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Tennis elbow

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Abstract

Tennis elbow is the most common cause of lateral-sided elbow pain with a major socioeconomic impact. The etiology of tennis elbow is not completely understood, but there are many different treatment options. This review gives an overview of the current concepts of diagnosis and treatment of tennis elbow and the impact on work participation.

Keywords

elbow, tennis elbow, tendinopathy, treatment

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Introduction

Tennis elbow (TE) is the most common cause of lateral-sided elbow pain. The designation TE is not entirely appropriate for the condition, but it is still widely used. Only 50% of all tennis players will get an episode of TE during their careers, but playing tennis contributes to only 5% of all cases.[1]

TE is common in the general population with a prevalence of 1% to 3%[2,3] and is associated with patients in working age, from 20 to 65 years, with a peak incidence between 40 and 50 years.[4] The incidence of TE seems independent of sex or ethnic background.[5] Among working populations, the incidence in prospective studies varies between 0.9 and 4.9 per 100 worker years.[6] The societal impact is high due to the absenteeism from work and health care use.[3,7] The three sectors with the highest incidence rate for TE classified as an occupational disease are construction, manufacturing industries, and wholesale/retail.[8]

The etiology of TE is not completely understood. However, it is assumed that overuse leads to an increase in tenocyte proliferation and production of ground substance. Repetitive overuse results in tendon dysrepair with macroscopic abnormalities of the tendon collagen. The end stage of tendinopathy is characterized by degenerative features, including an abnormal tendon structure and neovascularization. There is probably no presence of classic inflammation, but several cytokines might play a role in the etiology of TE.[5,9–13] Genetic predisposition also seems to play a role; individuals with the BstUI A1 allele and DpnII B2 allele of the COL5A1 gene have a high likelihood of developing symptoms of the TE.[14]

In TE, the extensor carpi radialis brevis (ECRB) tendon is involved in more than 95% of all cases.[12,15,16] Sometimes, the extensor digitorum, extensor digiti minimi, and extensor carpi ulnaris are also involved.[15]

In most cases, TE is a self-limiting condition; 80% resolve in six months and 90% resolve after one year with a wait-and-see policy and avoidance of aggravating activities.[4,10,17,18] In the long term, the natural course of TE is not completely known, but symptoms

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can last for more than two years in recalcitrant cases.[19,20] Despite this self-limiting character, effective treatment can be beneficial in order to shorten the duration of symptoms and to counter absenteeism from work. Consensus among different clinicians and medical professionals involved in examination, education, and treatment seems an important prerequisite for effective management of TE.[21]

Therefore, the aim of this review is to give an overview of the multidisciplinary treatment of TE and to improve pain and with special attention to imaging, functional recovery, including sporting activities and work.

Diagnosis and imaging

TE is a diagnosis usually based on the symptoms and physical examination only. Imaging studies are rarely needed in the initial workup of patients with lateral elbow pain. Nevertheless, there are conditions that warrant imaging, particularly when symptoms persist despite optimal conservative treatment, and/or to rule out other abnormalities in the lateral elbow compartment. Differential diagnoses include osteochondritis dissecans (OCD) with or without cartilage lesions, lateral ligament injury, posterior interosseous nerve entrapment syndrome, synovitis, synovial fold syndrome, and radio-capitellar arthritis.[12,22] In selected cases of TE, imaging (in OCD cases or if arthritis of the lateral compartment of elbow is suspected) may also contribute to the preoperative workup.

Presence of calcifications in the course of the proximal common extensor tendon along the lateral humerus epicondyle may support the diagnosis of TE. However, routine use of plain radiographs has not been found cost-effective.[23]

Using ultrasonography (US), the normal tendon is recognized as parallel-arranged fibrils without disruption. When degenerative tendinopathy is present, there is heterogeneous thickening of the tendon with areas of decreased echogenicity.[24] A complete tendon tear should be suggested when a full-thickness disruption of the fibrillar pattern is encountered, with a fluid filled gap of low echogenicity.

Severity of symptoms in patients with TE is associated with the presence of intra-tendinous calcifications, tendon thickening, bone irregularity, focal hypoechoic regions, and diffuse heterogeneity.[25] The reported low specificity may be due to the presence of abnormal US findings before the onset of symptoms. In general practice, US can be used to confirm the diagnosis of TE; however, this should not be done on a routine base. In selected cases, US can be used to guide local treatment.

