspinatus to rub against the acromium. This is exacerbated by overhead rotation of the shoulder joint. In some cases, the subacromial bursa can also become inflamed, which in turn can obstruct the supraspinatus as it has to move over the bursa due to its attachment to the anterior humeral head.[9] Because the supraspinatus is prone to complete or partial tears, MRI (magnetic resonance imaging) analysis is a welcome adjunct to any differential diagnosis in order to rule out other aetiologies for shoulder pain such as tumours, calcification of the bursa, brachial plexus syndrome and cervical disc bulges.[2]

Unfortunately, the anatomy of the shoulder hinders any direct manual stimulation of the supraspinatus tendon, as it lies deep to the acromial-clavicular (AC) joint. This is where an acupuncturist's ability to needle deeply into the body is advantageous. The first needle at Jugu L.I.-16 should be inserted at a 45-degree angle under the AC joint towards the axilla. Caution must be taken with this insertion to avoid puncturing the lung, which is situated inferior to this point. A 45-degree insertion angle will ensure the needle does not touch the lung. A one and a half inch needle can generally be inserted fairly deeply with this method. Needles are then inserted at Jianyu L.I.-15 and Jianliao SJ-14 with traditional angles. A fourth point is then added between Jianyu L.I.-15 and Jianliao SJ-14, slightly closer to Jianyu L.I.-15, which corresponds to the insertion of the supraspinatus tendon into the humeral head. Jugu L.I.-16 and this fourth point are then connected with electric stimulation, as are Jianyu L.I.-15 and Jianliao SJ-14 (see Figure 5). This combination is effective because the tip of needle inserted at Jugu L.I.-16 will lie close to or in the supraspinatus tendon, whilst the fourth point corresponds to the tendon insertion at the humeral head; thus these points directly stimulate the portion of the supraspinatus tendon that is prone to tendinosis. By adding stimulation between Jianliao SJ-14 and Jianyu L.I.-15, the entire osteotendinous insertion site of the humeral head can be stimulated. An added benefit of this combination is that it also stimulates the subacromial and subdeltoid bursas that, as stated above, can contribute to supraspinatus tendinosis.

Because of the shoulder's propensity for muscular imbalance, which can be a causative factor for supraspinatus tendinosis and can be diagnosed with orthopaedic muscle testing, addressing the compensatory muscles of the teres minor and infraspinatus is also usually appropriate. In cases of muscle imbalance, connecting Jianzhen SI-9 and Naoshu SI-10 will address the teres minor, while adding and connecting two ahshi points under the spine of the scapula will stimulate the infraspinatus muscle. This four-point needle pattern, when added to the pattern discussed above, allows the practitioner to move qi and blood through the entire rotator cuff region (see Figure 6).

