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LATERAL ELBOW TENDINOPATHY – GENERAL AND ORTHOPAEDIC PERSPECTIVES

Robert Hudek
Rhön Klinikum AG, Klinik für Schulter- und Ellbogenchirurgie, Bad Neustadt, Germany

SUMMARY
Lateral elbow tendinopathy remains a domain of conservative treatment. The pathology is self-limiting in most cases. There is neither superiority for any of the numerous non-operative methods nor for any of the surgical techniques described in literature. Surgery is reliable and well established for open and arthroscopic procedures but reserved for the few pertinacious cases that will not improve with conservative treatment. This short review discusses the mechanism of disease, symptoms and signs, investigations, current management protocols and potential new treatments.

Keywords: tennis elbow, lateral elbow tendinopathy

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ENTEZOPATIA NADKŁYKCIA BOCZNEGO-PODEJŚCIE OGÓLNE I ORTOPEDYCZNE

Robert Hudek
Rhön Klinikum AG, Klinik für Schulter- und Ellbogenchirurgie, Bad Neustadt, Niemcy

STRESZCZENIE
Entezopatia nadkłykcia bocznego- pozostaje domeną leczenia zachowawczego. Patologia w większości przypadków jest samoograniczająca. Nie ma wyższości dla żadnej z licznych metod nieoperacyjnych ani dla żadnej z technik chirurgicznych opisanych w literaturze. Operacja jest niezawodna i dobrze ugruntowana w procedurach otwartych i artroskopowych, ale zarezerwowana jest dla nielicznych przypadków, które nie poprawią się podczas stosowania leczenia zachowawczego. Ten krótki przegląd omawia mechanizmu choroby, dolegliwości i objawy, badania, aktualne algorytmy postępowania leczniczego i potencjalne nowe metody leczenia.

Słowa kluczowe: łokieć tenisisty, entezopatia nadkłykcia bocznego

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Introduction

Lateral elbow tendinopathy is a diagnostic term that describes a pattern of pain and localized tenderness at the lateral epicondyle at the insertion of the common extensors of the distal humerus. It is exacerbated by wrist extension and commonly termed "tennis elbow" after this term appeared in literature in 1882 (Morris, 1882). However, Karl Friedrich Ferdinand Runge was the first who described the pathology in 1873 in Berlin, Germany (Runge, 1873). Various names including tendinitis, tendinosis, paratenonitis, and peritendinitis have been used to represent this condition depending on the status of the tendon tissue at different stages of healing (Fedorczyk, 2006). However, most of the commonly used terms are misnomers since they let assume an inflammatory condition. Instead, acute or chronic inflammatory cells are absent on histologic examination (Nirschl, 1992) and most affected patients are not tennis players (Kaminsky and Baker, 2003). Therefore, the term "lateral epicondylalgia" was suggested because it may encompass all potential causes of lateral elbow pain without making an assumption about the underlying histopathology (Waugh, 2005). Although the terminology "lateral elbow tendinopathy" represents a good description most physicians, patients and academic discussions link to the phrase "tennis elbow" under which the pathology is found predominantly in database searches (Fedorczyk, 2006).

Aim

This short review discusses the mechanism of disease, symptoms and signs, investigations, current management protocols and potential new treatments.

Material and methods

Clinical presentation

Any of the wrist or digit extensor muscles that share the common extensor tendon may be involved, but the extensor carpi radialis brevis (ECRB) is more frequently implicated. Patients over the age of 35 are more likely to be involved, particularly when they exhibit manual work (Nirschl, 1992). In some cases a forceful grasp or heavy lifting can provoke the tendinopathy which becomes chronic and involves the dominant arm in most cases (Nirschl, 1992). The patient presents with point tenderness centered at the lateral epicondyle or up to 5mm anterior or distal to it (Fedorczyk, 2006). Resisted wrist or finger extension, radial deviation or forearm supination typically evokes pain which radiates depending on the severity and involvement of surrounding tissues (Nirschl, 1992; Fedorczyk, 2006). On inspection, there is no remarkable alteration in the early stages. As the disease evolves, a bony prominence over the lateral epicondyle can be detected. Muscle and skin atrophy as well as detachment of the common extensor origin can be seen as a result of previous corticosteroid injections or a long-standing disease (Vaquero-Picado *et al.,* 2016). The range of motion is not usually affected but it can be painful in more advanced stages where it can be elicited in full elbow extension with the forearm pronated. If limited elbow motion exists, other concomitant pathologies need to be excluded (Vaquero-Picado *et al.,* 2016).