Magnetic resonance (MR) imaging assists in the quantification of the degree of degenerative tendon disease.[12] It has been found more sensitive than US with equal specificity.[26] Normal tendons demonstrate low signal intensity. In the vast majority of symptomatic patients, tendon thickening with increased intratendinous signal intensity of the common extensor tendon can be found. Imaging abnormalities correlated well with surgical and histopathologic findings.[27] On the other hand, signal changes of the tendon can also be found in many patients over 40 years of age, without any symptoms. Similarly, signal changes may persist during follow-up of patients with TE, despite clinical improvement.[28]

Non-surgical treatment

Currently, there is no strong evidence for the effectiveness of one single non-surgical treatment option for TE.[29] This may explain the numerous new treatment options described in the scientific literature in the last decade. Management of expectations of treatment effects can be very helpful for both patient and physician. There are a number of factors associated with worse prognosis. Patients with more pain and disability at their first presentation, with cold hyperalgesia, or with associated neck or shoulder pain have a poorer prognosis.[30,31] In addition, work-related physical factors (manual work and physical strain) and psychological factors (low social support at work) are related to worse prognosis after one year.[10,31]

Excessive or unaccustomed activity is likely to be the most important factor to avoid in patients with TE. This educational approach differs between manual workers and tennis players. However, instructions to avoid pain-provoking activities will be of value in both subgroups. The pain-monitoring model can aid the patient to administer the amount of activity based on the experienced symptoms, during and after the specific activity.[32]

Tennis players can benefit from additional sport-specific advices. Technique errors that are considered to predispose to the etiology of TE are (1) a faulty backhand technique with the elbow leading, (2) excessive forearm pronation during a forehand topspin, and (3) excessive wrist flexion during a service.[33] Additional potential risk factors are racquet type, grip size, string tension, court surface and weight of the ball.[33] These factors affect biomechanical loading of the elbow during tennis.

Exercises are frequently incorporated in the initial treatment program for patients with TE. A recent systematic review included studies with a low risk of bias. The conclusion was that home-based strengthening exercises are more effective than a wait-and-see policy.[34] Furthermore, there is no difference in outcome after one-specific type of exercise (stretching, concentric exercises, or eccentric exercises). Additionally, supervised combined stretching and strengthening protocol is superior to a comparable home-based protocol.[34] These conclusions support the implementation of an exercise therapy program.

Non-steroidal anti-inflammatories (NSAIDs) are frequently used to treat TE. In tendons, several NSAIDs have been shown to inhibit expression of matrix proteins and cellular function.[13] In the acute stage of tendinopathy, this may be a preferred option because of the increased cell proliferation and matrix protein production. In the chronic stages of tendinopathy, NSAIDs have fallen out of favor because of the proposed absence of inflammatory drivers and the possible reduction in tendon repair.

There is currently conflicting evidence for the effectiveness of extracorporeal shock wave therapy on pain reduction when it is compared to placebo or other treatment modalities.[35]

Many different agents can be injected for TE. A few examples that are currently frequently applied in daily clinical practice are corticosteroids, platelet-rich plasma (PRP) or autologous blood injection, botulinum toxin-A injection, and prolotherapy. These injectables are based on the different mechanisms.

Preclinical studies show some evidence that blood products can result in increased tendon cell proliferation, production of Vascular Endothelial Growth Factor, and release of pro-inflammatory cytokines.[36] In the clinical setting, the proposed mechanisms were not observed using imaging modalities.[37] There are scientific reviews that support the use of these injections.[38,39] However, other systematic reviews and a meta-analysis do not support their use.[40,41]

Prolotherapy consists of an injection composed of a solution of hypertonic glucose. It is hypothesized to act as chemo-attractive agent and thereby can also have pro-inflammatory effects. Multiple randomized studies have been performed with conflicting evidence on efficacy for pain scores and grip strength.[29]

Corticosteroid injections are useful in the short term. Beneficial effects are frequently reported after corticosteroid injections in tendinopathies. However, a systematic review showed that the effects of corticosteroids on patient symptoms are detrimental on the longer term,[42] and, moreover, the effects on tendon tissue are potentially harmful.[43,44] Therefore, corticosteroid injections are discouraged for the treatment of TE.

