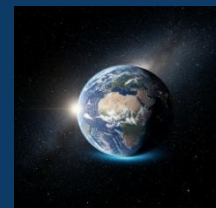




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Triangular Fibrocartilage Complex Tears, Extensor Carpi Ulnaris Subluxation and the Impact of Modern Topspin Technique on Wrist Injuries in Tennis: A Narrative Review

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Abstract

Background. Injury to the triangular fibrocartilage complex (TFCC) and instability of the extensor carpi ulnaris (ECU) tendon are both sources of ulnar-sided wrist pain in tennis players, yet compared with elbow and shoulder pathology they receive relatively little research attention. One proposed contributing factor is the shift toward Western and semi-Western grips used to generate heavy topspin.

Aim. This narrative review synthesizes the available evidence on the anatomy, biomechanics, epidemiology, diagnosis, and management of TFCC and ECU pathology in tennis players, focusing in particular on how modern topspin-oriented stroke technique may contribute to these injuries.

Material and methods. Twenty-eight sources covering the anatomy, biomechanics, epidemiology, diagnosis, and management of TFCC and ECU pathology in tennis players were reviewed, drawing on the biomechanical, clinical, and surgical-outcomes literature.

Results. Grip style and topspin-oriented stroke mechanics measurably alter wrist kinematics and loading, increasing the ulnar deviation and pronation-supination demands implicated in TFCC and ECU pathology. Diagnostic accuracy is a persistent concern, as conventional imaging correlates only imperfectly with symptomatic status in elite players. Conservative management succeeds in most cases, and surgical repair or reconstruction achieves consistently high success rates among patients who fail nonoperative treatment.

Conclusions. Ulnar-sided wrist injuries emerge as a mechanistically credible and clinically significant consequence of modern tennis technique. Conservative and surgical management both produce favorable outcomes when appropriately indicated, but the evidence base for tennis-specific conservative rehabilitation and diagnostic protocols remains thin.

Key words: triangular fibrocartilage complex, TFCC, ECU subluxation, ulnar-sided wrist pain, tennis, racquet sport, diagnosis, treatment, management, arthroscopy, biomechanics, topspin, grip.

1. Introduction

Tennis is one of the most widely played racquet sports in the world. Its repetitive, high-velocity strokes performed over long match durations place substantial cumulative load on the upper extremity [1]. The elbow and shoulder have historically dominated the sports medicine literature on tennis injury, but the wrist - and its ulnar aspect in particular - is now recognized as a clinically significant site of pathology that is frequently underdiagnosed [2]. Two conditions account for most of this presentation: injury to the triangular fibrocartilage complex (TFCC), the principal soft-tissue stabilizer of the distal radioulnar joint, and subluxation or instability of the extensor carpi ulnaris (ECU) tendon within its fibro-osseous subsheath [3, 4].

The technical evolution of the tennis stroke over recent decades may be part of the explanation. As classical Eastern-grip, flat-hitting technique has given way to Western and semi-Western grips built for heavy topspin, the kinematics of the forehand and double-handed

backhand have changed with it: wrist ulnar deviation has increased, as has the velocity of forearm pronation-supination at ball contact [5, 6]. Since the ECU subsheath and TFCC are loaded directly by this combination of movements, researchers have proposed this technical shift as a mechanism behind ulnar-sided wrist complaints in both competitive and recreational players [7].

Even so, the evidence connecting modern stroke biomechanics to ulnar wrist pathology is scattered across the biomechanics, radiology, and hand-surgery literatures rather than gathered in one place. Diagnosis adds a further complication: conventional imaging has been reported to correlate poorly with symptomatic status in elite players [8].

This narrative review brings together current evidence on the anatomy, biomechanical mechanisms, epidemiology, diagnosis, and management - both conservative and surgical - of ulnar-sided wrist injuries in tennis players, specifically TFCC tears and ECU subluxation, with particular attention to the role of modern topspin-oriented technique. Four questions guide the review: how topspin stroke technique influences ulnar-sided wrist loading; how common TFCC and ECU pathology are in this population; which diagnostic approaches perform best in this clinical context; and how conservative and surgical management compare.