Figure 5: Treatment of supraspinatus tendinosis

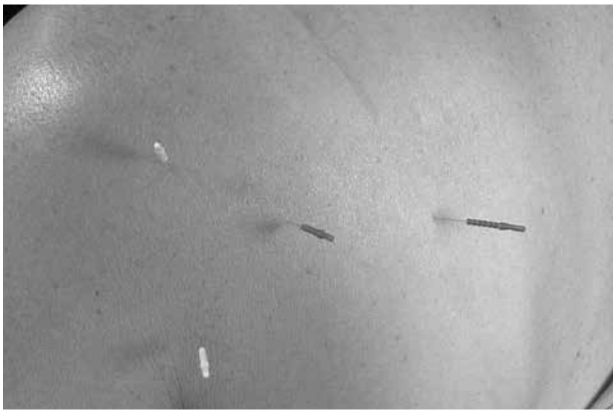

Figure 6: Acupuncture for rotator cuff muscular imbalance

Treating the hamstring tendons

Unlike the superficial location of most tendons, the hamstring tendon is deep to the skin where it inserts into ischial turberosity (approximately at Chengfu BL-36). When strained or damaged through repetitive motion this injury is referred to as a 'high hamstring strain'. However, because it involves a tendon, it often involves tendinosis. Because of its depth, threading an acupuncture needle horizontally along it is impossible. Therefore a modified four-needle technique is used. Using a needle at least two-inches in length, palpate the insertion of the hamstring tendon into the ischial tuberosity (the point Chengfu BL-36) and insert the first needle deeply into this point. Once again, if you are not using electro-stimulation it is advisable to elicit deqi. Because the tendon is not superficial, two additional needles should be inserted perpendicularly and deeply along each side of the ischial tuberosity and these should be connected with electro-stimulation. These three needles now surround the osteotendinous junction of the hamstring. Palpating along the large hamstring tendon, move down a few inches from the ischial tuberosity and insert the fourth needle into an ashi point along the Bladder channel at the myotendinous junction, which is usually very sensitive and tight. Then connect the first and the fourth needles together with electro-stimulation. Note that this needle combination once again uses a crossing pattern that stimulates the osteotendinous junction from two different directions.

Other tendons

Figure 7: Treatment of biceps tendinosis

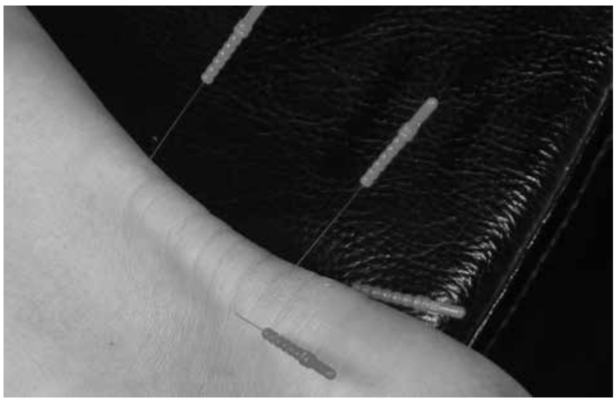

Figure 8: Treatment of Achilles tendinosis

Most other tendon injury sites tend to be very superficial and can therefore be treated using the four-needle pattern described for treating the elbow above. These include the biceps, medial epicondyle, wrist, patellar and Achilles tendons (See Figures 7 and 8). It is important to reiterate that muscle imbalance can be a cause of tendinosis. With most tendon injuries this will show as a stagnation of qi and blood in the muscles that attach to, or are compensatory to, the injured tendon. Do not hesitate to needle points that move qi and blood in these muscles, especially where orthopaedic examination indicates muscle imbalance.

General guidelines

To aid in reducing the stagnation seen in tendinosis, the use of tuina, cupping and guasha are appropriate. Cross-fibre massage, which involves applying pressure and stimulation perpendicular to the fibres, is also efficient in helping to move the stagnation and assisting the fibres to become more linear. In severe cases where cold is involved the use of moxa applied to the needle inserted at the osteotendinous junction can also be effective (often in cases where injuries have been 'over-iced').

Remember that the treatment method described above is for chronic tendon pain. Acute pain resulting from a one-time overuse of the tendon such as painting a room or strenuous gardening does indeed create inflammation due to the tendon fibres being traumatised through micro-tearing. However, this will be short-term, and it is only when the motion is repeated over and over that tendinosis begins to appear. That said, acute tendonitis also responds well to the four-needle configuration described above.

One other pathology should be considered in relation to chronic tendon pain, which is tenosynovitus (inflammation of the tendon sheath). This is frequently seen in the wrist and peroneal tendons. These are locations that have a retinaculum to hold the tendons in place, which can cause friction and irritation as the tendon moves underneath. The four-needle technique described above is extremely effective for this pathology.

The use of ice in the first 24 hours of initial injury or directly after an intense athletic performance is appropriate for any swelling. However, after 24 to 48 hours, the patient should switch to applying heat to the area in order to stimulate blood flow, as excess icing can hinder tissue regeneration.10 Alternating ice and heat can be effective if excessive swelling persists. Chinese liniments such as Zheng Gu Shui, Po Sum On Oil or Tiger Balm are also appropriate for both chronic and acute cases to assist in moving qi and blood.

A traditional Chinese aphorism states that a good Chinese doctor will try to find the root of their patient's disease. In most cases of tendinosis, repetitive motion is the causative factor. Therefore, in such cases, checking the ergonomics of an office-worker's computer workstation is equally as important aschecking the biomechanics of an injured baseball pitcher's throwing motion.

