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Lateral Epicondylitis: Bridging Clinical Assessment and Imaging in Diagnosis and Management – A Review of Current Evidence

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Abstract

Background. Lateral epicondylitis (tennis elbow) is an overuse tendinopathy of the wrist extensors associated with repetitive gripping and wrist extension. It is a common cause of lateral elbow pain and functional impairment. The condition is currently regarded as predominantly degenerative, although inflammatory features may be present at the initial stage of the disease.
Aim. The aim of this study was to review current evidence on the histopathology, diagnosis, and role of imaging in the evaluation and differential diagnosis of lateral epicondylitis, with consideration of main treatment approaches.
Material and methods. A literature search was conducted using databases such as PubMed and Google Scholar. The review included peer-reviewed articles focusing on lateral epicondylitis, its histopathology, clinical presentation, diagnostic methods, and imaging techniques, including ultrasound and magnetic resonance imaging.
Results. Clinical history and physical examination, including provocation tests and assessment of grip strength, remain the cornerstone of diagnosis. Differential diagnosis is essential due to the proportion of misdiagnosed cases. Imaging studies play a complementary role -

ultrasonography allows for dynamic assessment and identification of tendon abnormalities, while MRI enables a more detailed evaluation of intra-articular structures and the extent of tissue damage. Radiography (X-ray) and computed tomography arthrography (CTA) are mainly used in selected cases.

Conclusions. Lateral epicondylitis requires a comprehensive diagnostic approach based primarily on clinical assessment, supplemented by imaging when necessary. Ultrasonography represents the primary imaging modality for evaluating this condition, whereas magnetic resonance imaging is particularly useful in cases requiring more in-depth assessment and in treatment planning.

Keywords: lateral epicondylitis, tennis elbow, tendinosis, diagnosis, ultrasonography, magnetic resonance imaging, differential diagnosis, musculoskeletal imaging, elbow pain

1. Introduction

Lateral epicondylitis, commonly referred to as “tennis elbow,” is an overuse tendinopathy of the wrist extensor muscles at their attachment to the elbow. It is primarily caused by repetitive and excessive gripping and/or wrist extension, which explains its frequent occurrence in individuals engaged in activities such as tennis, badminton, or squash. The etiology is not fully understood; however, potential risk factors include microtrauma, as well as friction and degeneration of the extensor carpi radialis brevis (ECRB) tendon [1,2]. Lateral epicondylitis is one of the most common causes of pain in the lateral aspect of the elbow joint, leading to significant discomfort and impairment of upper limb function. It affects approximately 1-3% of the population, with a similar prevalence in men and women, most commonly between the ages of 40 and 50 years. The annual incidence is estimated at 4-7 cases per 1,000 individuals, while among tennis players the prevalence reaches up to 9.1% [3,4]. In the general population, higher risk is observed in individuals who are obese, smoke tobacco, engage in intensive physical activity, or suffer from other conditions affecting the hand, such as carpal tunnel syndrome and De Quervain’s tenosynovitis [1,2]. The condition is also more common among individuals whose occupations involve frequent, repetitive movements of the elbow and wrist,

including musicians, electricians, and mechanics [5]. The prognosis is generally favorable, with spontaneous resolution occurring within 1-2 years in up to 80-90% of patients [1].

2. Histopathology

Lateral epicondylitis was initially classified as tendinitis, implying an inflammatory process within the tendon. However, histopathological studies have demonstrated a minimal presence of inflammatory cells, such as macrophages and neutrophils. Consequently, the condition is currently regarded as tendinosis, defined as a degenerative process. It should be noted, however, that features of inflammation may be present at the initial stage of the disease [6,7]. The course of the disease can be divided into four stages. Stage 1 involves an acute inflammatory response that may resolve completely, representing the phase during which some patients initially seek medical attention. Stage 2 develops with continued overuse and is characterized by angiofibroblastic hyperplasia, including an increased number of fibroblasts, neovascularization, and disorganization of collagen fibers. This stage is associated with hypercellularity and is the most common stage at which patients present for treatment. Stage 3 is associated with progressive accumulation of pathological changes, leading to structural failure of the tendon and partial or complete rupture. Stage 4 includes features of stages 2 or 3, accompanied by additional changes such as fibrosis and calcifications, both within the collagen matrix (soft calcifications) and in the form of osseous deposits [6].

