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Current Concepts Review

Novel Approaches for the Management of Tendinopathy

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- Tendinopathy is a failed healing response of the tendon.
- Despite an abundance of therapeutic options, very few randomized prospective, placebo-controlled trials have been carried out to assist physicians in choosing the best evidence-based management.
- Eccentric exercises have been proposed to promote collagen fiber cross-link formation within the tendon, thereby facilitating tendon remodeling. Overall results suggest a trend for a positive effect of eccentric exercises, with no reported adverse effects. Combining eccentric training and shock wave therapy produces higher success rates compared with eccentric loading alone or shock wave therapy alone.
- The use of injectable substances such as platelet-rich plasma, autologous blood, polidocanol, corticosteroids, and aprotinin in and around tendons is popular, but there is minimal clinical evidence to support their use.
- The aim of operative treatment is to excise fibrotic adhesions, remove areas of failed healing, and make multiple longitudinal incisions in the tendon to detect intratendinous lesions and to restore vascularity and possibly stimulate the remaining viable cells to initiate cell matrix response and healing.
- New operative procedures include endoscopy, electrocoagulation, and minimally invasive stripping. The aim of these techniques is to disrupt the abnormal neoinnervation to interfere with the pain sensation caused by tendinopathy.
- Randomized controlled trials are necessary to better clarify the best therapeutic options for the management of tendinopathy.

Evolving Concepts in Tendinopathy: New Theories

Tendinopathies account for a substantial proportion of overuse injuries associated with sports[1] and are a common cause of disability[2,3]. Most major tendons, such as the Achilles, patellar, rotator cuff, and forearm extensor tendons (among others), are vulnerable to overuse, which induces pathological changes in the tendon[4].

The term “tendinopathy” is a generic descriptor of the clinical conditions (both pain and pathological characteristics) associated with overuse in and around tendons[5]. The histological descriptive terms “tendinosis” (a degenerative pathological condition with a lack of inflammatory change) and “tendonitis” or “tendinitis” (implying an inflammatory process) should be used only after histopathological confirmation[5]. However, it should be kept in mind that, despite the use of the term “tendinosis,” at histopathological examination the essence of a tendinopathic lesion is a failed healing response, with haphazard proliferation of tenocytes, intracellular abnormalities in tenocytes, disruption of collagen fibers, and a subsequent increase in noncollagenous matrix[6,7]. Tendinopathic tendons

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have an increased rate of matrix remodeling, leading to a mechanically less stable tendon that is probably more susceptible to damage[8]. Histological studies of surgical specimens from patients with established tendinopathy consistently show either absent or minimal inflammation[9-11]. They generally also show hypercellularity, a loss of the tightly bundled collagen fiber appearance, an increase in proteoglycan content, and commonly neovascularization[12,13]. Inflammation seems to play a role only in the initiation, but not in the propagation and progression, of the disease process[14]. Competing theories have been proposed to explain the pathogenesis of tendinopathy at specific stages and presentations of the condition[15-18]. A continuum of tendon pathology from asymptomatic tendons to tendon tears has been proposed[19,20].

Failed healing and tendinopathic features have been associated with chronic overload, but the same histopathological characteristics also have been described when a tendon is unloaded: stress shielding seems to exert a deleterious effect[9]. Unloading a tendon induces cell and matrix changes similar to those seen in an overloaded state and decreases the mechanical integrity of the tendon[19,20].

Despite an abundance of therapeutic options, very few randomized prospective, placebo-controlled trials have been conducted to assist physicians in choosing the best evidence-based management[21,22]. Treatments that have been investigated with use of a randomized controlled trial design include nonsteroidal anti-inflammatory medications[23-25], eccentric exercise[26-30], glyceryl trinitrate patches[31-33], sclerosing injections[34], aprotinin injections[35-37], ultrasound[38], and shock wave treatment[39-50]. What may appear clinically as an acute tendinopathy is actually a well-advanced failure of a chronic healing response in which there is neither histological nor biochemical evidence of inflammation[23]. The available literature suggests that, in the absence of an overt inflammatory process, there is no rational basis for the use of nonsteroidal anti-inflammatory drugs in chronic tendinopathy[51].

In this Current Concepts Review, we report the best available evidence for the management of tendinopathy and provide a comprehensive and up-to-date review of the development of future modalities for treatment.

Nonoperative Management Options

Eccentric Exercises

Eccentric exercises have been proposed to promote collagen fiber cross-link formation within the tendon, thereby facilitating tendon remodeling (see Appendix)[52]. Evidence of histological changes following a program of eccentric exercise is lacking, and the mechanisms by which eccentric exercises may help to relieve the pain of tendinopathy remain unclear.

Eccentric exercises have been proposed to counteract the failed healing response that underlies tendinopathy by promoting collagen fiber cross-linkage within the tendon, thereby facilitating tendon remodeling[50]. The concept of eccentric exercises is based on the structural adaptation of the musculotendinous units to protect them from increased stresses and thus prevent reinjury.

The basic principles in an eccentric loading regimen are unknown, although it has been speculated that forces generated during eccentric loading are of a greater magnitude than those in concentric exercises[53]. It is possible that eccentric exercises do not just exert a beneficial mechanical effect, but also act on pain mediators, decreasing their presence in tendinopathic tendons. Although microdialysis has shown raised intratendinous glutamate levels[54] and substance P and neurokinin-1 receptor[55] to be significantly higher in Achilles tendons with painful tendinopathy than in normal, pain-free tendons, and treatment with eccentric training has shown good clinical results with diminished tendon pain during activity, in vivo results have shown that successful treatment with eccentric training is not associated with lowered intratendinous glutamate levels[54]. Also, as the exercise regimen is supposed to produce pain and if the patient does not experience pain load is added to produce pain during the exercise, it is possible that progressive habituation to painful stimuli occurs[52,56-58]. Color Doppler sonography demonstrated decreased neovascularization following eccentric training intervention[59].

Excellent clinical results have been reported both in athletic and sedentary patients[26,60], although these results were not reproduced by other study groups[26,61]. In general, the overall trend suggests a positive effect of eccentric exercises, with no reported adverse effects[52]. In one study, the combination of eccentric training and shock wave therapy produced success rates that were higher than those with eccentric loading alone or shock wave therapy alone[30].

Extracorporeal Shock Wave Therapy

Extracorporeal shock wave therapy to address the failed healing response of a tendon is becoming more widely used among the medical community (see Appendix)[50]. Typical characteristics are high peak-pressure amplitudes (500 bar) with rise times of <10 ns, a short life cycle (10 ms), and a frequency spectrum (16 to 20 MHz) ranging from the audible to the far ultrasonic level[62]. This rapid rise is followed by periods of pressure dissipation and negative pressure before a gradual return to the ambient pressure. The shock wave entering the tissue may be reflected or dissipated, depending on the properties of the tissue. The energy of the shock wave may act through mechanical forces generated directly or indirectly via cavitation[63]. The rationale for the clinical use of extracorporeal shock wave therapy is stimulation of soft-tissue healing and inhibition of pain receptors.

There is no consensus on the use of repetitive low-energy extracorporeal shock wave therapy, which does not require local anesthesia, versus the use of high-energy extracorporeal shock wave therapy, which requires local or regional anesthesia[63]. In several well-conducted randomized controlled trials, low-energy extracorporeal shock wave therapy was administered once a week for three or four consecutive weeks, with final assessment undertaken twelve weeks after the last shock wave therapy session[30,50]. At the time of a four-month follow-up, eccentric loading and low-energy shock wave therapy showed comparable results[62], whereas eccentric loading alone was less effective than the combination of eccentric loading and repetitive low-energy shock wave treatment[30].

When used, high-energy extracorporeal shock wave therapy is administered only one time.

Low-energy shock wave therapy has been proposed for tendinopathy to stimulate soft-tissue healing and inhibit pain receptors[30,63-65]. Low-energy shock wave therapy or eccentric training for the management of Achilles tendinopathy produced comparable results in a randomized controlled trial[50], and both management modalities showed outcomes superior to those of no intervention[50]. However, the results of low-energy shock wave therapy were disappointing in another study[66].

Use of Injectable Substances

A wide variety of substances have been injected and are routinely injected in and around tendons.