Last, but not least, there are a number of areas in which Chinese medicine provides significant advantages in preventing and treating tendinosis. Our ability to administer herbs to nourish Liver blood, for example, or to nourish yin in cases of constitutional yin deficiency could play a significant role in preventing tendon injury, as both acute and chronic dehydration is known to cause fibre degeneration in older athletes.[11] Recent studies showing the genetic factors involved in tendinosis suggest that some patients may have a deficiency in jing-essence that predisposes them to tendon pathology.[12] These are sometimes referred to as intrinsic factors in tendinosis.[1]

Conclusion

Numerous studies show inflammation plays a minimal role in chronic tendon injury and pain, and that the diagnosis of tendonitis should only be applied to acute tendon injuries. All chronic cases should be treated according to the more appropriate diagnosis of tendinosis, or tendinopathy where calcification, adhesions or extensive degeneration are present. With chronic tendon injuries, the collagen fibres need at least six to 10 weeks to fully heal. The use of the four-needle technique described in this article is a simple and effective protocol that can be used to treat chronic tendon pain. The treatment of damaged tendon fibres using acupuncture, electro-stimulation, manual manipulation and herbal medicine (both internal and external) can be effective in assisting in collagen regeneration and healing of the damaged tendon.

Mark Kastner *originally trained in 1985 at the Guan An Men Hospital in Bejing, China, and graduated from the California Acupuncture School in 1986. He has been in private practice for 27 years and specialises in orthopaedics, specifically sports acupuncture. He currently teaches in the graduate orthopeadic programme at Pacific College of Oriental Medicine.*

References

1 Sharma, P. & Maffulli, N. (2005). "Tendon Injury and Tendinopathy: Healing and Repair". *J. Bone Joint Surg. Am*, 87:187-202

2 Khan, K. (2003). "The painful nonruptured tendon: clinical aspects". *Clin Sports Med*, 22: 711– 725

3 U.S. Department of Health and Human Services "National Ambulatory Medical Care Survey 1998-2006." National Center for Health Statistics, Centers for Disease Control and Prevention

4 U.S. Department of Labor Occupational Safety and Health Administration (2000). "Ergonomics: The Study of Work" (Revised) available at https://www.osha.gov/Publications/osha3125.pdf [accessed 03/09/14]

5 Araújo, R.C., Franciulli, P.M., Assis, R.O. et al. (2007). "Effects of laser, ultrasound and electrical stimulation on the repair of Achilles tendon injuries in rats: a comparative study". *Braz. J. Morphol*. Sci., 24(3): 187-191

6 Julias, M., Edgar, L., Buettner, H. et al. (2008). "An *in vitro* assay of collagen fiber alignment by acupuncture needle rotation - Evaluation of the Effects of Acupuncture on Blood Flow in Humans with Ultrasound Color Doppler Imaging". *Biomed Eng Online*. 7: 19. doi: 10.1186/1475-925X-7-19

7 Further studies need to be completed to identify which frequency and intensity levels optimise healing during electro-stimulation for tendon pain.

8 Takayama, T., Watanabe M., Kusuyama, H. et al. (2012). Evaluation of the Effects of Acupuncture on Blood Flow in Humans with Ultrasound Color Doppler Imaging". *Evid. Based Complement. Alternat. Med*., Article ID 513638, doi:10.1155/2012/513638

9 DeBerardino, T.M. & Chang, W. (2013). "Supraspinatus Tendonitis'. Available at < http://emedicine.medscape.com/article/93095-overview> [accessed 03/09/14]

10 Stone, J. (N.D.). "Why Ice and Anti-inflammatory Medication is NOT the Answer". Available at <http://stoneathleticmedicine.com/2013/11/why-ice-and-anti-inflammatory-medication-is-not-the-answer/> [Accessed 03/09/14]

11 Kita, K. (2013). "The Effects of Dehydration". Available at <http://www.lensaunders.com/wp/the-effects-of-dehydration/> [Accessed 03/09/14]

12 Mokone, G.G., Schwellnus, M.P., Noakes, T.T. et al. (2006). "The COL5A1 gene and Achilles tendon pathology." *Scand J Med Sci Sports*. 16(1):19-26.