3. Clinical diagnosis

Clinical diagnosis of lateral epicondylitis is primarily based on a thorough medical history and physical examination. In cases of diagnostic uncertainty, depending on the suspected underlying pathology, additional imaging modalities such as ultrasonography, computed tomography, or magnetic resonance imaging may be considered. It should be emphasized, however, that history taking and physical examination are inexpensive, non-invasive, and time-efficient methods, while also playing a crucial role in differentiating lateral epicondylitis from other conditions requiring different management strategies. Careful differential diagnosis is essential, as it is estimated that at least 11% of cases of lateral elbow pain are misdiagnosed as lateral epicondylitis [8]. The clinical presentation of lateral epicondylitis most commonly includes pain or a burning sensation over the lateral epicondyle, which may radiate along the forearm and, in some cases, extend to the upper arm. Symptoms are typically exacerbated during activities involving resisted wrist extension, such as gripping objects or performing rotational movements. The severity of pain may vary, ranging from mild and intermittent to

chronic and significantly limiting daily activities. Reduced grip strength and difficulty lifting objects are also frequently observed. On physical examination, localized tenderness at the origin of the extensor carpi radialis brevis (ECRB) tendon is characteristic. Pain may be elicited or intensified during resisted wrist extension, resisted extension of the middle finger, and forearm supination with the elbow extended. The diagnosis is based mainly on clinical history and physical examination, including assessment of occupational activities, hand dominance, duration of symptoms, and frequency of recurrence. Provocative maneuvers play an important diagnostic role. In clinical practice, commonly used tests include Cozen's test, Mill's test, and Maudsley's test, all of which aim to reproduce characteristic pain. Cozen's test involves eliciting pain during resisted wrist extension. In Maudsley's test, pain occurs during resisted extension of the middle finger. Mill's test provokes pain with the elbow extended and the wrist flexed and pronated. Additionally, reduced grip strength represents an important diagnostic indicator. In equivocal cases, imaging studies may be required to complement the diagnostic process [9,8].

4. Differential diagnosis

Differential diagnosis of lateral elbow pain in middle-aged patients presenting with typical symptoms and clinical features most commonly includes lateral epicondylitis. However, other potential causes of pain in this region should be carefully excluded, such as cervical radiculopathy presenting with pain in the elbow and forearm, as well as elbow joint overload secondary to compensatory mechanisms related to dysfunction in adjacent joints, for example in the course of frozen shoulder. Important components of the differential diagnosis also include posterior interosseous nerve (PIN) compression and radial tunnel syndrome (RTS) [10]. PIN compression may lead to two distinct clinical entities: PIN syndrome and radial tunnel syndrome. PIN syndrome is characterized by motor weakness, typically preceded by forearm pain, followed by an inability to extend the fingers or thumb, loss of thumb abduction, and radial deviation of the wrist. On MRI, edema and/or atrophy of muscles innervated by the PIN are typically observed. In contrast, radial tunnel syndrome is characterized by pain in the lateral aspect of the forearm without motor deficits and results from compression of the PIN within the radial tunnel. RTS may coexist with lateral epicondylitis, which can further complicate the diagnostic process. MRI may reveal muscle edema along the course of the PIN, while electromyography (EMG) findings are usually normal. Ultrasound examination may demonstrate compression of the PIN with associated nerve swelling and hypoechogenicity, as well as secondary causes of nerve compression, such as ganglion cysts, pannus, and

bicipitoradial bursitis. During ultrasound evaluation of the lateral elbow, it is important to precisely determine the location and nature of the patient's symptoms. In both PIN syndrome and RTS, MRI may show increased T2 signal intensity in muscles along the course of the PIN. MRI may also assist in identifying nerve compression by demonstrating abnormalities such as thickening of the anterior edge of the ECRB, prominent recurrent radial vessels, schwannoma, or distension of the bicipitoradial bursa [11]. In cases of chronic pain localized to the lateral aspect of the elbow, it is important to consider degenerative changes as well as osteochondritis dissecans (OCD) of the capitellum in the diagnostic work-up. It has been reported that in 59% of cases of lateral elbow pain refractory to conservative treatment, chondral changes are present in the radiocapitellar joint. OCD occurs more frequently in young, physically active individuals, and its characteristic symptoms include mild crepitus and pain elicited during the moving valgus test. A relatively high incidence of edema of the anconeus muscle has also been reported in patients presenting with lateral elbow pain. This finding may be visualized on MRI and should be taken into account in the differential diagnosis of lateral epicondylitis. In the evaluation of patients with lateral elbow pain, it is also essential to consider and rule out posterolateral instability of the elbow joint. This condition has been reported to coexist with lateral epicondylitis, particularly in the context of excessive corticosteroid use or local tissue damage. The clinical presentation may be subtle, which can make diagnosis challenging and, in some cases, may require examination under anesthesia. During the diagnostic process, attention should also be paid to the presence of cubitus varus, as well as to a history of previous elbow surgery or dislocations [10]. Other potential causes of pain in the lateral elbow include infectious processes and inflammatory diseases such as rheumatoid arthritis, as well as rotator cuff injuries, synovitis, intra-articular loose bodies, post-traumatic osteoarthritis, and ligament injuries [10,7].

