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CONTEMPORARY DIAGNOSTIC APPROACHES AND THERAPEUTIC OPTIONS FOR LATERAL EPICONDYLITIS: A COMPREHENSIVE REVIEW

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ABSTRACT

Lateral epicondylitis (LE), commonly known as tennis elbow, is a prevalent tendinopathy involving the extensor origin at the lateral humeral epicondyle. It represents a frequent cause of pain and functional limitation in adults performing repetitive upper-limb activities.
This review aims to summarize current evidence regarding the diagnosis and management of LE, integrating findings from clinical, radiological, and therapeutic studies.
A systematic search of the PubMed database and manual review of relevant literature were conducted, including studies published in English and Polish that addressed diagnostic techniques and treatment strategies for LE.
Diagnosis is primarily clinical, supported by imaging modalities such as ultrasound and MRI in refractory or atypical cases. Conservative treatment - comprising patient education, ergonomic modification, and progressive loading - remains first-line management. Pharmacological interventions, including topical NSAIDs and short-term corticosteroid injections, offer temporary symptom relief but limited long-term benefit. Adjunctive modalities such as extracorporeal shock wave therapy and acupuncture may improve pain and function in selected patients, whereas low-level laser therapy shows inconsistent results. Surgical intervention, reserved for chronic and treatment-resistant cases, yields favorable outcomes with both open and arthroscopic approaches. Emerging regenerative therapies, particularly mesenchymal stem cell injections, demonstrate encouraging preliminary outcomes but require further validation through large-scale clinical trials.
The management of lateral epicondylitis should follow an evidence-based, stepwise approach emphasizing conservative care and individualized escalation. While novel regenerative modalities show promise, robust randomized data are needed to confirm their efficacy and establish standardized treatment protocols.

KEYWORDS

Lateral Epicondylitis, Tennis Elbow, Diagnosis, Conservative Treatment, Pharmacological Therapy, Adjunctive Therapies, Surgery, Regenerative Medicine

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Introduction

One of the most prevalent musculoskeletal conditions affecting the tendinous origin of the wrist extensor muscles at the lateral epicondyle of the humerus is lateral epicondylitis (LE), also referred to as tennis elbow. It is a major source of pain and functional impairment in adults, especially for individuals who perform repetitive upper-limb movements such as for forearm rotation, gripping, or wrist extension [1, 2]. Most cases occur in the general working population when performing repeated or unsafe manual jobs, even though it initially appeared amongst tennis players [3].

Over the last few decades, the understanding of LE has advanced significantly. Previously thought to be an inflammatory condition ("epicondylitis"), modern histological and imaging evidence supports the idea of a degenerative tendinopathy characterized by microtears, collagen disorganization, fibroblast proliferation, and neovascularization but no significant inflammation [4, 5]. Although the illness is usually self-limiting, with 89% of patients healing within a year, severe instances can continue longer [6].

LE presents challenges to clinicians due to its multifactorial origin, variable clinical presentations, and the broad spectrum of available treatment options, ranging from conservative rehabilitation to regenerative and surgical therapies. A thorough examination of its diagnosis and evidence-based management is therefore required to aid in optimal therapeutic decision-making and identify future research priorities.

Epidemiology

In the general population, LE is known to affect 1% to 3% of people, with an annual incidence of roughly 0.5% to 1% [7]. It most typically affects adults between 35 and 55 years of age, with no obvious gender dominance, while other research imply a slightly higher prevalence among women [8].

In South Korea, a nationwide database revealed that the mean annual age-adjusted incidence rate of LE was 9.7 per 1000 individuals. During the study period, the prevalence of LE rose dramatically, indicating that the condition's burden is increasing [9].

Occupational factors have an important impact in the development of LE. A study in France discovered that workers over 45 had a higher frequency of LE than younger workers. Furthermore, severe physical effort mixed with repetitive arm movements or extreme wrist bending (more than 2 hours per day) has been identified as a risk factor for LE [10].

Characteristics

The main symptom of LE is localized discomfort over the lateral epicondyle of the humerus, which often radiates into the dorsal forearm and is aggravated by activities that include wrist extension, gripping, or raising [11]. Physical examination often elicits sensitivity above the origin of the extensor carpi radialis brevis tendon, and pain may be reproduced during resisted wrist extension or middle-finger extension tests [12].

Patients may also experience decreased grip strength and trouble completing regular tasks like lifting, twisting, or shaking hands. Although the condition primarily affects the dominant limb, bilateral involvement can occur in up to 20% of cases [13].

Psychological factors have been found as major contributors to the severity and duration of LE symptoms. Patients with LE frequently have lower scores on personality qualities including extraversion and agreeableness. Furthermore, they report increased rates of perfectionism, anxiety, and sadness, particularly among men. This demographic also experiences work-related stress, which is characterized by a heavy workload and a lack of autonomy [14].