Botulinum toxin-A injection results in a paralysis of the extensor muscles of the wrist, with the aim to prevent further tendon overuse and the ability of the tendon to recover. Randomized studies show conflicting evidence for pain reduction, and all studies show a reduced grip strength for several weeks after the injection.[29] Many patients also experience transient weakness in finger extension. This therapy does not improve the quality of life, and therefore, it is less favorable.

Surgical treatment

Surgical intervention should be indicated with caution and reserved for those patients with persisting symptoms in daily life after failure of conservative (or less invasive) treatment.[4,10,17,18] In the 1980s and 1990s, 5%–10% of patients underwent surgery for TE.[45,46] This number then decreased in the United States to 1.1% in 2000–2002. However, in the years thereafter (2009–2011), there was an increase to 3.2% (Mayo Clinic).[3]

The main dispute about surgical interventions for TE concerns its effectiveness compared to wait-and-watch, conservative or less invasive procedures. A recent review by Bateman et al.[47] on surgery for TE suggests that surgical interventions are no more effective than non-surgical and sham interventions. These findings are based on the limited evidence and a lack of a high-quality placebo-controlled surgical trial with an additional conservative arm.[47]

Various surgical techniques have been described in the literature; there is still controversy and little evidence as to which technique is superior.[48–50] Surgical procedures for TE can be divided into three types: open, percutaneous, or arthroscopic procedures.

Open procedure

An open procedure aims to debride the origin of the ECRB tendon using an incision over the lateral epicondyle. There is no standard procedure for this surgery. In most open procedures, the technique (or a variant of the technique) described by Nirschl and Pettrone is used.[51,52] The pathologic tendinosis tissue of the ECRB origin is identified and resected. This debridement can be performed with or without a release of the ECRB tendon from the lateral humeral epicondyle. The ECRB tendon is usually not reinserted because the origin of this tendon is extensive and barely retracts.[52,53] Additionally, the radiohumeral joint can be explored to identify the associated articular disorders such as synovitis or arthritis. The short-term and long-term results of all descripted procedures are good to excellent in 82%–85% of patients.[52,54] However, these results were not compared with a control group.

Percutaneous procedure

The percutaneous procedure is performed with a stab incision. The technique was described by Yerger and Turner.[55] A puncture incision is made in the skin anterior to the lateral epicondyle at the level of the tendinous origin of the common extensors and the insertion is released from the bone.[55,56] The results were rated as 91% excellent by Baumgard and Schwartz, but comparable studies are not available.[56]

Arthroscopic procedure

In the arthroscopic procedure, access to the joint is obtained by a minimum of two portals. The ECRB tendon is debrided inside out and released from the lateral epicondyle, e.g. by a shaver.[57] Short-term studies show an improvement in pain of 85%–90% and long-term studies report a satisfaction rate of 87%.[50,57–59] Even after the learning curve, this arthroscopic technique is more complex and time consuming than the open or percutaneous procedure.[60,61]

An advantage of arthroscopic treatment is the ability to assess and address associated intra-articular pathology. Chondromalacia of the capitellum is frequently seen.[62] Kaminsky and Baker[63] found associated disorders in 69% of the elbows including synovial pathology (synovitis or synovial thickening (55%)), bone spurs (12%), loose bodies (7.1%), and degenerative joint disease (2%). Another study by Grewal et al.[64] noted intra-articular pathology in 58% of the elbows, synovitis (60%), osteophytes (20%), and chondromalacia of the radial head (20%). Apparently, not all associated pathologies are clinically symptomatic.

Complications

The overall complication rate for surgical interventions for TE is low. A recent review by Pomerantz reported a complication rate of 4.3% for open procedures, 1.9% for percutaneous procedures, and 1.1% for arthroscopic procedures. Despite the low number of complications for arthroscopic surgery, it should be noted that these complications are potentially more severe than in open or percutaneous procedures considering this procedure can result in nerve damage. Most common complications in all procedures were wound related or nerve injury in open or arthroscopic procedures. The majority of nerve injuries are temporary, but cases of permanent nerve damage are reported in arthroscopic procedures for TE.[65] In both percutaneous and open procedures, there is also the risk of posterolateral rotatory instability caused by an accidental release of the lateral ulnar collateral ligament (LUCL). Given the complexity of the arthroscopic procedure, it is more time consuming and costly.