High-Volume Injections: Normal Saline Solution, Corticosteroids, and Anesthetics

Neovascularization is a characteristic feature of Achilles and patellar tendinopathy; it is generally accompanied by nerve ingrowth and normally is not present in patients without tendon pathology[67,68]. The ingrowth of new blood vessels and associated nerves from the peritendinous tissues may be a source of pain[69]. Histopathological studies showed immunoreactions for neurokinin-1 receptor and alpha-1-adrenoreceptor in biopsy specimens from the ventral area of tendinopathic Achilles[70] and patellar[71] tendons as well as elevated levels of the neurotransmitter glutamate and the presence of its receptor, N-methyl-d-aspartate receptor type 1[71-73].

The hypothesized rationale behind this management modality was that high-volume injections of normal saline solution, corticosteroids, or anesthetics would produce local mechanical effects causing new blood vessels to stretch, break, or occlude. Occluding and possibly breaking these vessels would lead to the accompanying nerve supply also being damaged by either trauma or ischemia, therefore decreasing the pain in patients with resistant Achilles tendinopathy.

Preliminary studies showed that high-volume injection of normal saline solution, corticosteroids, or anesthetics reduces pain and improves short and long-term function in patients with Achilles[74] or patellar[75] tendinopathy, regardless of their symptoms (see Appendix). High-volume injection is safe and relatively inexpensive, with the potential to offer an alternative to operative treatment, resulting in a quicker return to sports[76].

Hydrocortisone acetate is used in the high-volume injections, primarily to prevent an acute mechanical inflammatory reaction produced by the large amount of fluid injected in the proximity of the tendon. The injection is performed under ultrasound guidance, so that corticosteroids have no direct action on the tendon itself. The role of corticosteroids in the management of tendinopathy is still debated. Meta-analysis of the effects of corticosteroids has shown that published data are insufficient to determine the risk of rupture following corticosteroid injections[77], and we do not advocate their intratendinous injection[76].

Platelet-Rich Plasma

Platelet-rich plasma is a bioactive component of whole blood, which is now being widely tested in different fields of medicine for its possibilities in aiding the regeneration of tissue with poor healing potential[78-82].

The use of platelet-rich plasma to help wound-healing has been proposed since the early 1980s[83]. Its use in orthopaedic surgery, especially for augmentation of bone-grafting, began during the present decade, although to date there is no definitive evidence that it improves bone healing[84]. The use of platelet-rich plasma to improve tendon healing has been advocated only recently[85-87]. In general, the concentration of platelets in platelet-rich plasma is higher than that in blood[88,89].

Dense granules may play a role in tissue modulation and regeneration by releasing their content of adenosine, serotonin, histamine, and calcium. The alpha granules release transforming growth factor-β, platelet-derived growth factor, and vascular endothelial growth factor, with concentrations increasing linearly with increasing platelet concentration. The released cytokines bind to transmembrane receptors on the surface of local or circulating cells and induce intracellular signaling. This may result in the production of proteins responsible for cellular chemotaxis, matrix synthesis, and proliferation[86].

Tendon healing occurs through three overlapping phases (inflammation, proliferation, and remodeling), which are controlled by a variety of growth factors[86,90-92]. The rationale for the use of platelet-rich plasma to promote tendon healing is the high content of these cytokines and cells in hyperphysiologic doses of platelet-rich plasma. Several studies on the application of platelet-rich plasma to promote tendon healing are ongoing worldwide, although the exact mechanisms by which platelet-rich plasma promotes tendon healing are still not clear (see Appendix). One of the main advantages is that platelet-rich plasma is autologous and is prepared at the time of treatment (point of care) and therefore has an excellent safety profile. De Vos et al.[93] performed a stratified, block-randomized, double-blind, placebo-controlled trial of fifty-four patients with Achilles tendinopathy treated, at a single center, with exercises (usual care) as well as injection of either platelet-rich plasma or saline solution (the placebo group). The authors concluded that, compared with the saline-solution injection, the platelet-rich-plasma injection did not result in greater pain relief or improvement in activity.

Autologous Blood Injection

An injection of autologous blood for the management of tendinopathy has been reported[94]. The aim of this treatment is to provide cellular and humoral mediators to induce healing in areas where the healing response has failed (see Appendix). The use of autologous blood injection is thought to lead to tendon healing through collagen regeneration and the stimulation of a well-ordered angiogenic response[89]. It has been hypothesized that transforming growth factor-β and basic fibroblast growth factor carried in the blood will act as humoral mediators to induce the healing cascade[95,96]. Although the results of laboratory studies are encouraging, such studies have always involved healthy tendons or surgically induced lesions, given the lack of a good experimental model for tendinopathy. At present, it is unclear whether these results can be extrapolated to tendinopathic tendons[89]. So-called needling of the tendon has been described in conjunction with the use of autologous blood. However, it could be difficult to distinguish between the effect of needling and the effect of autologous blood injection[96].

Polidocanol

In patients with chronic painful Achilles tendinopathy, there is neovascularization outside and inside the ventral part of the tendinopathic area[97,98]. Local anesthetic injected in the area of neovascularization outside the tendon may result in a pain-free tendon, indicating that this area is involved in pain generation. These are the bases for the injection of the sclerosing substance polidocanol (Aetoxisclerol; Kreussler Pharma, Wiesbaden, Germany) under ultrasonography and color Doppler guidance in the area with neovessels outside the tendon[99-104].

Injections with polidocanol in a randomized controlled trial showed the potential to reduce tendon pain during activity in patients with chronic painful midportion Achilles tendinopathy (see Appendix)[102].

In Achilles and patellar tendinopathy, there is evidence of neural ingrowth in conjunction with neovascularization. Injections of polidocanol close to the tendon seem to be remarkably safe.

Of 150 patients in whom Achilles tendinopathy had been managed with polidocanol, two experienced a complication[105]. One patient who had insertional Achilles tendinopathy sustained a total rupture in the proximal part of the tendon at the end of an 800-m running race, and the other patient sustained a partial rupture in the midportion of the tendon, where he previously had received four intratendinous corticosteroid injections.

Intratendinous Injections of Corticosteroids

The use of corticosteroid injections is highly controversial[14,106-110]. There is a lack of good-quality research data to support the widespread use of these drugs. There are numerous case reports of tendon rupture after corticosteroid injections in patients[111,112]. Animal studies have suggested that local corticosteroid injections may lead to a reduction in tendon strength[113], but this finding is not universal[114].

At present, there is insufficient evidence from which to draw firm conclusions on the utility of local corticosteroid treatments for Achilles tendinopathy (see Appendix). Three randomized controlled trials[115-117] showed different results in terms of the effects of local corticosteroids on healing, with two studies demonstrating some benefit[115,116] and the other showing none[117]. A meta-analysis of the effects of corticosteroid injections showed little benefit[77]. The safety of corticosteroid injections can be enhanced with the use of ultrasound imaging needle guidance. With the high-volume-injection technique, the needle is kept extratendinous and outside the peritendinous space[118], so that the fluid is injected only in the Kager triangle (for the Achilles tendon) or in the Hoffa body (for the patellar tendon).

Operative Treatment

The objectives of operative treatment are to excise fibrotic adhesions, remove or debride areas of failed healing, restore vascularity, and possibly stimulate viable cells to initiate protein synthesis and to promote healing[13,119]. Recent studies have shown that multiple longitudinal tenotomies trigger neoangiogenesis in the Achilles tendon, with increased blood flow[120]. This would result in improved nutrition and a more favorable environment for healing.

Multiple percutaneous longitudinal tenotomies can be performed when conservative management has failed in patients who have isolated tendinopathy with no involvement of the paratenon and a well-defined nodular lesion <2.5 cm long[121]. This procedure may be ultrasound guided to confirm the precise location of the area of tendinopathy[121-123]. It is a simple procedure and can be performed in an ambulatory setting with the use of local anesthesia and without a tourniquet.

Percutaneous longitudinal ultrasound-guided internal tenotomy of the Achilles tendon can be also performed on an outpatient basis. However, it requires the use of high-resolution ultrasound to properly locate the tendinopathic area and to place the initial stab incision[121-123]. Complications (with wound-healing) are minimal and lead to no long-term morbidity. The technique is not as effective in patients with pantendinopathy.