2. Materials and Methods

PubMed and supplementary academic search engines were searched using the string: ("triangular fibrocartilage complex" OR TFCC OR "ECU subluxation" OR "ulnar-sided wrist pain") AND (tennis OR "racquet sport") AND (diagnosis OR treatment OR management OR arthroscopy) AND (biomechanics OR topspin OR grip). Twenty-eight peer-reviewed sources met inclusion criteria, comprising original research articles, systematic reviews, and narrative reviews on the anatomy, biomechanics, epidemiology, diagnosis, and management (conservative and surgical) of ulnar-sided wrist pathology in tennis players. Most were published between 2006 and 2026, consistent with how recent the tennis-specific biomechanical and clinical evidence base is; a handful of older anatomical studies were also included because they remain the reference standard for TFCC and ECU anatomy.

3. Results

3.1. Anatomy of the Ulnar Wrist: The Triangular Fibrocartilage Complex and Extensor Carpi Ulnaris

The ulnar wrist is stabilized by the triangular fibrocartilage complex (TFCC), a composite fibrocartilaginous and ligamentous structure, together with the extensor carpi ulnaris (ECU) tendon and its stabilizing subsheath [9]. Early anatomic and biomechanical work showed that the TFCC is a confluent complex rather than a single discrete structure, made up of the articular disc, the dorsal and volar radioulnar ligaments, the meniscus homologue, the ulnar collateral ligament, and the sheath of the ECU tendon - components so interconnected that they could not be cleanly dissected from one another [10]. In that original cadaveric series, more than half of specimens showed TFCC perforation, and perforation was consistently linked to degenerative changes in the cartilage of the lunate and distal ulna; this is part of why TFCC degeneration is now understood chiefly as an age- and load-related process, with trauma as a secondary contributor [10]. Functionally, the complex does two jobs: it cushions the ulnar carpus under load, and it acts as the primary soft-tissue stabilizer of the distal radioulnar joint (DRUJ) - a role that matters most in activities involving repetitive forearm rotation under load [10].

The ECU muscle-tendon unit contributes to this stability while also actively producing wrist extension and ulnar deviation; its position relative to the ulnar groove of the distal ulna shifts continuously as the forearm pronates and supinates [4]. The tendon has to stay mobile enough to travel across the wrist while still sitting securely in the ulnar groove, and it is a distinct fibro-osseous subsheath - separate from the extensor retinaculum proper - that meets this dual demand, restraining the tendon against subluxation during forearm rotation. This subsheath has since been identified as the ECU tendon's principal stabilizing structure, with direct implications for how surgical reconstruction is approached [4, 11]. Cadaveric dissection across three anatomic zones of the subsheath - the ulnar groove, the ulnar styloid process, and the triquetrum - showed that the tendon displaces ulnarly with forearm supination, wrist flexion, and ulnar deviation, and that a shallower groove is linked to greater subluxation [12]. In the same study, simply sectioning the subsheath, including its distal extension, was enough to produce frank tendon subluxation - evidence that it is the subsheath's integrity, not the groove alone, that principally restrains ECU instability [12].

Both the TFCC and the ECU subsheath are loaded most heavily when forearm rotation and wrist deviation occur together. That makes the specific wrist and forearm kinematics of a given tennis stroke - above all, the ulnar deviation and rotational velocity tied to different grip styles - directly relevant to how ulnar-sided wrist injuries actually occur in tennis players.

Clinically, TFCC lesions are classified using a system built on anatomic dissection, imaging, arthroscopy, and clinical experience, which separates Class 1 (traumatic) from Class 2 (degenerative) lesions [13]. Traumatic lesions are further divided by location: Type 1A tears involve the central articular disc, Type 1B tears are detachments of the TFCC origin from the distal ulna or an associated ulnar styloid fracture, Type 1C tears involve avulsion of the ulnocarpal ligament attachments with possible carpal instability, and Type 1D tears are complete radial-sided detachments [13]. This is still the standard clinical framework for TFCC pathology, and it directly shapes the choice between debridement, repair, and reconstruction: peripheral, vascularized tears such as Type 1B generally respond well to repair, while central, avascular Type 1A tears are more often managed with debridement alone [13].