Differential diagnosis

It is important to differentiate a tennis elbow from other conditions that occur with very similar clinical presentation. A radial tunnel syndrome can provoke similar pain in an acute case at the lateral elbow. However, the point tenderness is usually found more distal at the edge of the supinator muscle approximately 3 cm distal and posterior to the lateral epicondyle (Nirschl, 1992; Fedorczyk, 2006). Posterolateral rotatory instability (O'Driscoll, 2000) and posterolateral plica syndrome (Ruch *et al.,* 2006) or osteochondrosis dissecans (OCD) and radio-capitellar osteoarthritis can mimic symptoms similar to a tennis elbow (Vaquero-Picado *et al.,* 2016). Medications should be reviewed with focus on antibiotic therapy, specifically fluoroquinolones can be inductive for tendinopathies (Khaliq and Zhanel, 2003; Mehlhorn and Brown, 2007).

Main differential diagnoses

1. Cervical radiculopathy with pain in the elbow and forearm.
2. Posterior interosseous nerve (PIN) entrapment ("radial tunnel syndrome"). The pain is not reproduced by wrist extension. Resisted supination can compress the PIN via the supinator muscle and thereby produce pain. An anaesthetic block of the PIN can help to establish the diagnosis, but the injection should not diffuse to the lateral epicondyle (Vaquero-Picado *et al.,* 2016).
3. Degenerative changes and OCD of the capitellum: When lateral elbow pain is refractory to conservative treatment chondral changes in the radiocapitellar joint have to be explored (Rajeev and Pooley, 2009). OCD typically affects young individuals involved in sports and physical activities who have mild symptoms when performing a moving valgus test (Vaquero-Picado *et al.,* 2016).
4. Chronic exertional compartment syndrome (CECS) of the forearm is very rare condition (Raphael *et al.,* 2011) but

can be linked an edema of the anconeus muscle (Coel *et al.,* 1993). In severe cases fasciotomy should be discussed (Soderberg, 1996).

5. Posterolateral elbow instability is associated with a tennis elbow mainly after excessive steroid use. The presence of cubitus varus, previous surgery or dislocations of the elbow should be assessed (Vaquero-Picado *et al.,* 2016).

Epidemiology

Tennis elbow is considered the most prevalent work-related musculoskeletal disorder of the elbow affecting 1–3% of the population (Vaquero-Picado *et al.,* 2016). It affects generally middle aged patients between 45-54 years without gender predisposition (Shiri *et al.,* 2006). Sufficient evidence exists for a strong association between its prevalence and a combination of physical risk factors including force, repetition, and posture (Piligian *et al.,* 2000). When patients are involved in heavy physical workplaces with high repetition the prognosis of medical treatment is poor (Haahr and Andersen, 2003a,b). Smoking and obesity were additionally identified as strong independent determinants for lateral elbow tendinopathy (Shiri *et al.,* 2006).

Imaging

Plain anteroposterior (AP) and lateral radiographs are useful for the assessment of bone diseases such as OCD, osteoarthritis or loose bodies. In chronic tennis elbows, a calcification of the ECRB insertion at the lateral epicondyle can be seen (Vaquero-Picado *et al.,* 2016). Ultrasound can be very helpful in the diagnosis of a tennis elbow because it displays structural tendon changes (thickening, thinning, intra-substance degenerative areas and tendon tears), bone irregularities or calcific deposits. Neovascularity identified with power Doppler ultrasonography when compared to grey scale changes was described to be superior in identifying chronic tennis elbow (du Toit *et al.,* 2008). The lack of both neovascularity and grey scale changes on ultrasound examination also substantially increases the probability that the condition is not present and should prompt the clinician to consider other causes for lateral elbow pain (du Toit *et al.,* 2008). Magnetic resonance imaging (MRI) can contribute to the clinical assessment in the tennis elbow. However, the results are not always discriminatory. An increased signal intensity within the extensor tendon is indicative of a tennis elbow but the changes in signal intensity and morphology of the ECRB tendon can persist despite clinical improvement. Therefore, MRI imaging is best for determining structural changes within the joint and ligament integrity, but it cannot differentiate between the severity of clinical symptoms (Savnik *et al.,* 2004).

Tendon structure and function

A thin network of connective tissue called the endotenon binds collagen fibers together that are composed in primary, secondary and tertiary fascicles. The major cellular components of a tendon are highly elongated tenocytes, or tendon fibroblasts, which play a major role in tendon homeostasis, remodeling, and repair by producing matrix components such as collagens. Tendons that are not enclosed in a sheath are surrounded by two connective tissue layers, the epitenon and the paratenon. The paratenon is the outermost layer and it serves as an elastic sleeve to improve sliding against other tissues. The epitenon is a dense network of collagen fibrils and connects the inner tendon and the paratenon. Both, the epi- and paratenon are rich in free nerve endings functioning as pain receptors. Tendons are vascularized from the myotendinous junction, the osteotendinous junction and from the paratenon. Abnormal vascularity may contribute to pain mediation in chronic tendinopathies (Knobloch *et al.,* 2006). A new type of tendon cells, which was discovered in 2007 is the tendon stem/progenitor cells (TSCs) (Bi *et al.,* 2007). TSCs can self-renew and differentiate into tenocytes and non-tenocytes, depending on the environmental conditions. Appropriate mechanical loading is essential in maintaining the structural integrity and functional competence of the tendon and excessive mechanical loading causes tendon injury (Thampatty and Wang, 2017). Furthermore, aging alters tendon biology and leads to deterioration of structure and mechanical properties (Thampatty and Wang, 2017).