Radiofrequency Microtenotomy

Radiofrequency microtenotomy is a safe and effective procedure for managing patients with chronic tendinopathy (see Appendix). It is a technically simple procedure to perform and has been proposed to produce a rapid and uncomplicated recovery[124-127]. It is hypothesized that the mechanism of action may be to induce acute degeneration and/or ablation of sensory nerve fibers. Early degeneration followed by later regeneration of nerve fibers after bipolar radiofrequency treatment may explain long-term postoperative pain relief[124-127].

Neovessel Destruction

Pathological nerve ingrowth accompanies pathological neovascularization in the tendinopathic tendon, and it has been considered as a possible cause of the pain. Some authors have attempted to disrupt the abnormal neoinnervation to interfere with the pain sensation caused by tendinopathy. Endoscopy[128-133], electrocoagulation[134], and minimally invasive stripping[135-138] have been proposed to achieve this aim. Endoscopy allows direct visualization of the area of tendinopathy and allows use of a motorized shaver or diathermy to destroy neovessels.

Endoscopy-Assisted Treatment

Tendoscopy may allow endoscopic access to several tendons, including the posterior tibial tendon[129], the peroneal tendons[128,139] and the Achilles tendon[131,132,140,141] (see Appendix). This operative technique provides access to the posterior aspect of the ankle and subtalar joints. Also, extra-articular structures of the hindfoot such as the os trigonum, the flexor hallucis longus, and the deep portion of the deltoid ligament can be accessed[130].

Thermann et al.[132] described a different technique of endoscopic debridement of the ventral neovascularized area, the peritenon, and the Achilles tendon and reported good short-term clinical results in eight patients.

Best Modalities for Management of Tendinopathy

In general, it would be reasonable to treat a patient with tendinopathy with physical therapy involving a program of eccentric exercises, to be performed for twelve weeks. If the condition does not respond to this intervention, shock wave therapy or a nitric oxide patch might be considered, although data on their efficacy are limited. If the condition does not respond to those interventions, injections could be considered. The use of operative treatment should be discussed with the patient after at least three to six months of nonoperative management. Moreover, patients should understand that symptoms may recur with either conservative or operative approaches.

The Future and Conclusions

In the last few decades, biomaterials have become critical components in the development of effective new medical therapies for wound care[142,143]. Many new tissue-engineered materials have been introduced, including artificial polymers, biodegradable films, and biomaterials derived from animal or human tissues[143,144].

Biological scaffolds are protein-based extracellular matrices, usually derived from human or animal connective tissues[145]. Advantages of biological scaffolds include a well-defined three-dimensional microstructure (allowing host cell integration) and natural porosity (which provides a much larger space for host cell attachment, proliferation, and migration and assists gas and metabolite diffusion). These proprieties allow biological scaffolds to quickly interact with host tissue and induce new tissue formation faster than synthetic scaffolds. Limitations of biological scaffolds are their poor mechanical properties, undefined rate of degradation, variation in biocompatibility, propensity to induce an inflammatory response, and potential for implant rejection[145].

On the other hand, synthetic scaffolds are manufactured from chemical compounds[145], which permit better control of the chemical and physical properties, leading to stronger mechanical strength and consistency in quality. However, the biocompatibility of synthetic scaffolds is very poor, as they can never be absorbed or integrated into host tissue. High incidences of postoperative infection, and chronic immune responses, have been reported with the use of such materials[145].

A genetic component has been implicated in tendinopathies, but investigations into the genetic factors involved in their etiology are still in their infancy[146-148]. An enhanced understanding of these factors holds the promise of new approaches to the prevention and management of these common conditions. Additional randomized controlled trials are necessary to better clarify the best therapeutic options for the management of tendinopathy.

Appendix

eA Tables summarizing the studies on the various treatments of tendinopathy are available with the electronic version of this article on our web site at jbjs.org (go to the article citation and click on "Supporting Data"). ■

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References

1. Longo UG, Rittweger J, Garau G, Radonic B, Gutwasser C, Gilliver SF, Kusy K, Zieliński J, Felsenberg D, Maffulli N. No influence of age, gender, weight, height, and impact profile in Achilles tendinopathy in masters track and field athletes. Am J Sports Med. 2009;37:1400-5.

2. Ames PR, Longo UG, Denaro V, Maffulli N. Achilles tendon problems: not just an orthopaedic issue. Disabil Rehabil. 2008;30:1646-50.

3. Herring SA, Nilson KL. Introduction to overuse injuries. Clin Sports Med. 1987;6:225-39.

4. Rees JD, Wilson AM, Wolman RL. Current concepts in the management of tendon disorders. Rheumatology (Oxford). 2006;45:508-21.

5. Maffulli N, Khan KM, Puddu G. Overuse tendon conditions: time to change a confusing terminology. Arthroscopy. 1998;14:840-3.

6. Maffulli N, Longo UG, Maffulli GD, Rabitti C, Khanna A, Denaro V. Marked pathological changes proximal and distal to the site of rupture in acute Achilles tendon ruptures. Knee Surg Sports Traumatol Arthrosc. 2010 Jun 19 [Epub ahead of print].

7. Maffulli N, Longo UG, Franceschi F, Rabitti C, Denaro V. Movin and Bonar scores assess the same characteristics of tendon histology. Clin Orthop Relat Res. 2008;466:1605-11.

8. Arya S, Kulig K. Tendinopathy alters mechanical and material properties of the Achilles tendon. J Appl Physiol. 2010;108:670-5.

9. Longo UG, Franceschi F, Ruzzini L, Rabitti C, Morini S, Maffulli N, Forriol F, Denaro V. Light microscopic histology of supraspinatus tendon ruptures. Knee Surg Sports Traumatol Arthrosc. 2007;15:1390-4.

10. Longo UG, Franceschi F, Ruzzini L, Rabitti C, Morini S, Maffulli N, Denaro V. Characteristics at haematoxylin and eosin staining of ruptures of the long head of the biceps tendon. Br J Sports Med. 2009;43:603-7.

11. Longo UG, Franceschi F, Ruzzini L, Rabitti C, Morini S, Maffulli N, Denaro V. Histopathology of the supraspinatus tendon in rotator cuff tears. Am J Sports Med. 2008;36:533-8.

12. Longo UG, Ronga M, Maffulli N. Acute ruptures of the Achilles tendon. Sports Med Arthrosc. 2009;17:127-38.

13. Longo UG, Ronga M, Maffulli N. Achilles tendinopathy. Sports Med Arthrosc. 2009;17:112-26.

14. Rees JD, Maffulli N, Cook J. Management of tendinopathy. Am J Sports Med. 2009;37:1855-67.

15. Garau G, Rittweger J, Mallarias P, Longo UG, Maffulli N. Traumatic patellar tendinopathy. Disabil Rehabil. 2008;30:1616-20.

16. Longo UG, Franceschi F, Spiezia F, Forriol F, Maffulli N, Denaro V. Triglycerides and total serum cholesterol in rotator cuff tears: do they matter? Br J Sports Med. 2010 May 10 [Epub ahead of print].

17. Longo UG, Oliva F, Denaro V, Maffulli N. Oxygen species and overuse tendinopathy in athletes. Disabil Rehabil. 2008;30:1563-71.

18. Longo UG, Franceschi F, Ruzzini L, Spiezia F, Maffulli N, Denaro V. Higher fasting plasma glucose levels within the normoglycaemic range and rotator cuff tears. Br J Sports Med. 2009;43:284-7.

19. Lewis JS. Rotator cuff tendinopathy: a model for the continuum of pathology and related management. Br J Sports Med. 2010 Jun 11 [Epub ahead of print].

20. Cook JL, Purdam CR. Is tendon pathology a continuum? A pathology model to explain the clinical presentation of load-induced tendinopathy. Br J Sports Med. 2009;43:409-16.

21. Maffulli N, Longo UG. Conservative management for tendinopathy: is there enough scientific evidence? Rheumatology (Oxford). 2008;47:390-1.

22. Lippi G, Banfi G, Favaloro EJ, Rittweger J, Maffulli N. Updates on improvement of human athletic performance: focus on world records in athletics. Br Med Bull. 2008; 87:7-15.

23. Aström M, Westlin N. No effect of piroxicam on Achilles tendinopathy. A randomized study of 70 patients. Acta Orthop Scand. 1992;63:631-4.

24. Auclair J, Georges M, Grapton X, Gryp L, D'Hooghe M, Meisser RG, Noto R, Schmidtmayer B. A double-blind controlled multi-center study of percutaneous niflumic acid gel and placebo in the treatment of Achilles heel tendinitis. Curr Ther Res. 1989;46:782-8.