3.2. Biomechanics of Modern Topspin Technique and Wrist Loading

Grip choice directly shapes the kinematic demands placed on the wrist and forearm. A three-dimensional motion-capture comparison of the two-handed backhand found that the non-dominant limb, when gripped in an Eastern style, moved through smaller wrist extension and ulnar deviation during the forward swing than the same stroke hit with a Continental grip - and did so while producing faster horizontal racket-head velocity, with no loss of accuracy or spin rate. The authors read this as evidence that grip selection can place the wrist in a more or less vulnerable position independently of how effective the stroke is [5]. Normative kinematic data from elite juniors point the same way: the two-handed backhand loads the wrist into ulnar deviation on both sides of the body, with the non-dominant wrist reaching slightly greater ulnar deviation than the dominant wrist at peak backswing (non-dominant forearm pronated, dominant forearm supinated), and deviation continuing to build from backswing through impact, peaking only after the ball is struck [14].

A similar grip-dependent pattern shows up in the forehand. An electromyographic and accelerometric comparison of the Eastern and Western forehand grips found that the Eastern grip - marked by forearm pronation and wrist ulnar deviation - produced significantly greater flexor carpi ulnaris activity than the Western grip, along with a higher peak impact load, a greater amplitude of impact-load attenuation, and higher jerk on the ulnar side of the wrist [6].

The ulnar side did absorb a greater peak load under the Eastern grip, but it also dissipated that load more quickly and completely than under the Western grip - so peak loading magnitude alone cannot fully explain the injury patterns seen across grip styles; how efficiently and how fast the load is attenuated may matter just as much [6]. This lines up with earlier clinical-epidemiological work in a large cohort of nonprofessional players, where Western and semi-Western grips were tied to a higher proportion of ulnar-sided wrist injuries and the Eastern grip to more radial-sided injury [7].

These findings point toward a mechanism: Western and semi-Western grip styles, adopted to generate heavier topspin, favor greater wrist ulnar deviation and faster forearm pronation-supination at ball contact, and so may increase cumulative loading on the very structures - the TFCC and ECU subsheath - that are vulnerable to combined rotational and deviational stress. But grip style alone does not fully explain injury risk; the rate and efficiency of load attenuation matter too. Nor is overuse loading confined to groundstrokes - joint loading during the serve has separately been identified as a major contributor to overuse pathology across the kinetic chain, so wrist-specific risk is best considered alongside a player's full stroke repertoire rather than in isolation [15].

3.3. Epidemiology and Risk Factors

Population-level surveillance places wrist pathology within the wider pattern of tennis-related injury. An estimated 17.9 million people play tennis in the United States alone, and the combination of long match durations and repetitive stroke mechanics leaves players at risk of both acute and overuse injury at every level of play [1]. ECU tendinitis and subluxation are routinely listed alongside shoulder and elbow pathology as characteristic tennis injuries, reflecting the wrist's established, rather than incidental, place in the sport's overall injury profile. Broader clinical reviews of upper-extremity overuse injury and imaging-based surveys of tennis overuse injury both identify the wrist as a recurrent site of pathology, corroborating this pattern [1, 16, 17].

At the elite level, injury-surveillance data from the Australian Open (2011–2016) found a substantially higher overall injury rate among women than men (201.7 versus 148.6 injuries per 10,000 game exposures). The wrist ranked among the four most commonly injured regions in women (3.1 ± 1.5 injuries per year), alongside the shoulder, foot, and knee; among men, the leading sites were the knee, ankle, and thigh, and the wrist did not feature [18]. Over the same five-year period, upper-arm injuries and in-event treatment frequency rose at least

2.4-fold in both sexes - a rising burden of upper-extremity pathology that was independent of any overall change in injury rates [18]. This sex difference fits broader findings on female athlete injury risk, which point to a need for upper-extremity prevention strategies tailored specifically to female, woman, and girl athletes given how disproportionately they appear in this injury category [19].

Within this population specifically, a clinical case series of 28 elite tennis players seen over several years of specialist practice identified three distinct patterns of ECU-related pathology - acute instability, tendinopathy, and frank tendon rupture - each calling for a different therapeutic approach [3]. This indicates that “ECU injury” in tennis players spans a spectrum of presentations rather than a single entity, which matters directly for how it is diagnosed and treated.

Risk factors for wrist injury in tennis players fall into modifiable and non-modifiable categories. Grip style is the most extensively documented modifiable factor: a cross-sectional study of 370 nonprofessional players found Western and semi-Western grips associated with more ulnar-sided wrist injuries, and the Eastern grip more often associated with radial-sided injury [7]. Beyond grip, the specific wrist pathology a player presents with has been reported to vary with playing level, stroke mechanics, and where in the competitive season presentation occurs, so wrist-injury risk in tennis cannot be reduced to any single variable [2].