Methodology

This review is based on an analysis of peer-reviewed scientific publications related to the diagnosis and treatment of tennis elbow. The literature was obtained through a systematic search of the PubMed database and supplemented by a manual review of relevant journal articles. Only studies published in English and Polish were considered. The selection process focused on studies presenting current clinical approaches, diagnostic methods, and therapeutic options for lateral epicondylitis.

Diagnosis

LE is diagnosed using both clinical and imaging studies. In most situations, the condition can be diagnosed based on usual symptoms and findings during physical examination. Radiological methods can be used as a supplementary tool to confirm the diagnosis, assess the extent of tendon injury, and rule out alternative causes of lateral elbow pain [15, 16]. Therefore, diagnostic procedures are usually divided into clinical and radiological evaluations.

Clinical diagnosis

The clinical diagnosis of tennis elbow predominantly relies on physical examination findings. Typical symptoms include insidious onset of pain localized to the lateral epicondyle of the humerus, sometimes radiating along the extensor surface of the forearm. Clinical assessment reveals tenderness on palpation at the tendinous insertion of the lateral epicondyle and pain provoked by resisted extension of the wrist or fingers, particularly the middle finger [17].

Several clinical tests are widely employed in the diagnosis of lateral elbow tendinopathy (tennis elbow). The assessment begins with grip strength evaluation using a hand-held dynamometer; a reduction in grip strength on the affected side is considered a positive sign. Cozen's test involves resisted wrist extension with the elbow extended and forearm pronated and is positive if it reproduces the lateral elbow pain. Maudsley's test assesses pain reproduction during resisted extension of the middle finger, while Mill's test involves passive wrist plantar flexion with elbow extension, which stretches the extensor tendons and is also considered positive if pain is elicited [18-20]. According to a systematic review by Karanasios et al. (2022), Cozen's test demonstrates high sensitivity (91%) for diagnosing lateral elbow tendinopathy, suggesting it is highly reliable for identifying patients with the condition. Additionally, grip strength measurement - a difference of 5-10% between elbow flexion and extension - shows both high sensitivity (78-83%) and specificity (80-90%), making it a valuable objective method in clinical evaluation [21].

The publication by Greene et al. (2022) introduces a novel physical maneuver, termed the "index test". In this maneuver, a positive result is defined by the patient's inability to resist maximum dorsal wrist extension against resistance. This test specifically targets the detection of intrasubstance tears, which are not reliably diagnosed by traditional clinical provocative maneuvers. The study reports that the index test displayed high sensitivity (0.86) and good overall accuracy (0.79) in identifying instrasubstance tear among patients with LE, with specificity at 0.64. The index test outperformed both Cozen's test and the presence of nocturnal pain in diagnostic accuracy for identifying intrasubstance tears [22].

As for other characteristics, it is a pain of increasing intensity, without a specific injury, which worsens after unusual strain, usually a few days after more intense exertion. There are no signs of radiculopathy or sensory disturbances, which could suggest another pathology, such as radial nerve entrapment syndrome [15]. An essential differential diagnosis to consider is osteoarthritis of the radiocapitellar joint, characterized by pain localized to the joint line upon palpation, often accompanied by a reduced range of motion in elbow pronation and supination, movements that are usually unaffected in lateral epicondylitis. Additional differential diagnoses include cervical radiculopathy and osteochondritis dissecans [3, 19, 23].

Radiological diagnosis

LE is principally diagnosed based on clinical assessment, and imaging studies are generally reserved for cases where patients do not exhibit adequate improvement or when atypical features are present [24].

Plain radiography has limited utility in the assessment of LE, but may reveal calcification at the lateral epicondyle or exclude other bony pathologies such as osteoarthritis or osteochondritis dissecans [25].

Ultrasound imaging enables visualization of tendon architecture and can assess for changes such as hypoechogenicity, tendon thickening, neovascularity, and peritendinous fluid. Combined grayscale and power Doppler imaging has demonstrated a sensitivity of up to 90% but relatively low specificity for LE, reflecting a high frequency of tendinopathic changes in asymptomatic individuals. Ultrasound findings must be carefully correlated with clinical symptoms to avoid overdiagnosis [26].

Magnetic resonance imaging (MRI) plays a significant role in the radiological diagnosis of LE, particularly in cases where clinical findings are ambiguous or when conservative treatment fails. MRI provides detailed visualization of the structural integrity of the common extensor tendon, allowing identification of tendinosis, partial-thickness tears, and degenerative changes. According to recent studies, MRI demonstrates high sensitivity and reliability in detecting tendon pathology, with specific signal alterations correlating with symptom severity and disease chronicity [27]. Moreover, research confirms the interobserver reliability of MRI in grading tendinopathy severity and differentiating between tendinosis and partial tears, which is critical for guiding therapeutic decisions [28]. MRI also effectively identifies associated abnormalities such as ligamentous injuries and joint effusions that may influence patient management [29]. However, it is essential to note that tendon abnormalities detected on MRI can also be present in asymptomatic individuals, which limits the standalone diagnostic and prognostic value of MRI and emphasizes the necessity for clinical correlation [30]. Therefore, MRI should be reserved for refractory or atypical cases, serving as a complementary tool that aids in detailed anatomical assessment and therapeutic planning rather than as a primary diagnostic modality [27, 31].