25. Jakobsen TJ, Petersen L, Christiansen S, Haarbo J, Munch M, Larsen PB, Haugegaard M, Pichard J. Tenoxicam vs placebo in the treatment of tendinitis, periostitis, and sprains. Curr Ther Res. 1989;45:213-20.

26. Roos EM, Engström M, Lagerquist A, Söderberg B. Clinical improvement after 6 weeks of eccentric exercise in patients with mid-portion Achilles tendinopathy—a randomized trial with 1-year follow-up. Scand J Med Sci Sports. 2004;14:286-95.

27. Frohm A, Saartok T, Halvorsen K, Renström P. Eccentric treatment for patellar tendinopathy: a prospective randomised short-term pilot study of two rehabilitation protocols. Br J Sports Med. 2007;41:e7.

28. Petersen W, Welp R, Rosenbaum D. Chronic Achilles tendinopathy: a prospective randomized study comparing the therapeutic effect of eccentric training, the AirHeel brace, and a combination of both. Am J Sports Med. 2007;35: 1659-67.

29. de Jonge S, de Vos RJ, Van Schie HT, Verhaar JA, Weir A, Tol JL. One-year follow-up of a randomised controlled trial on added splinting to eccentric exercises in chronic midportion Achilles tendinopathy. Br J Sports Med. 2010;44: 673-7.

30. Rompe JD, Furia J, Maffulli N. Eccentric loading versus eccentric loading plus shock-wave treatment for midportion Achilles tendinopathy: a randomized controlled trial. Am J Sports Med. 2009;37:463-70.

31. Paoloni JA, Appleyard RC, Nelson J, Murrell GA. Topical glyceryl trinitrate treatment of chronic noninsertional Achilles tendinopathy. A randomized, double-blind, placebo-controlled trial. J Bone Joint Surg Am. 2004;86:916-22.

32. Paoloni JA, Murrell GA. Three-year followup study of topical glyceryl trinitrate treatment of chronic noninsertional Achilles tendinopathy. Foot Ankle Int. 2007; 28:1064-8.

33. Kane TP, Ismail M, Calder JD. Topical glyceryl trinitrate and noninsertional Achilles tendinopathy: a clinical and cellular investigation. Am J Sports Med. 2008; 36:1160-3.

34. Hoksrud A, Ohberg L, Alfredson H, Bahr R. Ultrasound-guided sclerosis of neovessels in painful chronic patellar tendinopathy: a randomized controlled trial. Am J Sports Med. 2006;34:1738-46.

35. Brown R, Orchard J, Kinchington M, Hooper A, Nalder G. Aprotinin in the management of Achilles tendinopathy: a randomised controlled trial. Br J Sports Med. 2006;40:275-9.

36. Capasso G, Testa V, Maffulli N, Bifulco G. Aprotinin, corticosteroids and normosaline in the management of patellar tendinopathy in athletes: a prospective randomized study. Sports Exerc Injury. 1997;3:111-5.

37. Capasso G, Maffulli N, Testa V, Sgambato A. Preliminary results with peritendinous protease inhibitor injections in the management of Achilles tendinitis. J Sports Traumatol Relat Res. 1993;15:37-43.

38. Chester R, Costa ML, Shepstone L, Cooper A, Donell ST. Eccentric calf muscle training compared with therapeutic ultrasound for chronic Achilles tendon pain—a pilot study. Man Ther. 2008;13:484-91.

39. Schmitt J, Haake M, Tosch A, Hildebrand R, Deike B, Griss P. Low-energy extracorporeal shock-wave treatment (ESWT) for tendinitis of the supraspinatus. A prospective, randomised study. J Bone Joint Surg Br. 2001;83:873-6.

40. Speed CA, Nichols D, Richards C, Humphreys H, Wies JT, Burnet S, Hazleman BL. Extracorporeal shock wave therapy for lateral epicondylitis—a double blind randomised controlled trial. J Orthop Res. 2002;20:895-8.

41. Speed CA, Richards C, Nichols D, Burnet S, Wies JT, Humphreys H, Hazleman BL. Extracorporeal shock-wave therapy for tendonitis of the rotator cuff. A double-blind, randomised, controlled trial. J Bone Joint Surg Br. 2002;84:509-12.

42. Cosentino R, De Stefano R, Selvi E, Frati E, Manca S, Frediani B, Marcolongo R. Extracorporeal shock wave therapy for chronic calcific tendinitis of the shoulder: single blind study. Ann Rheum Dis. 2003;62:248-50.

43. Gerdesmeyer L, Wagenpfeil S, Haake M, Maier M, Loew M, Wörtler K, Lampe R, Seil R, Handle G, Gassel S, Rompe JD. Extracorporeal shock wave therapy for the treatment of chronic calcifying tendonitis of the rotator cuff: a randomized controlled trial. JAMA. 2003;290:2573-80.

44. Chung B, Wiley JP. Effectiveness of extracorporeal shock wave therapy in the treatment of previously untreated lateral epicondylitis: a randomized controlled trial. Am J Sports Med. 2004;32:1660-7.

45. Pettrone FA, McCall BR. Extracorporeal shock wave therapy without local anesthesia for chronic lateral epicondylitis. J Bone Joint Surg Am. 2005;87: 1297-304.

46. Lebrun CM. Low-dose extracorporeal shock wave therapy for previously untreated lateral epicondylitis. Clin J Sport Med. 2005;15:401-2.

47. Albert JD, Meadeb J, Guggenbuhl P, Marin F, Benkalfate T, Thomazeau H, Chalès G. High-energy extracorporeal shock-wave therapy for calcifying tendinitis of the rotator cuff: a randomised trial. J Bone Joint Surg Br. 2007;89:335-41.

48. Staples MP, Forbes A, Ptasznik R, Gordon J, Buchbinder R. A randomized controlled trial of extracorporeal shock wave therapy for lateral epicondylitis (tennis elbow). J Rheumatol. 2008;35:2038-46.

49. Schofer MD, Hinrichs F, Peterlein CD, Arendt M, Schmitt J. High- versus low-energy extracorporeal shock wave therapy of rotator cuff tendinopathy: a prospective, randomised, controlled study. Acta Orthop Belg. 2009;75:452-8.

50. Rompe JD, Nafe B, Furia JP, Maffulli N. Eccentric loading, shock-wave treatment, or a wait-and-see policy for tendinopathy of the main body of tendo Achillis: a randomized controlled trial. Am J Sports Med. 2007;35:374-83.

51. Magra M, Maffulli N. Nonsteroidal antiinflammatory drugs in tendinopathy: friend or foe. Clin J Sport Med. 2006;16:1-3.

52. Maffulli N, Longo UG. How do eccentric exercises work in tendinopathy? Rheumatology (Oxford). 2008;47:1444-5.

53. Rees JD, Lichtwark GA, Wolman RL, Wilson AM. The mechanism for efficacy of eccentric loading in Achilles tendon injury; an in vivo study in humans. Rheumatology (Oxford). 2008;47:1493-7.

54. Alfredson H, Lorentzon R. Intratendinous glutamate levels and eccentric training in chronic Achilles tendinosis: a prospective study using microdialysis technique. Knee Surg Sports Traumatol Arthrosc. 2003;11:196-9.

55. Andersson G, Danielson P, Alfredson H, Forsgren S. Presence of substance P and the neurokinin-1 receptor in tenocytes of the human Achilles tendon. Regul Pept. 2008;150:81-7.

56. Allison GT, Purdam C. Eccentric loading for Achilles tendinopathy—strengthening or stretching? Br J Sports Med. 2009;43:276-9.

57. Langberg H, Kongsgaard M. Eccentric training in tendinopathy—more questions than answers. Scand J Med Sci Sports. 2008;18:541-2.

58. Rees JD, Wolman RL, Wilson A. Eccentric exercises; why do they work, what are the problems and how can we improve them? Br J Sports Med. 2009;43:242-6.

59. Ohberg L, Alfredson H. Effects on neovascularisation behind the good results with eccentric training in chronic mid-portion Achilles tendinosis? Knee Surg Sports Traumatol Arthrosc. 2004;12:465-70.