5. Ultrasound imaging

Musculoskeletal ultrasonography (MSK US) is an important diagnostic tool in the evaluation, differential diagnosis, and management of lateral epicondylitis [12]. The diagnostic accuracy of this method in detecting tennis elbow is variable, with reported sensitivity ranging from 64% to 100% and specificity from 36% to 100% [13]. MSK ultrasonography has several important advantages in the assessment of lateral epicondylitis. It is a dynamic imaging modality that enables real-time evaluation of the condition and allows correlation of imaging findings with the patient's reported symptoms. It is also characterized by high spatial resolution for superficial structures, making it particularly useful for imaging tendons and ligaments. In addition,

ultrasound facilitates the performance of procedures such as corticosteroid injections and platelet-rich plasma (PRP) administration. It is a relatively inexpensive and widely available technique; however, its effectiveness largely depends on the operator's experience and skill. Limitations of this modality include reduced value in assessing deeper structures, particularly osseous and intra-articular components, as well as susceptibility to imaging artifacts [12]. In ultrasonographic evaluation of lateral epicondylitis, typical findings involve the common extensor tendon origin, particularly its deep layer corresponding to the extensor carpi radialis brevis (ECRB). Tendinosis is most often limited to approximately one-third of the epicondylar attachment. On ultrasound, it appears as hypoechogenicity and tendon thickening, whereas tendon tears are usually hypoechoic or anechoic and are associated with a loss of tendon volume. Doppler assessment allows visualization of vascular flow in cases of an active reparative process and may help differentiate early stages of tendinosis from tendon tears, in which vascular signal is absent [14]. It is also worth noting that preliminary studies suggest the potential usefulness of machine learning models in the analysis of ultrasound images, which may indicate their future role as supportive tools in the diagnosis of tendon pathologies [15].

6. Magnetic resonance imaging (MRI)

Magnetic resonance imaging is a highly reproducible imaging modality that is less operator-dependent and allows for a more detailed assessment of intra-articular structures compared to ultrasonography. However, it should be emphasized that imaging findings do not always correlate with the severity of clinical symptoms. Moreover, due to its high cost, MRI has limited applicability in the routine diagnosis of lateral epicondylitis. In cases where capsular injury is suspected, computed tomography arthrography may provide greater diagnostic value [10]. MRI plays an important role in the evaluation of lateral epicondylitis, particularly in equivocal cases or those refractory to treatment. It enables not only the identification of abnormalities within the common extensor tendon origin, such as tendinosis or tears, but also the assessment of other potential causes of pain in the lateral aspect of the elbow. On MRI, tendinosis corresponds to areas of increased signal intensity on both T1- and T2-weighted sequences, accompanied by changes in tendon thickness. Partial- or full-thickness tears are visualized as areas of high signal intensity corresponding to fluid or granulation tissue, with disruption of tendon continuity [11]. T2-weighted imaging allows for clearer differentiation between intact and torn tendon due to the high signal intensity associated with fluid or granulation tissue, whereas T1-weighted sequences are less sensitive in this regard. Furthermore, T2-weighted sequences are less affected by the magic angle artifact [16]. Both extensive damage to the common extensor

tendon and injury to the lateral collateral ligament are associated with a poorer prognosis and reduced effectiveness of conservative treatment. MRI plays a key role in surgical planning by enabling assessment of the extent of tissue damage and the integrity of ligamentous structures. Lateral epicondylitis rarely occurs as an isolated condition, and abnormalities of the common extensor tendon origin frequently coexist with other pathologies, particularly injury to the lateral ulnar collateral ligament (LUCL). A positive correlation has been demonstrated between the degree of tendon damage and the severity of LUCL involvement, which further highlights the importance of MRI in assessing disease severity [17]. In some patients, secondary osseous changes, such as bone marrow edema, may also be observed. Identification of granulation tissue in treatment-resistant cases may additionally influence the choice of therapeutic strategy and help limit the extent of surgical intervention [16].