Histopathology of tendinopathies

Tendinosis is characterized by disordered arrangement of collagen fibers, increased vascularity, calcification, mucoid degeneration and other degenerative changes (Khan *et al.,* 1999). It is linked to an absence of inflammatory cells and it is the result of mechanical overload and aging (Khan *et al.,* 1999). At the cellular level, mechanical loading at physiological levels is essential for normal functioning of tendon cells for young and aging tendons, while excessive mechanical loading induces dysfunction of tendon cells. However, the precise molecular mechanisms are not well understood. TSCs may play an important role because they could differentiate into non-tenocyte lineages of cells in response to excessive mechanical loads (Thampatty and Wang, 2017). Four stages of tendinosis were described by Nirschl and Kraushaar (Kraushaar and Nirschl, 1999; Nirschl, 1992). However, clinical staging via examination is challenging and difficult in clinical routine. Stage 1 is described as a peritendinous inflammation with crepitation over the common extensor tendon. Stages 2, 3, and 4 refer to the presence of angiofibroblastic degeneration which is a manifestation of granulation tissue that disturbs correct collagen synthesis.

Results

Treatment

Despite the high prevalence, there is no effective and consistent algorithm of management (Vaquero-Picado *et al.,* 2016). However, 90% of patients recover within one year because the condition is self-limiting. When severe or persistent symptoms are present, operative options can be evaluated. Although physiotherapy is the predominant treatment option chosen by most orthopedic surgeons, there is no evidence of its superiority on comparison to relative rest or better known as "wait-and-see" policy (Smidt *et al.,* 2002; Smidt *et al.,* 2003). Corticosteriod injections are reported to deliver better results in the short term at 6 weeks with a success rate of 92%, but after one year, physiotherapy or relative rest were reported to be superior to steroid injections (Smidt *et al.,* 2002).

Non-Operative treatment

1. When the elbow is rested, and painful activities are avoided, symptomatic relief can be expected in most cases.
2. No standard physiotherapy regime has been found to be superior to any other method. The fundamental principle is to load the tendon as close as possible to its limit without overstreching (Vaquero-Picado *et al.,* 2016). Eccentric partial load excercises are most commonly conducted.
3. Elbow orthoses (strap and sleeve) are superior to a wrist splint and they can result in an immediate increase in pain-free grip strength (Jafarian *et al.,* 2009). There are reports of secondary nerve problems due to prolonged use of a counterforce brace (Vaquero-Picado *et al.,* 2016).
4. Non-steroidal anti-inflammatory drugs (NSAIDs) can be useful for the short-term relief of symptoms for up to 4 weeks, although oral NSAID use may result in gastrointestinal adverse effects in some people (Pattanittum *et al.* 2013). Even if their use is superior to a placebo, no differences between oral and topical NSAIDs has been established (Pattanittum *et al.,* 2013)
5. Steroid injections: For intermediate (6 weeks – 6 months) and long-term outcomes (>or = 6 months), no statistically

significant or clinically relevant results in favour of corticosteroid injections were reported (Smidt *et al.,* 2002). Although the available evidence shows superior short-term effects for corticosteroid injections, it is impossible to draw firm conclusions on the effectiveness of injections, due to the lack of high quality studies. No beneficial effects were found for intermediate or long-term follow-up (Smidt *et al.,* 2002). However, many clinicians continue to use corticosteroids, backed up by numerous papers demonstrating that it is a highly effective treatment – but only if outcomes 6 weeks post-injection are considered (Osborne, 2010). There are high rates of recurrence of symptoms and only few studies followed patients beyond 6 months and none of these studies showed positive outcomes for corticosteroid injections beyond 6 months (Osborne, 2010). Corticosteroid injections are therefore not recommended to treat patients with tennis elbow with symptom duration of less than 12 months (Osborne, 2010).