60. Mafi N, Lorentzon R, Alfredson H. Superior short-term results with eccentric calf muscle training compared to concentric training in a randomized prospective multicenter study on patients with chronic Achilles tendinosis. Knee Surg Sports Traumatol Arthrosc. 2001;9:42-7.

61. Maffulli N, Longo UG, Loppini M, Denaro V. Current treatment options for tendinopathy. Expert Opin Pharmacother. 2010;11:2177-86.

62. Rompe JD, Furia J, Weil L, Maffulli N. Shock wave therapy for chronic plantar fasciopathy. Br Med Bull. 2007;81-82:183–208.

63. Rompe JD, Maffulli N. Repetitive shock wave therapy for lateral elbow tendinopathy (tennis elbow): a systematic and qualitative analysis. Br Med Bull. 2007; 83:355-78.

64. Rompe JD, Furia JP, Maffulli N. Mid-portion Achilles tendinopathy—current options for treatment. Disabil Rehabil. 2008;30:1666-76.

65. Rompe JD, Furia J, Maffulli N. Eccentric loading compared with shock wave treatment for chronic insertional Achilles tendinopathy. A randomized, controlled trial. J Bone Joint Surg Am. 2008;90:52-61.

66. Costa ML, Shepstone L, Donell ST, Thomas TL. Shock wave therapy for chronic Achilles tendon pain: a randomized placebo-controlled trial. Clin Orthop Relat Res. 2005;440:199-204.

67. Alfredson H, Ohberg L, Forsgren S. Is vasculo-neural ingrowth the cause of pain in chronic Achilles tendinosis? An investigation using ultrasonography and colour Doppler, immunohistochemistry, and diagnostic injections. Knee Surg Sports Traumatol Arthrosc. 2003;11:334-8.

68. Kristoffersen M, Ohberg L, Johnston C, Alfredson H. Neovascularisation in chronic tendon injuries detected with colour Doppler ultrasound in horse and man: implications for research and treatment. Knee Surg Sports Traumatol Arthrosc. 2005;13:505-8.

69. Ohberg L, Lorentzon R, Alfredson H. Neovascularisation in Achilles tendons with painful tendinosis but not in normal tendons: an ultrasonographic investigation. Knee Surg Sports Traumatol Arthrosc. 2001;9:233-8.

70. Andersson G, Danielson P, Alfredson H, Forsgren S. Nerve-related characteristics of ventral paratendinous tissue in chronic Achilles tendinosis. Knee Surg Sports Traumatol Arthrosc. 2007;15:1272-9.

71. Danielson P, Andersson G, Alfredson H, Forsgren S. Marked sympathetic component in the perivascular innervation of the dorsal paratendinous tissue of the patellar tendon in arthroscopically treated tendinosis patients. Knee Surg Sports Traumatol Arthrosc. 2008;16:621-6.

72. Schizas N, Lian Ø, Frihagen F, Engebretsen L, Bahr R, Ackermann PW. Coexistence of up-regulated NMDA receptor 1 and glutamate on nerves, vessels and transformed tenocytes in tendinopathy. Scand J Med Sci Sports. 2010;20:208-15.

73. Danielson P, Alfredson H, Forsgren S. Immunohistochemical and histochemical findings favoring the occurrence of autocrine/paracrine as well as nerve-related cholinergic effects in chronic painful patellar tendon tendinosis. Microsc Res Tech. 2006;69:808-19.

74. Chan O, O'Dowd D, Padhiar N, Morrissey D, King J, Jalan R, Maffulli N, Crisp T. High volume image guided injections in chronic Achilles tendinopathy. Disabil Rehabil. 2008;30:1697-708.

75. Crisp T, Khan F, Padhiar N, Morrissey D, King J, Jalan R, Maffulli N, Frcr OC. High volume ultrasound guided injections at the interface between the patellar tendon and Hoffa's body are effective in chronic patellar tendinopathy: a pilot study. Disabil Rehabil. 2008;30:1625-34.

76. Humphrey J, Chan O, Crisp T, Padhiar N, Morrissey D, Twycross-Lewis R, King J, Maffulli N. The short-term effects of high volume image guided injections in resistant non-insertional Achilles tendinopathy. J Sci Med Sport. 2010;13:295-8.

77. Shrier I, Matheson GO, Kohl HW 3rd. Achilles tendonitis: are corticosteroid injections useful or harmful? Clin J Sport Med. 1996;6:245-50.

78. Kon E, Filardo G, Delcogliano M, Presti ML, Russo A, Bondi A, Di Martino A, Cenacchi A, Fornasari PM, Marcacci M. Platelet-rich plasma: new clinical application: a pilot study for treatment of jumper's knee. Injury. 2009;40:598-603.

79. Foster TE, Puskas BL, Mandelbaum BR, Gerhardt MB, Rodeo SA. Platelet-rich plasma: from basic science to clinical applications. Am J Sports Med. 2009;37: 2259-72.

80. Sánchez M, Anitua E, Orive G, Mujika I, Andia I. Platelet-rich therapies in the treatment of orthopaedic sport injuries. Sports Med. 2009;39:345-54.

81. Sampson S, Gerhardt M, Mandelbaum B. Platelet rich plasma injection grafts for musculoskeletal injuries: a review. Curr Rev Musculoskelet Med. 2008;1: 165-74.

82. Hall MP, Band PA, Meislin RJ, Jazrawi LM, Cardone DA. Platelet-rich plasma: current concepts and application in sports medicine. J Am Acad Orthop Surg. 2009; 17:602-8.

83. Knighton DR, Hunt TK, Thakral KK, Goodson WH 3rd. Role of platelets and fibrin in the healing sequence: an in vivo study of angiogenesis and collagen synthesis. Ann Surg. 1982;196:379-88.

84. Forriol F, Longo UG, Concejo C, Ripalda P, Maffulli N, Denaro V. Platelet-rich plasma, rhOP-1 (rhBMP-7) and frozen rib allograft for the reconstruction of bony mandibular defects in sheep. A pilot experimental study. Injury. 2009;40 Suppl 3:S44-9.

85. Mishra A, Pavelko T. Treatment of chronic elbow tendinosis with buffered platelet-rich plasma. Am J Sports Med. 2006;34:1774-8.

86. Mishra A, Woodall J Jr, Vieira A. Treatment of tendon and muscle using platelet-rich plasma. Clin Sports Med. 2009;28:113-25.

87. Sánchez M, Anitua E, Azofra J, Andía I, Padilla S, Mujika I. Comparison of surgically repaired Achilles tendon tears using platelet-rich fibrin matrices. Am J Sports Med. 2007;35:245-51.

88. Mei-Dan O, Mann G, Maffulli N. Platelet-rich plasma: any substance into it? Br J Sports Med. 2010;44:618-9.

89. de Vos RJ, van Veldhoven PL, Moen MH, Weir A, Tol JL, Maffulli N. Autologous growth factor injections in chronic tendinopathy: a systematic review. Br Med Bull. 2010 Mar 2 [Epub ahead of print].

90. Sharma P, Maffulli N. Tendinopathy and tendon injury: the future. Disabil Rehabil. 2008;30:1733-45.

91. Sharma P, Maffulli N. Biology of tendon injury: healing, modeling and remodeling. J Musculoskelet Neuronal Interact. 2006;6:181-90.

92. Sharma P, Maffulli N. Basic biology of tendon injury and healing. Surgeon. 2005; 3:309-16.

93. de Vos RJ, Weir A, van Schie HT, Bierma-Zeinstra SM, Verhaar JA, Weinans H, Tol JL. Platelet-rich plasma injection for chronic Achilles tendinopathy: a randomized controlled trial. JAMA. 2010;303:144-9.

94. Edwards SG, Calandruccio JH. Autologous blood injections for refractory lateral epicondylitis. J Hand Surg Am. 2003;28:272-8.

95. Iwasaki M, Nakahara H, Nakata K, Nakase T, Kimura T, Ono K. Regulation of proliferation and osteochondrogenic differentiation of periosteum-derived cells by transforming growth factor-beta and basic fibroblast growth factor. J Bone Joint Surg Am. 1995;77:543-54.

96. Rabago D, Best TM, Zgierska AE, Zeisig E, Ryan M, Crane D. A systematic review of four injection therapies for lateral epicondylosis: prolotherapy, polidocanol, whole blood and platelet-rich plasma. Br J Sports Med. 2009;43:471-81.