7. Other imaging modalities

Plain radiography has a limited role in the diagnostic evaluation of tennis elbow. Nevertheless, it may prove useful in the context of differential diagnosis, and therefore its use should be considered in patients who do not demonstrate improvement following conservative treatment, particularly prior to qualification for surgical intervention [18]. This imaging modality allows for the assessment of bony structures and facilitates the identification of concomitant abnormalities, such as degenerative changes, osteochondral defects, intra-articular loose bodies, as well as calcifications located at the origin of the extensor carpi radialis brevis (ECRB) [9]. Computed tomography arthrography (CTA) represents a potentially valuable diagnostic tool in the evaluation of tennis elbow, as it enables detailed assessment of capsular lesions. In comparison with magnetic resonance imaging, it demonstrates higher sensitivity and specificity, as well as greater reproducibility of findings and reduced dependence on operator experience [19]. Despite the fact that computed tomography is more sensitive than MRI in the detection of capsular damage, this modality is rarely utilized in the diagnostic workup of tennis elbow due to the use of ionizing radiation [9]. Consequently, its application remains limited to selected cases in which a more detailed assessment of specific structures, particularly the joint capsule, is required [19].

8. Treatment

Lateral epicondylitis is most commonly treated conservatively, with the use of such methods as rest, pharmacotherapy, immobilization, physiotherapy, as well as local corticosteroid injections [20]. The cornerstone of treatment is based on eccentric exercises, applied in combination with

ergonomic interventions and comprehensive patient education. Modification of risk factors related to occupational exposure and daily activities may reduce the likelihood of recurrence and support a sustained return to full function. Eccentric exercises have been shown to reduce pain by up to 42% and to improve functional outcomes by up to 35% [21]. Physiotherapeutic methods also play a significant role, including manual therapy, the Cyriax method, deep transverse friction massage, Mill's manipulation, myofascial release techniques, laser therapy, pulsed shortwave diathermy, as well as ultrasound therapy, all of which have demonstrated effectiveness in reducing pain, improving function, and facilitating tissue repair processes [22]. Orthotic interventions, such as counterforce braces and wrist splints, are also commonly used and have been shown to provide symptomatic relief and improve functional outcomes [23]. In individualized treatment protocols, adjunctive therapies such as extracorporeal shock wave therapy and platelet-rich plasma injections may also be applied, offering promising short-term clinical benefits [21]. In cases of failure of conservative treatment, surgical management is taken into consideration, with reported rates ranging from 0 to 22%. The most commonly performed procedures include open release of the ECRB, percutaneous extensor tenotomy, as well as arthroscopic release of the ECRB, achieving success rates in the range of 80-97% [20].

9. Conclusions

Lateral epicondylitis represents a common and clinically relevant cause of lateral elbow pain, requiring a structured diagnostic approach based primarily on detailed history taking and physical examination. Provocation tests and assessment of grip strength remain essential components of the diagnostic process, while careful differential diagnosis is necessary due to the substantial proportion of misclassified cases and the presence of overlapping clinical entities. Imaging studies play a complementary role, particularly in equivocal or treatment-resistant cases. Ultrasonography should be considered the first-line imaging modality due to its availability, dynamic capabilities, and high resolution for superficial structures, enabling accurate assessment of tendon morphology and vascularity. Magnetic resonance imaging provides a more comprehensive evaluation of intra-articular structures and the extent of tissue damage, and is particularly valuable in complex cases, in the presence of coexisting pathologies, and in preoperative planning. Other imaging modalities, including plain radiography and computed tomography arthrography, are reserved for selected indications, mainly within the differential diagnostic process. Management is predominantly conservative and includes eccentric exercises, physiotherapy, ergonomic modifications, and patient education. Adjunctive therapies may offer additional benefits in selected patients, whereas surgical intervention should

be limited to chronic or refractory cases that do not respond to appropriately conducted conservative management. Overall, the prognosis is favorable, with most patients achieving significant clinical improvement; however, the course of the disease may be prolonged, and recurrence remains possible, particularly in the presence of persistent risk factors.

Disclosure

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