Table 1. Summary of epidemiological data on wrist injury in tennis players

Study / Population	Metric	Finding	Source
Australian Open Grand Slam, 2011–2016 (elite)	Overall injury rate	201.7 injuries/10,000 game exposures (women) vs. 148.6 (men)	[18]
Australian Open Grand Slam, 2011–2016 (elite)	Wrist injury (women)	3.1 ± 1.5 injuries/year; among top 4 most-injured regions in women	[18]
Australian Open Grand Slam, 2011–2016 (elite)	Upper-arm injury trend	≥ 2.4 -fold increase over 5-year surveillance period (both sexes)	[18]
Elite tennis players (specialist clinical series)	ECU-related presentations	28 cases; 3 clinical patterns (instability, tendinopathy, rupture)	[3]

Nonprofessional players (n = 370)	Grip–injury association	Western/semi-Western grip → ulnar-sided injury; Eastern grip → radial-sided injury	[7]
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3.4. Clinical Diagnosis

Ulnar-sided wrist pathology in tennis players tends to present nonspecifically - activity-related pain, swelling, and a sensation of snapping or clicking are the most commonly reported symptoms, usually reproducible with provocative maneuvers on examination [20]. The structures involved - the TFCC, the ECU tendon and subsheath, the distal radioulnar and ulnocarpal joints, and occasionally the hamate - sit close together and can produce overlapping symptoms, so a broad differential diagnosis is necessary. Which pathology is actually present in a given player has been shown to vary with player type, stroke mechanics, and where in the season presentation occurs [2, 20].

Imaging has a central but imperfect role here. A cross-sectional study comparing symptomatic and asymptomatic elite double-handed-backhand players against healthy controls, using blinded radiological review, found only a marginal difference in total MRI abnormalities between symptomatic players and the other two groups, with substantial overlap in degenerative-appearing findings across all three [8]. Players with pain did show significantly more osseous-articular lesions and ECU tendon and dorsal radioulnar ligament abnormalities than asymptomatic players, but there was no significant difference between groups in ganglia, most TFCC structures, or ECU subsheath tearing and subluxation. The authors took this as evidence that radiological findings need to be weighed carefully against the clinical picture, since tennis-related structural change can be present without symptoms [8]. For clinical practice, this means an abnormal MRI in a tennis player with wrist pain does not by itself confirm that the abnormality is causing the symptoms, and a normal-looking scan does not rule out clinically significant pathology.

MRI is not the only modality showing this pattern. A cross-sectional ultrasonographic study of 26 asymptomatic recreational players, examining the ECU tendon bilaterally at rest and in motion, found tendinosis or partial-thickness tearing in 75% of tendons examined, affecting 92% of players in at least one wrist; dynamic instability was detected in 42% of wrists, present in 73% of players despite none reporting symptoms [21]. Two independent imaging

modalities, in separate player cohorts, converge on the same conclusion: structural and dynamic ECU abnormalities are common, largely asymptomatic features of the tennis-playing wrist, and cannot serve alone as reliable markers of clinical pathology [8, 21].

Given these limitations, imaging findings need to be read against a detailed clinical picture. In one reported case, a competitive player with ulnar-sided wrist pain had MRI findings of ulnocarpal joint effusion and synovitis alongside longitudinal tearing of the ulnotriquetral ligament - a palmar thickening of the TFCC's ulnar collateral component - and arthroscopic-assisted repair was reported to safely and effectively treat the ulnotriquetral split tear and peripheral TFCC tear identified this way [22]. The case makes the broader point: a structured, team-based approach that combines history, physical examination, and imaging serves competitive players better than treating imaging as diagnostic on its own, especially given the physical demands placed on their wrists [22].

3.5. Conservative Management

Conservative management is the first-line approach for both ECU tendinopathy and non-displaced TFCC injury in tennis players, consistent with the general principle that surgery is reserved for cases that fail nonoperative care [9]. For ECU tendinopathy, first-line measures include relative rest, anti-inflammatory medication, and, where appropriate, corticosteroid or platelet-rich plasma injection, alongside structured occupational or physical therapy - therapeutic exercise, splinting, activity modification, manual therapy, and adjuncts such as therapeutic ultrasound [23]. Once symptoms and function have improved enough, a graded, sport-specific interval return-to-play program is recommended; tennis-specific protocols of this kind have already been published, and training load is increased gradually rather than resumed at full competitive volume all at once [23].