97. Knobloch K, Schreibmueller L, Longo UG, Vogt PM. Eccentric exercises for the management of tendinopathy of the main body of the Achilles tendon with or without an AirHeel Brace. A randomized controlled trial. B: effects of compliance. Disabil Rehabil. 2008;30:1692-6.

98. Knobloch K, Schreibmueller L, Longo UG, Vogt PM. Eccentric exercises for the management of tendinopathy of the main body of the Achilles tendon with or without the AirHeel Brace. A randomized controlled trial. A: effects on pain and microcirculation. Disabil Rehabil. 2008;30:1685-91.

99. Jonsson P, Alfredson H. Superior results with eccentric compared to concentric quadriceps training in patients with jumper's knee: a prospective randomised study. Br J Sports Med. 2005;39:847-50.

100. Ohberg L, Alfredson H. Ultrasound guided sclerosis of neovessels in painful chronic Achilles tendinosis: pilot study of a new treatment. Br J Sports Med. 2002; 36:173-7.

101. Alfredson H, Ohberg L. Neovascularisation in chronic painful patellar tendinosis—promising results after sclerosing neovessels outside the tendon challenge the need for surgery. Knee Surg Sports Traumatol Arthrosc. 2005;13:74-80.

102. Alfredson H, Ohberg L. Sclerosing injections to areas of neo-vascularisation reduce pain in chronic Achilles tendinopathy: a double-blind randomised controlled trial. Knee Surg Sports Traumatol Arthrosc. 2005;13:338-44.

103. Alfredson H, Harstad H, Haugen S, Ohberg L. Sclerosing polidocanol injections to treat chronic painful shoulder impingement syndrome-results of a two-centre collaborative pilot study. Knee Surg Sports Traumatol Arthrosc. 2006;14:1321-6.

104. Alfredson H, Ohberg L, Zeisig E, Lorentzon R. Treatment of midportion Achilles tendinosis: similar clinical results with US and CD-guided surgery outside the tendon and sclerosing polidocanol injections. Knee Surg Sports Traumatol Arthrosc. 2007; 15:1504-9.

105. Alfredson H. Conservative management of Achilles tendinopathy: new ideas. Foot Ankle Clin. 2005;10:321-9.

106. Metcalfe D, Achten J, Costa ML. Glucocorticoid injections in lesions of the Achilles tendon. Foot Ankle Int. 2009;30:661-5.

107. Chen SK, Lu CC, Chou PH, Guo LY, Wu WL. Patellar tendon ruptures in weight lifters after local steroid injections. Arch Orthop Trauma Surg. 2009;129: 369-72.

108. Hamilton B, Remedios D, Loosemore M, Maffulli N. Achilles tendon rupture in an elite athlete following multiple injection therapies. J Sci Med Sport. 2008;11:566-8.

109. Paavola M, Kannus P, Järvinen TA, Järvinen TL, Józsa L, Järvinen M. Treatment of tendon disorders. Is there a role for corticosteroid injection? Foot Ankle Clin. 2002;7:501-13.

110. Hayes DW Jr, Gilbertson EK, Mandracchia VJ, Dolphin TF. Tendon pathology in the foot. The use of corticosteroid injection therapy. Clin Podiatr Med Surg. 2000;17:723-35.

111. Kleinman M, Gross AE. Achilles tendon rupture following steroid injection. Report of three cases. J Bone Joint Surg Am. 1983;65:1345-7.

112. Ford LT, DeBender J. Tendon rupture after local steroid injection. South Med J. 1979;72:827-30.

113. Kapetanos G. The effect of the local corticosteroids on the healing and biomechanical properties of the partially injured tendon. Clin Orthop Relat Res. 1982;163:170-9.

114. Matthews LS, Sonstegard DA, Phelps DB. A biomechanical study of rabbit patellar tendon: effects of steroid injection. J Sports Med. 1974;2:349-57.

115. Neeter C, Thomeé R, Silbernagel KG, Thomeé P, Karlsson J. Iontophoresis with or without dexamethazone in the treatment of acute Achilles tendon pain. Scand J Med Sci Sports. 2003;13:376-82.

116. Fredberg U, Bolvig L, Pfeiffer-Jensen M, Clemmensen D, Jakobsen BW, Stengaard-Pedersen K. Ultrasonography as a tool for diagnosis, guidance of local steroid injection and, together with pressure algometry, monitoring of the treatment of athletes with chronic jumper's knee and Achilles tendinitis: a randomized, double-blind, placebo-controlled study. Scand J Rheumatol. 2004;33:94-101.

117. DaCruz DJ, Geeson M, Allen MJ, Phair I. Achilles paratendonitis: an evaluation of steroid injection. Br J Sports Med. 1988;22:64-5.

118. Gill SS, Gelbke MK, Mattson SL, Anderson MW, Hurwitz SR. Fluoroscopically guided low-volume peritendinous corticosteroid injection for Achilles tendinopathy. A safety study. J Bone Joint Surg Am. 2004;86:802-6.

119. Kannus P, Józsa L. Histopathological changes preceding spontaneous rupture of a tendon. A controlled study of 891 patients. J Bone Joint Surg Am. 1991;73:1507-25.

120. Maffulli N. Re: etiologic factors associated with symptomatic Achilles tendinopathy. Foot Ankle Int. 2007;28:660-1.

121. Maffulli N, Testa V, Capasso G, Bifulco G, Binfield PM. Results of percutaneous longitudinal tenotomy for Achilles tendinopathy in middle- and long-distance runners. Am J Sports Med. 1997;25:835-40.

122. Testa V, Capasso G, Benazzo F, Maffulli N. Management of Achilles tendinopathy by ultrasound-guided percutaneous tenotomy. Med Sci Sports Exerc. 2002;34:573-80.

123. Testa V, Maffulli N, Capasso G, Bifulco G. Percutaneous longitudinal tenotomy in chronic Achilles tendonitis. Bull Hosp Jt Dis. 1996;54:241-4.

124. Ochiai N, Tasto JP, Ohtori S, Takahashi N, Moriya H, Amiel D. Nerve regeneration after radiofrequency application. Am J Sports Med. 2007;35:1940-4.

125. Takahashi N, Tasto JP, Ritter M, Ochiai N, Ohtori S, Moriya H, Amiel D. Pain relief through an antinociceptive effect after radiofrequency application. Am J Sports Med. 2007;35:805-10.

126. Tasto JP. The role of radiofrequency-based devices in shaping the future of orthopedic surgery. Orthopedics. 2006;29:874-5.

127. Tasto JP, Cummings J, Medlock V, Hardesty R, Amiel D. Microtenotomy using a radiofrequency probe to treat lateral epicondylitis. Arthroscopy. 2005;21:851-60.

128. van Dijk CN, Kort N. Tendoscopy of the peroneal tendons. Arthroscopy. 1998;14:471-8.

129. van Dijk CN, Kort N, Scholten PE. Tendoscopy of the posterior tibial tendon. Arthroscopy. 1997;13:692-8.

130. van Dijk CN, Scholten PE, Krips R. A 2-portal endoscopic approach for diagnosis and treatment of posterior ankle pathology. Arthroscopy. 2000;16:871-6.

131. van Dijk CN, van Dyk GE, Scholten PE, Kort NP. Endoscopic calcaneoplasty. Am J Sports Med. 2001;29:185-9.

132. Thermann H, Benetos IS, Panelli C, Gavriilidis I, Feil S. Endoscopic treatment of chronic mid-portion Achilles tendinopathy: novel technique with short-term results. Knee Surg Sports Traumatol Arthrosc. 2009;17:1264-9.

133. Willberg L, Sunding K, Forssblad M, Alfredson H. Ultrasound- and Doppler-guided arthroscopic shaving to treat Jumper's knee: a technical note. Knee Surg Sports Traumatol Arthrosc. 2007;15:1400-3.

134. Boesen MI, Torp-Pedersen S, Koenig MJ, Christensen R, Langberg H, Hölmich P, Nielsen MB, Bliddal H. Ultrasound guided electrocoagulation in patients with chronic non-insertional Achilles tendinopathy: a pilot study. Br J Sports Med. 2006;40:761-6.

135. Khanna A, Friel M, Gougoulias N, Longo UG, Maffulli N. Prevention of adhesions in surgery of the flexor tendons of the hand: what is the evidence? Br Med Bull. 2009;90:85-109.