Impact of TE on work participation

The evidence whether occupational factors indeed contribute to the onset of TE has rapidly increased in the last couple of years. A recent meta-analysis of five prospective cohort studies on incident TE among 3449 workers showed an odds ratio of 2.6 (95% confidence interval 1.9–3.5) for occupational risk factors.[6] The five included studies were performed among workers in France and United States, had a low risk of bias, and each prospective study found a significant risk controlling for confounders (Table 1). These studies indicated that in 50%–70% of these patients, their work was related to the onset of TE. The type of work that increases the risk of TE is characterized by strenuous manual activities for the wrist and/or elbow which consist of both force and posture. The specific physical exposures are presented in Table 1. In contrast to some beliefs, performing computer work appeared not to be a risk factor for TE such as social support from employer and co-workers, job satisfaction, job demands, and job security (there was limited and inconsistent evidence in five prospective studies).[66–70]

Despite the strong association between work and TE and the high prevalence of TE among working-aged adults, remarkably little evidence is available regarding the impact of TE on work participation like absence of work. In the United Kingdom, 5% of the patients diagnosed with TE had taken sickness days.[7] The median number of sickness days was 29 days in the past 12 months. In the Netherlands in 2015, the median of the estimated sickness absence period for workers diagnosed with TE due to a high physical strain at work by their occupational physician was one to three months (according to the sentinel surveillance for occupational disease notification).[8] No description was given of the characteristics of these TE patients on sick leave that might benefit from more complex and expensive health care interventions.

The evidence for effectiveness of workplace management or interventions for patients with TE is limited. Therefore, there is a lack of high-quality evidence to inform workers and employers about effective work-directed care in terms of prevention and return to work. Despite this limited evidence, the following actions, listed in Table 2, should be considered by the occupational physician and/or occupational therapist, occupational hygienists, ergonomist, or physiotherapist, especially for patients with a poor prognosis in their communication with worker and employer.[6,31,71–73]

Discussion and conclusions

TE has a major socioeconomic impact. In particular, because TE is frequently encountered in patients in working age and often results in absenteeism of work. Occupational factors that contribute to the onset of TE are characterized by strenuous manual activities for the

Table 1. Manual strenuous activities adjusted for confounders that increase the risk of clinically diagnosed incident tennis elbow among workers.

Study	Manual strenuous activity	Risk estimate (95% CI), Total number of incident cases (n)	Adjusted for
Leclerc et al.[67]	"Repetitively turn and screw"	OR = 2.1 (1.2–3.7), n = 64	Age, sex, number of other upper-limb disorders, and depressive symptoms
Descatha et al.[70]	"Bending and twisting hand or wrist ≥ 4 hours/day and rotating, twisting or screwing of the forearm ≥ 2 hours/day"	OR = 2.5 (1.1–5.3), n = 50	Age, sex, educational level, social support at work, body mass index, and comorbidity due to diabetes, rheumatic arthritis, or osteoarthritis
Herquelot et al.[68]	"High physical exertion (Borg rating > 13) with elbow flexion/extension > 2 hours/day or extreme wrist bending > 2 hours/day"	Men, IRR = 3.2 (1.5–6.4), n = 103 Women, IRR = 3.3 (1.4–7.6), n = 68	Age
Fan et al.[69]	"Strain Index Score ≥ 5.1"[a]	HR = 2.1 (1.2–3.6), n = 57	Age, sex, and poor general health
Garg et al.[66]	"Strain Index Score > 6.1"[a]	HR = 2.3 (1.1–4.8), n = 56	Age, family problems, and swimming

OR: odds ratio; IRR: incident rate ratio; HR: hazard ratio; CI: confidence interval; n: number.
[a]Strain Index Score is based on the following six task variables that describe the physical load of a job: intensity of exertion, duration of exertion, efforts per minute, hand/wrist posture, speed of work, and duration per day of the job.