For acute ECU subsheath instability specifically, four to six weeks of wrist immobilization can achieve tendon stability in appropriately selected cases, sparing patients the longer immobilization and rehabilitation typically needed after surgical reconstruction of the sixth dorsal compartment. Whether conservative or surgical management gives better long-term outcomes for this injury pattern is still debated, though. A recent outcomes study of racquet-sport athletes with TFCC injury found conservative management successful in the large majority of cases (73.3%), with surgery reserved for those who failed an adequate nonoperative trial - a result consistent with this generally favorable picture for nonoperative care [24].

Activity or technique modification is often listed among conservative measures in the broader ECU literature, though no dedicated tennis-specific trial has yet tested this intervention on its own [4].

3.6. Surgical Management

Surgery for ECU instability and TFCC injury is generally reserved for cases that do not respond adequately to conservative management. For posttraumatic ECU instability, a systematic review pooling eight retrospective studies (97 wrists; mean age 32, range 13–61) found that patients were treated either with primary repair using sutures and anchors (40% of cases) or with reconstruction using an extensor retinaculum flap (60%); one included study also performed surgical deepening of the ulnar groove [25]. Across the pooled cohort, patients saw consistent improvement in pain, function, satisfaction, and grip strength, with a low complication rate and no reported recurrence of instability. The authors did caution, though, that considerable heterogeneity in patient populations, operative techniques, and outcome measures across the included studies weakens any single treatment recommendation and points to a need for more standardized comparative research [25].

A recent retrospective outcomes study specific to TFCC injury in racquet-sport athletes identified 20 patients (21 injuries occurred during tennis specifically); 5 were treated surgically, 4 by arthroscopic debridement and 1 by open repair, after conservative management failed [24]. All of the surgically treated patients eventually returned to baseline activity, compared with 73.3% of those managed nonoperatively - a small surgical subgroup, but one suggesting surgery is a reliable salvage option when conservative care does not work [24]. Prior TFCC pathology and age above 50 were both associated with failure to return to baseline activity, suggesting that patient-specific factors shape surgical outcomes alongside the treatment chosen [24]. This fits case-level evidence that arthroscopic-assisted repair can safely and effectively treat peripheral TFCC tears and associated ulnotriquetral ligament injury in competitive players once conservative measures have been exhausted [22].

These favorable figures need an important qualification from broader, non-tennis-specific outcomes data on Palmer Type 1 TFCC injury. A systematic review pooling 43 studies found that, across all Palmer Type 1 classes, 92% of patients treated with debridement returned to work - but only 44% were entirely free of pain; among Type 1B lesions treated with repair, 68.3% returned to work while 41% still reported persistent pain [26]. Return-to-activity and complete symptom resolution measure different things: a player counted as a treatment

“success” by return-to-play criteria may still be living with some residual pain, so outcome reporting based on return-to-activity alone can overstate how complete surgical recovery actually is [26].

Table 2. Summary of treatment outcomes for TFCC and ECU injury in racquet-sport/tennis players

Condition	Treatment	Sample	Outcome / Return-to-Activity Rate	Avg. Time to Return	Source
TFCC injury	Conservative (immobilization + therapy)	15 patients	73.3% returned to baseline activity	~103 days	[24]
TFCC injury	Surgical (arthroscopic debridement / open repair)	5 patients	100% returned to baseline activity	~210 days	[24]
ECU instability	Surgical (primary repair 40%; reconstruction 60%)	97 wrists (8 pooled studies)	Favorable pain/function/satisfaction/grip outcomes; low complication rate; 6.7% failed to return to prior activity level	Not consistently reported across studies	[25]

3.7. Return to Play Considerations

Return to competitive tennis after either conservative or surgical management of ulnar-sided wrist injury is best thought of as a graduated process rather than a single event - restoring physical function, confirming safe sport-specific loading capacity, and following a structured interval training program before resuming full competitive volume. Interval return-to-play programs have been developed specifically for tennis, as well as baseball and golf, to reintroduce sport-specific loading progressively rather than all at once, letting tendon and

ligamentous tissue adapt as training demands increase; building training volume gradually is advocated specifically to reduce the risk of re-injury from a sharp jump in workload [23].