136. Longo UG, Ramamurthy C, Denaro V, Maffulli N. Minimally invasive stripping for chronic Achilles tendinopathy. Disabil Rehabil. 2008;30:1709-13.

137. Maffulli N, Longo UG, Oliva F, Ronga M, Denaro V. Minimally invasive surgery of the Achilles tendon. Orthop Clin North Am. 2009;40:491-8, viii-ix.

138. Maffulli N, Longo UG, Denaro V. Letter to the editor: minimally invasive paratenon release for non-insertional Achilles tendinopathy. Foot Ankle Int. 2009;30:1027-8.

139. Scholten PE, van Dijk CN. Tendoscopy of the peroneal tendons. Foot Ankle Clin. 2006;11:415-20, vii.

140. Steenstra F, van Dijk CN. Achilles tendoscopy. Foot Ankle Clin. 2006;11:429-38, viii.

141. Scholten PE, van Dijk CN. Endoscopic calcaneoplasty. Foot Ankle Clin. 2006;11:439-46, viii.

142. Coons DA, Alan Barber F. Tendon graft substitutes-rotator cuff patches. Sports Med Arthrosc. 2006;14:185-90.

143. Aurora A, McCarron J, Iannotti JP, Derwin K. Commercially available extracellular matrix materials for rotator cuff repairs: state of the art and future trends. J Shoulder Elbow Surg. 2007;16(5 Suppl):S171-8.

144. Longo UG, Lamberti A, Maffulli N, Denaro V. Tendon augmentation grafts: a systematic review. Br Med Bull. 2010;94:165-88.

145. Chen J, Xu J, Wang A, Zheng M. Scaffolds for tendon and ligament repair: review of the efficacy of commercial products. Expert Rev Med Devices. 2009;6:61-73.

146. Magra M, Maffulli N. Genetic aspects of tendinopathy. J Sci Med Sport. 2008;11:243-7.

147. Lippi G, Longo UG, Maffulli N. Genetics and sports. Br Med Bull. 2010;93:27-47.

148. Longo UG, Fazio V, Poeta ML, Rabitti C, Franceschi F, Maffulli N, Denaro V. Bilateral consecutive rupture of the quadriceps tendon in a man with BstUI polymorphism of the COL5A1 gene. Knee Surg Sports Traumatol Arthrosc. 2010;18:514-8.

149. Purdam CR, Jonsson P, Alfredson H, Lorentzon R, Cook JL, Khan KM. A pilot study of the eccentric decline squat in the management of painful chronic patellar tendinopathy. Br J Sports Med. 2004;38:395-7.

150. Young MA, Cook JL, Purdam CR, Kiss ZS, Alfredson H. Eccentric decline squat protocol offers superior results at 12 months compared with traditional eccentric protocol for patellar tendinopathy in volleyball players. Br J Sports Med. 2005;39:102-5.

151. Bahr R, Fossan B, Løken S, Engebretsen L. Surgical treatment compared with eccentric training for patellar tendinopathy (jumper's knee). A randomized, controlled trial. J Bone Joint Surg Am. 2006;88:1689-98.

152. Jonsson P, Wahlström P, Ohberg L, Alfredson H. Eccentric training in chronic painful impingement syndrome of the shoulder: results of a pilot study. Knee Surg Sports Traumatol Arthrosc. 2006;14:76-81.

153. Sayana MK, Maffulli N. Eccentric calf muscle training in non-athletic patients with Achilles tendinopathy. J Sci Med Sport. 2007;10:52-8.

154. Croisier JL, Foidart-Dessalle M, Tinant F, Crielaard JM, Forthomme B. An isokinetic eccentric programme for the management of chronic lateral epicondylar tendinopathy. Br J Sports Med. 2007;41:269-75.

155. Nørregaard J, Larsen CC, Bieler T, Langberg H. Eccentric exercise in treatment of Achilles tendinopathy. Scand J Med Sci Sports. 2007;17:133-8.

156. Jonsson P, Alfredson H, Sunding K, Fahlström M, Cook J. New regimen for eccentric calf-muscle training in patients with chronic insertional Achilles tendinopathy: results of a pilot study. Br J Sports Med. 2008;42:746-9.

157. Maffulli N, Walley G, Sayana MK, Longo UG, Denaro V. Eccentric calf muscle training in athletic patients with Achilles tendinopathy. Disabil Rehabil. 2008;30:1677-84.

158. Kulig K, Lederhaus ES, Reischl S, Arya S, Bashford G. Effect of eccentric exercise program for early tibialis posterior tendinopathy. Foot Ankle Int. 2009;30:877-85.

159. Jakobeit C, Winiarski B, Jakobeit S, Welp L, Spelsberg G. Ultrasound-guided, high-energy extracorporeal - shock-wave treatment of symptomatic calcareous tendinopathy of the shoulder. ANZ J Surg. 2002;72:496-500.

160. Peters J, Luboldt W, Schwarz W, Jacobi V, Herzog C, Vogl TJ. Extracorporeal shock wave therapy in calcific tendinitis of the shoulder. Skeletal Radiol. 2004;33:712-8.

161. Chung B, Wiley JP, Rose MS. Long-term effectiveness of extracorporeal shockwave therapy in the treatment of previously untreated lateral epicondylitis. Clin J Sport Med. 2005;15:305-12.

162. Moretti B, Garofalo R, Genco S, Patella V, Mouhsine E. Medium-energy shock wave therapy in the treatment of rotator cuff calcifying tendinitis. Knee Surg Sports Traumatol Arthrosc. 2005;13:405-10.

163. Furia JP. Safety and efficacy of extracorporeal shock wave therapy for chronic lateral epicondylitis. Am J Orthop (Belle Mead NJ). 2005;34:13-9.

164. Furia JP. High-energy extracorporeal shock wave therapy as a treatment for insertional Achilles tendinopathy. Am J Sports Med. 2006;34:733-40.

165. Vulpiani MC, Vetrano M, Savoia V, Di Pangrazio E, Trischitta D, Ferretti A. Jumper's knee treatment with extracorporeal shock wave therapy: a long-term follow-up observational study. J Sports Med Phys Fitness. 2007;47:323-8.

166. Hsu CJ, Wang DY, Tseng KF, Fong YC, Hsu HC, Jim YF. Extracorporeal shock wave therapy for calcifying tendinitis of the shoulder. J Shoulder Elbow Surg. 2008;17:55-9.

167. Vulpiani MC, Trischitta D, Trovato P, Vetrano M, Ferretti A. Extracorporeal shockwave therapy (ESWT) in Achilles tendinopathy. A long-term follow-up observational study. J Sports Med Phys Fitness. 2009;49:171-6.

168. Filardo G, Kon E, Della Villa S, Vincentelli F, Fornasari PM, Marcacci M. Use of platelet-rich plasma for the treatment of refractory jumper's knee. Int Orthop. 2010;34:909-15.

169. Suresh SP, Ali KE, Jones H, Connell DA. Medial epicondylitis: is ultrasound guided autologous blood injection an effective treatment? Br J Sports Med. 2006;40:935-9.

170. Connell DA, Ali KE, Ahmad M, Lambert S, Corbett S, Curtis M. Ultrasound-guided autologous blood injection for tennis elbow. Skeletal Radiol. 2006;35:371-7.

171. James SL, Ali K, Pocock C, Robertson C, Walter J, Bell J, Connell D. Ultrasound guided dry needling and autologous blood injection for patellar tendinosis. Br J Sports Med. 2007;41:518-21.

172. Moon YL, Jo SH, Song CH, Park G, Lee HJ, Jang SJ. Autologous bone marrow plasma injection after arthroscopic debridement for elbow tendinosis. Ann Acad Med Singapore. 2008;37:559-63.

173. Ohberg L, Alfredson H. Sclerosing therapy in chronic Achilles tendon insertional pain-results of a pilot study. Knee Surg Sports Traumatol Arthrosc. 2003;11:339-43.

174. Zeisig E, Ohberg L, Alfredson H. Sclerosing polidocanol injections in chronic painful tennis elbow-promising results in a pilot study. Knee Surg Sports Traumatol Arthrosc. 2006;14:1218-24.

175. Lind B, Ohberg L, Alfredson H. Sclerosing polidocanol injections in mid-portion Achilles tendinosis: remaining good clinical results and decreased tendon thickness at 2-year follow-up. Knee Surg Sports Traumatol Arthrosc. 2006;14:1327-32.