Treatment

A variety of therapeutic options are available for the management of LE. Treatment strategies can be categorized into conservative management, pharmacological interventions, physical and adjunctive therapies, surgical management, and emerging or experimental treatments [32].

Conservative management

Conservative management of LE aims to relieve pain, restore tendon load tolerance and function, and avoid unnecessary invasive procedures by employing patient education, activity modification, ergonomic correction and temporally graded loading strategies as first-line measures. Clinical guidelines that systematically reviewed randomized trials and graded available evidence endorse an initial non-operative pathway that emphasizes counselling about natural history and shared decision-making [33].

Simple, evidence-based behavioural and ergonomic interventions include targeted activity modification by reducing provocative repetitive wrist extension and forearm supination tasks, work-task redesign, and temporary relative rest with progressive reintroduction of load. These measures are recommended as foundational because lateral epicondylitis is frequently self-limiting and many randomized trials comparing active modalities report either transient benefits or inconsistent long-term superiority over conservative advice alone [34].

Orthotic devices such as counterforce straps or wrist splints can provide short-term symptomatic relief and improved capacity for activities of daily living in some patients. However, randomized data indicate that bracing alone is inferior to supervised physical therapy for pain and disability at early follow-up, and at medium and long term of 26 and 52 weeks, differences between brace, physical therapy, and combined approaches are not statistically significant. Accordingly, orthoses may be considered as an initial temporizing option or adjunct for symptomatic control, rather than definitive therapy [35].

Structured conservative care should incorporate progressive, tendon-oriented loading when clinically appropriate. High-quality syntheses of physiotherapy literature identify eccentric strengthening and manual therapy techniques as the modalities most consistently associated with clinically meaningful improvement and favourable cost-benefit profiles. These interventions are frequently combined with education and graded return-to-activity programs. Other physiotherapy adjuncts - orthoses, shockwave, taping, laser, diacutaneous fibrolysis - have variable and less consistent supporting evidence and therefore are generally positioned as complementary to an exercise-based program rather than as sole treatments [36].

Prognosis under conservative management is favorable for most patients, with up to 90% experiencing resolution over time, though recurrences are common and a minority develop persistent symptoms. Decisions to escalate from conservative care to pharmacological injections, procedural adjuncts, or surgery should be based on duration and severity of symptoms, objective functional impairment, and failure of a time-limited, typically several months, trial of appropriately delivered conservative interventions. Contemporary systematic reviews and practice summaries stress the importance of documenting baseline pain and function, applying standardized exercise and ergonomic programs, and reassessing outcomes to support shared decision-making about next steps [37, 38].

Pharmacological interventions

Pharmacological strategies for LE are adjunctive to the conservative measures described previously and aim to provide short- to medium-term analgesia, reduce local symptoms, and in selected cases to modify the local biological milieu. The principal categories addressed in the literature are topical and oral non-steroidal anti-inflammatory drugs (NSAIDs), peritendinous corticosteroid injections, and biologic or autologous injectates such as platelet-rich plasma and autologous whole blood. Additional data exists for other injectables including hyaluronate, botulinum toxin, and prolotherapy. Epidemiological analyses demonstrate substantial primary-care and specialty utilization underscore the clinical need for evidence-based pharmacological options [3].

Topical and oral NSAIDs constitute accessible pharmacological options. The Cochrane systematic review by Pattanittum et al. evaluated 13 randomized controlled trials and found that topical NSAIDs produce a small but statistically significant pain-reducing effect over placebo in the short term, up to approximately two to four weeks. Oral NSAIDs did not demonstrate consistent superiority versus placebo or other comparators in existing trials and are associated with a higher risk of systemic adverse events including gastrointestinal, renal, and cardiovascular complications. The authors caution that the clinical relevance of observed pain differences is modest, functional outcomes are largely unassessed, and the evidence base is of low to moderate quality. Therefore, topical NSAIDs may be judiciously applied for limited durations in LE, while long-term or systemic NSAID use should be guided by comorbidity profile and risk mitigation [39].