Table 2. Recommended actions to inform workers and employers about effective work-directed care in terms of prevention and return to work.

For the worker	For the employer
• Reassure by informing that TE in general has a good prognosis for pain	• Inform that TE in general has a good prognosis for pain and that it is unlikely to result in long-term disability unless occupational factors are at stake like depicted in Table 1
• That it is unlikely to result in long-term disability	• Explain that workers with TE whose condition is aggravated by their work or appear work-related, need temporarily modified duties or sick leave to allow time for the condition to improve
• Stimulate to continue functioning	• Engage the employer in taking responsibility of securing a healthy and productive workplace if disease-specific occupational risk factors like depicted in Table 1 appear at stake
• Discuss the presence of possible occupational risk factors like depicted in Table 1 and possibilities the worker has to reduce or overcome these	• Advice what occupational experts like occupational physicians, for instance, in cooperation with occupational therapist, occupational hygienists, ergonomist, or physiotherapist can do to

(continued)

Table 2. Continued.

For the worker	For the employer
	assess whether the work indeed has contributed to TE, preferably using a health impact assessment, and about possible preventive work-related measures that reduce the risk factors at stake and facilitate return to work
• Temporarily refrain from tasks that are very painful and stimulate the worker to discuss this with the employer	
• After a period of sickness absence or modified duties, help to return to work according to a time-contingent work resumption plan with a gradual increase in activities	

TE: tennis elbow.

wrist and/or elbow which consist of both force and posture. When it is suspected that work contributes to the creation of symptoms and/or absence from work, active referral is required by clinician to occupational physician for prevention and return to work.

The diagnosis is based on the symptoms and physical examination. Plain radiographs can differentiate from other pathology such as an osteochondral lesion, arthritis, or calcifications. However, routine use of plain radiographs has not been found to be cost-effective.[23]

Both US imaging and MR imaging are good modalities to confirm the clinical diagnosis and the extent of TE (these are, however, rarely needed and TE remains primarily a clinical diagnosis). MR imaging has the additional advantage in that it can demonstrate alternative diagnoses or concurrent ligamentous abnormalities in the lateral elbow compartment and is useful for preoperative planning in selected cases.

Given the disabling symptoms, a suitable treatment may be indicated to reduce intensity or duration of symptoms. There is currently no strong evidence of the effectiveness of one single treatment option for patients with TE. It is therefore important to focus treatment on the least invasive options first, with the smallest risk for complications. The heterogeneity in clinical presentation of patients with TE suggests that tailored treatments are more likely to be successful. Exercise therapy is considered as the most effective treatment in cases of chronic symptoms. To date, there is no specific exercise that can be advocated based on the available evidence. There is currently no consensus on the optimum dosage of the exercises, the amount of pain that should be tolerated during the exercises, and the value of additional exercises to address specific deficits. Injection therapies can be considered as second-line treatment option, but there is no strong evidence of their effectiveness. However, steroid injections should be avoided given the worse outcomes in the long term compared to a wait-and-watch policy. Because of the degenerative underlying pathology, there are high expectations of regenerative therapies. These include prolotherapy and injections with autologous blood, PRP injections, and stem cell therapy. To date, there are no high-quality studies proving an effect of these injectables. The major problem is that studies, with a standardized, reproducible injection technique, are lacking in the current literature. Injections carried out manually for the treatment of TE are not accurate.[74] For future research on the effect of injection therapy, it is important that injections should be carried out in a reproducible and standardized way.

There is no strong evidence that operative treatment is superior to conservative treatment or even a wait-and-watch policy. Therefore, overall, the role of surgery is still controversial in what is essentially a self-limiting condition. Surgery should be reserved for the minority of patients in selected cases with concordant symptoms. However, even after a year of symptoms, surgery has not been proven superior to an expectant policy. Comparative studies on the results of open, percutaneous, or arthroscopic surgery report no differences in outcomes but do state that less invasive techniques allow a faster return to work. In the case of surgery, it is recommended that patients postoperatively start an early exercise therapy program in order to achieve a more rapid functional recovery.

Given the major social impact, a multidisciplinary approach seems appropriate in the diagnosis, treatment, and follow-up of TE. It is conceivable that the different stages of TE need a different approach.

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