176. Willberg L, Sunding K, Ohberg L, Forssblad M, Fahlström M, Alfredson H. Sclerosing injections to treat midportion Achilles tendinosis: a randomised controlled study evaluating two different concentrations of Polidocanol. Knee Surg Sports Traumatol Arthrosc. 2008;16:859-64.

177. Hoksrud A, Ohberg L, Alfredson H, Bahr R. Color Doppler ultrasound findings in patellar tendinopathy (jumper's knee). Am J Sports Med. 2008;36:1813-20.

178. Zeisig E, Fahlström M, Ohberg L, Alfredson H. A two-year sonographic follow-up after intratendinous injection therapy in patients with tennis elbow. Br J Sports Med. 2010;44:584-7.

179. Clementson M, Lorén I, Dahlberg L, Aström M. Sclerosing injections in midportion Achilles tendinopathy: a retrospective study of 25 patients. Knee Surg Sports Traumatol Arthrosc. 2008;16:887-90.

180. Saartok T, Eriksson E. Randomized trial of oral naproxen or local injection of betamethasone in lateral epicondylitis of the humerus. Orthopedics. 1986;9:191-4.

181. Anderson BC, Manthey R, Brouns MC. Treatment of De Quervain's tenosynovitis with corticosteroids. A prospective study of the response to local injection. Arthritis Rheum. 1991;34:793-8.

182. Price R, Sinclair H, Heinrich I, Gibson T. Local injection treatment of tennis elbow—hydrocortisone, triamcinolone and lignocaine compared. Br J Rheumatol. 1991;30:39-44.

183. Vecchio PC, Hazleman BL, King RH. A double-blind trial comparing subacromial methylprednisolone and lignocaine in acute rotator cuff tendinitis. Br J Rheumatol. 1993;32:743-5.

184. Sölveborn SA, Buch F, Mallmin H, Adalberth G. Cortisone injection with anesthetic additives for radial epicondylalgia (tennis elbow). Clin Orthop Relat Res. 1995;316:99-105.

185. Verhaar JA, Walenkamp GH, van Mameren H, Kester AD, van der Linden AJ. Local corticosteroid injection versus Cyriax-type physiotherapy for tennis elbow. J Bone Joint Surg Br. 1996;78:128-32.

186. Stahl S, Kaufman T. The efficacy of an injection of steroids for medial epicondylitis. A prospective study of sixty elbows. J Bone Joint Surg Am. 1997;79:1648-52.

187. Hay EM, Paterson SM, Lewis M, Hosie G, Croft P. Pragmatic randomised controlled trial of local corticosteroid injection and naproxen for treatment of lateral epicondylitis of elbow in primary care. BMJ. 1999;319:964-8.

188. Smidt N, van der Windt DA, Assendelft WJ, Devillé WL, Korthals-de Bos IB, Bouter LM. Corticosteroid injections, physiotherapy, or a wait-and-see policy for lateral epicondylitis: a randomised controlled trial. Lancet. 2002;359:657-62.

189. Crowther MA, Bannister GC, Huma H, Rooker GD. A prospective, randomised study to compare extracorporeal shock-wave therapy and injection of steroid for the treatment of tennis elbow. J Bone Joint Surg Br. 2002;84:678-9.

190. Koenig MJ, Torp-Pedersen S, Qvistgaard E, Terslev L, Bliddal H. Preliminary results of colour Doppler-guided intratendinous glucocorticoid injection for Achilles tendonitis in five patients. Scand J Med Sci Sports. 2004;14:100-6.

191. Lewis M, Hay EM, Paterson SM, Croft P. Local steroid injections for tennis elbow: does the pain get worse before it gets better? Results from a randomized controlled trial. Clin J Pain. 2005;21:330-4.

192. Bisset L, Beller E, Jull G, Brooks P, Darnell R, Vicenzino B. Mobilisation with movement and exercise, corticosteroid injection, or wait and see for tennis elbow: randomised trial. BMJ. 2006;333:939.

193. Tonks JH, Pai SK, Murali SR. Steroid injection therapy is the best conservative treatment for lateral epicondylitis: a prospective randomised controlled trial. Int J Clin Pract. 2007;61:240-6.

194. Peters-Veluthamaningal C, Winters JC, Groenier KH, Jong BM. Corticosteroid injections effective for trigger finger in adults in general practice: a double-blinded randomised placebo controlled trial. Ann Rheum Dis. 2008;67:1262-6.

195. Lindenhovius A, Henket M, Gilligan BP, Lozano-Calderon S, Jupiter JB, Ring D. Injection of dexamethasone versus placebo for lateral elbow pain: a prospective, double-blind, randomized clinical trial. J Hand Surg Am. 2008;33:909-19.

196. Ekeberg OM, Bautz-Holter E, Tveitå EK, Juel NG, Kvalheim S, Brox JI. Subacromial ultrasound guided or systemic steroid injection for rotator cuff disease: randomised double blind study. BMJ. 2009;338:a3112.

197. Taverna E, Battistella F, Sansone V, Perfetti C, Tasto JP. Radiofrequency-based plasma microtenotomy compared with arthroscopic subacromial decompression yields equivalent outcomes for rotator cuff tendinosis. Arthroscopy. 2007;23:1042-51.

198. Liu YJ, Wang ZG, Li ZL, Cai X, Zhou M, Wei M, Zhu JL. [Arthroscopically assisted radiofrequency probe to treat Achilles tendinitis]. Zhonghua Wai Ke Za Zhi. 2008;46:101-3. Chinese.

199. Meknas K, Odden-Miland A, Mercer JB, Castillejo M, Johansen O. Radiofrequency microtenotomy: a promising method for treatment of recalcitrant lateral epicondylitis. Am J Sports Med. 2008;36:1960-5.

200. Al-Duri ZA, Aichroth PM. Surgical aspects of patellar tendonitis: technique and results. Am J Knee Surg. 2001;14:43-50.

201. Owens BD, Murphy KP, Kuklo TR. Arthroscopic release for lateral epicondylitis. Arthroscopy. 2001;17:582-7.

202. Maquirriain J, Ayerza M, Costa-Paz M, Muscolo DL. Endoscopic surgery in chronic Achilles tendinopathies: a preliminary report. Arthroscopy. 2002;18:298-303.

203. Budoff JE, Rodin D, Ochiai D, Nirschl RP. Arthroscopic rotator cuff debridement without decompression for the treatment of tendinosis. Arthroscopy. 2005;21:1081-9.

204. Cummins CA. Lateral epicondylitis: in vivo assessment of arthroscopic debridement and correlation with patient outcomes. Am J Sports Med. 2006;34:1486-91.

205. Ogon P, Maier D, Jaeger A, Suedkamp NP. Arthroscopic patellar release for the treatment of chronic patellar tendinopathy. Arthroscopy. 2006;22:462.e1-5.

206. Jerosch J, Schunck J. Arthroscopic treatment of lateral epicondylitis: indication, technique and early results. Knee Surg Sports Traumatol Arthrosc. 2006;14:379-82.

207. Willberg L, Sunding K, Ohberg L, Forssblad M, Alfredson H. Treatment of Jumper's knee: promising short-term results in a pilot study using a new arthroscopic approach based on imaging findings. Knee Surg Sports Traumatol Arthrosc. 2007;15:676-81.

208. Lorbach O, Diamantopoulos A, Paessler HH. Arthroscopic resection of the lower patellar pole in patients with chronic patellar tendinosis. Arthroscopy. 2008;24:167-73.

209. Vega J, Cabestany JM, Golanó P, Pérez-Carro L. Endoscopic treatment for chronic Achilles tendinopathy. Foot Ankle Surg. 2008;14:204-10.

210. Baker CL Jr, Baker CL 3rd. Long-term follow-up of arthroscopic treatment of lateral epicondylitis. Am J Sports Med. 2008;36:254-60.

211. Grewal R, MacDermid JC, Shah P, King GJ. Functional outcome of arthroscopic extensor carpi radialis brevis tendon release in chronic lateral epicondylitis. J Hand Surg Am. 2009;34:849-57.

212. Wada T, Moriya T, Iba K, Ozasa Y, Sonoda T, Aoki M, Yamashita T. Functional outcomes after arthroscopic treatment of lateral epicondylitis. J Orthop Sci. 2009;14:167-74.