6. Growth factor technologies are increasingly used to enhance healing in musculoskeletal injuries. Platelet-rich plasma (PRP) and autologous blood, have a growing body of supporting evidence (Creaney *et al.,* 2011). Autologous blood injections are thought to work by stimulating an inflammatory response which will bring in the necessary nutrients to promote healing. However, no long-term benefits were observed and it should be strictly evaluated for those chronic cases where other treatments have failed (Vaquero-Picado *et al.,* 2016). A single injection of platelet-rich plasma (PRP), glucocorticoid (GC), or saline were reported to have a dropout rate of 58% at 3 months which demonstrated that none of PRP, glucocorticoid, or saline injections adequately reduced the pain and disability of lateral epicondylitis (Shiple, 2013).
7. Ultrasonographically guided percutaneous radiofrequency thermal lesioning is a minimally invasive procedure for treating recalcitrant lateral epicondylitis (Lin *et al.,* 2011). Thereby, a radiofrequency electrode produces a thermal injury at the ECRB insertion. Satisfactory short term results have been reported, but long term data are missing and a recommendation cannot be made on the basis of these data (Lin *et al.,* 2011).
8. With extracorporeal shock-wave therapy sound waves are generated and applied directly onto the overlying skin of the ECRB tendon. Based upon systematic review of 9 placebo-controlled trials, there were no benefits in terms of pain and function in lateral elbow pain (Buchbinder *et al.,* 2006).
9. Low-level laser therapy aims at the stimulation of laser on collagen production in tendons. When administered with optimal doses of 904 nm and possibly 632 nm wavelengths directly to the lateral elbow tendon insertions, a short-term pain relief can be observed. However, long term data are missing (Bjordal *et al.,* 2008).
10. Acupuncture can be effective in the short-term to relief lateral elbow pain, but long term data are missing (Trinh *et al.,* 2004).
11. Botulinum toxin A injections diminish the muscle tone of the common extensors and lead to a short termed pain relief. If these effects are superior to physiotherapy or relative rest is unclear (Placzek *et al.,* 2007).

Operative Treatment

Surgery may be recommended for people with persistent symptoms of lateral elbow pain who have failed to respond to non-surgical management. Numerous uncontrolled trials do not take into account the favourable natural history of the condition, the tendency for people to regress to the mean; they also do not control for the placebo effect, which may be more profound with a surgical intervention (Buchbinder *et al.,* 2011). There is a paucity of high quality evidence to either support or discourage the use of surgical interventions for lateral elbow pain. Patients undergoing surgical procedures for lateral elbow pain should do so in the knowledge that it is still an unproven treatment modality in this condition.

Open surgery involves debriding the angiofibrotic tissue of the ECRB with or without tendon repair. There are numerous variations of open surgery in literature including extensor tendon release with intraarticular modifications, extensor fasciotomy, V-Y slide of the common extensor tendon, denervation of the lateral epicondyle, epicondylar resection with an anconeus muscle transfer and lengthening of the ECRB (Vaquero-Picado *et al.,* 2016). The ECRB insertion is approached via a Kocher approach over the lateral aspect of the elbow. The tendon insertion is detached and debrided. After debridement, a tendon repair, a lengthening, drilling and decortication of the epicondyle to stimulate blood flow may be performed. Care must be taken with excessive tendon release which may lead to lateral elbow instability (Vaquero-Picado *et al.,* 2016).

An arthroscopic treatment represents a viable option to cure a tennis elbow surgically. Intraarticular pathologies can be addressed simultaneously. Thereby, debridement of the ECRB insertion and reconstruction are possible. Care must be taken due to the risk of damage of the radial nerve and to the lateral collateral ligament with excessive debridement posterior to the centre of the epicondyle (Vaquero-Picado *et al.,* 2016). Good to excellent long-term results have been reported with this technique (Savoie and O'Brien, 2015). Desk-workers can return to work immediately and manual workers are encouraged to restart work after four weeks (Vaquero-Picado *et al.,* 2016).

Discussion and conclusions

Lateral elbow tendinopathy or the "tennis elbow" is related to mechanical tendon overuse which is predominatly caused by occupational physical activity and due to aging. It is a self-limiting entity and symptoms resolve with non-operative treatment in 90% of the cases by implementing activity modification, physiotherapy or relative rest. However, different pathologies mimicking a tennis elbow have to be recognized. Plentiful non-operative treatments were described to treat the chronic tennis elbow but to date, none of them indicated to be superior over the other. Operative methods demonstrate reliable results in recalcitrant cases when conservative therapy fails. Likewise, no operative treatment has proven any superiority over the other. Future research of cellular signaling and tendon progenitor cell differentiation is necessary to better understand the disease etiology and to identify novel treatment approaches.

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Author responsible for correspondence:

Robert Hudek
Rhön Klinikum AG
Klinik für Schulter- und Ellbogenchirurgie
Salzburger Leite 1
97616 Bad Neustadt
Germany
robert@hudek.de

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Autor odpowiedzialny za korespondencję:

Robert Hudek
Rhön Klinikum AG
Klinik für Schulter- und Ellbogenchirurgie
Salzburger Leite 1
97616 Bad Neustadt
Niemcy
robert@hudek.de