Peritendinous corticosteroid injections produce a reproducible short-term analgesic effect but are associated with inferior intermediate and long-term outcomes and higher recurrence rates in comparison with placebo or alternative non-corticosteroid modalities. Rigorous trials and meta-analyses demonstrate large short-term reductions in pain after corticosteroid injection that reverse over 3-12 months, with some randomized evidence showing worse recovery at one year and elevated recurrence after corticosteroid treatment. These data support limiting corticosteroid injections to carefully selected patients when rapid symptomatic relief is prioritized, combined with counselling regarding adverse longitudinal outcomes [12, 40].

Biologic and autologous injectates have heterogeneous evidence bases and variable methodological quality. Pilot and controlled cohort studies of platelet-rich plasma (PRP) report substantial reductions in pain and improvements in function in patients refractory to nonoperative care, with some sustained benefit on medium-term follow-up. However, controlled trials and pooled analyses indicate inconsistent efficacy across tendinopathy sites and preparation protocols. Autologous whole-blood injections have produced encouraging results in small prospective series of refractory LE, yet randomized comparisons and standardized protocols remain limited. The systematic injection review identified that non-corticosteroid injectates including hyaluronate and prolotherapy may offer longer-term benefits, but overall, the evidence is heterogeneous and not uniformly conclusive. Thus, use of PRP or autologous blood should be considered experimental relative to established conservative care and discussed within shared decision-making [12, 41, 42].

Adjunctive therapies

Adjunctive therapies include extracorporeal shock wave therapy (ESWT), acupuncture and low-level laser therapy (LLLT).

ESWT has demonstrated short-term improvements in pain and grip strength compared with placebo or standard care. Meta-analyses report statistically significant but modest benefits, with considerable heterogeneity among study protocols and follow-up durations. Current evidence supports its use as an adjunct in patients unresponsive to initial therapy [43, 44].

Acupuncture may yield short-term pain relief and functional improvement compared with sham or pharmacological treatments. However, trial quality and consistency remain limited. It can be considered as an optional adjunct in selected patients [45].

Evidence for LLLT is weak and inconsistent. Umbrella reviews indicate minimal clinical benefit and substantial variability in treatment parameters, precluding firm recommendations for routine use [46].

Surgical management

Surgery is considered only for patients with chronic, refractory LE unresponsive to conservative, pharmacological, and adjunctive measures. The main objective is removal of degenerated extensor carpi radialis brevis tissue with or without tendon repair, performed through open, arthroscopic, or percutaneous techniques [47].

Recent comparative evidence shows similar long-term pain and function between arthroscopic and open procedures. A 2024 meta-analysis found no significant difference in scores measuring disability of the arm, shoulder, and hand (DASH score), which assesses upper limb function, or in the Mayo Elbow Performance Index, a tool evaluating elbow pain, range of motion, stability, and daily function. However, patients undergoing arthroscopic surgery experienced an earlier return to work and transiently better grip strength compared to those treated with open surgery [48].

Large cohort analyses report low complication and reoperation rates overall. Open debridement with tendon repair demonstrated a slightly lower 5-year reoperation rate than debridement alone, with comparable safety [49].

Emerging and experimental treatments

Novel approaches for resistant LE focus on regenerative therapies aimed at tendon healing and modulation of local inflammation. The most studied option is mesenchymal stem cell (MSC) injection. A pilot randomized study using ultrasound-guided allogeneic adipose-derived MSCs mixed with fibrin glue showed no adverse events and demonstrated marked improvements in pain and elbow function at 52 weeks, though based on a small cohort [50].

A recent review summarized similar findings from early clinical studies, noting consistent symptomatic and structural improvement but substantial heterogeneity in cell source, dosage, and administration. The authors emphasized that MSC therapy remains experimental and requires larger, standardized trials before clinical implementation [51].

Conclusions

LE is a common, activity-related tendinopathy that predominantly affects adults in midlife and presents with lateral epicondylar pain, reduced grip strength and functional limitations. Diagnosis remains principally clinical, supported selectively by ultrasound or MRI when atypical features or refractory symptoms warrant further anatomical clarification. First-line management emphasizes activity modification, patient education and progressive, tendon-oriented loading programs, with orthoses as a temporary adjunct. Pharmacological measures—including topical NSAIDs and time-limited corticosteroid injections—serve primarily for symptomatic control, while biologic injectates remain of uncertain, heterogeneous efficacy. Adjunctive modalities such as extracorporeal shock wave therapy and acupuncture may benefit selected patients, whereas low-level laser therapy lacks convincing pooled evidence. Surgical debridement, performed via open or arthroscopic approaches, is indicated only after a documented trial of nonoperative care and yields favourable outcomes in carefully selected cases. Regenerative strategies, notably mesenchymal stem-cell injections, show preliminary promise but require larger, standardized trials before routine adoption. Clinical decision-making should therefore be individualized, guided by symptom severity, functional impact, comorbidity profile and the strength of current evidence, with rigorous documentation and reassessment at defined intervals.

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