Empirical return-to-activity data in racquet-sport athletes with wrist injury support this graduated approach, though recovery timelines vary considerably by treatment pathway. Among racquet-sport athletes with TFCC injury, average time to baseline activity was longer after surgical debridement than after nonoperative management - surgically treated players evidently need a longer, presumably more structured rehabilitation period before returning to full training and competition. Prior TFCC pathology and age above 50 were both linked to failure to return to baseline activity, so return-to-play expectations should be set individually by injury history and age rather than applied uniformly [24]. A similar pattern appears in the pooled surgical cohort for ECU instability, where a small but clinically meaningful share of patients did not return to their previous activity level despite technically successful surgery, showing that structural repair alone does not guarantee full functional recovery and that rehabilitation quality and individual factors matter throughout [25].

3.8. Injury Prevention Strategies

Primary injury prevention in tennis has a thinner evidence base than diagnosis and treatment, though recent studies do support several concrete strategies for the upper extremity. A systematic review of upper-extremity injury prevention programs in overhead youth athletes, drawing on five studies and 456 athletes aged 10–17, found that programs combining strength, mobility, and plyometric training produced measurable improvements in strength, mobility, and sport-specific performance in 30.4%, 28.6%, and 22.2% of assessed outcomes respectively; strength training was the most consistently included and most studied component [27]. This evidence is limited in size and drawn from overhead sports generally rather than tennis specifically, but it does give preliminary support for structured strength-based conditioning as part of upper-extremity injury prevention in young athletes.

More directly relevant to tennis, a systematic review spanning adolescent and adult high-performance players identified three interrelated prevention domains with moderate-to-low certainty evidence behind them: external workload management, kinetic-chain conditioning, and technique or equipment modification [28]. For wrist injury specifically, wrist-mounted inertial sensors identified a threshold of roughly 3,500 racquet impacts per training session above which wrist overuse symptoms increased; adjusting training sessions using that

feedback cut wrist overuse symptoms by 9% in adult players [28]. The same review found grip-size personalization roughly halved the prevalence of lateral epicondylalgia in both adolescent and adult cohorts - evidence for individualized equipment fitting as a preventive measure, even though this particular finding concerns the elbow rather than the wrist [28].

On balance, wrist-specific injury prevention in tennis players is probably best approached as an extension of general upper-extremity load management - structured strength conditioning, individualized equipment fitting, objective load monitoring - rather than through wrist-isolated interventions, simply because dedicated research on wrist-specific prevention protocols in tennis is still largely missing from the literature.

4. Discussion

This review brought together current evidence on the anatomy, biomechanics, epidemiology, diagnosis, and management of ulnar-sided wrist injuries in tennis players - TFCC tears and ECU instability specifically - with particular attention to how modern topspin-oriented technique contributes to them.

The anatomical vulnerability of the TFCC and ECU subsheath to combined forearm rotation and wrist deviation [4, 12, 10] fits closely with the kinematic demands of Western and semi-Western grip strokes, which produce greater wrist ulnar deviation and faster pronation-supination than classical Eastern-grip technique [5, 6, 14]. The anatomical mechanism and the biomechanical loading pattern, considered jointly, offer a credible biological explanation for why Western and semi-Western grips are associated with more ulnar-sided wrist injury in the clinical-epidemiological data [7]. That said, this evidence is correlational, not causal - no study identified here tracked individual players longitudinally from grip adoption to injury onset, and the biomechanical data come instead from cross-sectional comparisons of stroke kinematics in uninjured players. Peak biomechanical load and injury risk also turned out to be more complicated than grip style alone: how efficiently and quickly impact load is attenuated may matter just as much [6].

The diagnostic evidence carries a message that may run counter to routine practice: MRI abnormalities of the ulnar wrist are common in asymptomatic tennis players, and they do not reliably separate symptomatic from asymptomatic status [8]. That finding, from a well-controlled cross-sectional comparison that included a healthy control group, argues for

treating imaging as one piece of a broader clinical assessment rather than a stand-alone diagnostic tool - and for caution before attributing a player's symptoms to a structural abnormality found incidentally.

The management evidence is generally favorable for both conservative and surgical approaches, though its overall quality is limited. Much of the surgical outcomes literature here comes from small, retrospective case series with mixed patient populations, operative techniques, and outcome measures [24, 25], which rules out direct comparison between specific techniques or firm conclusions about which approach suits a given presentation best. No randomized controlled trial comparing conservative and surgical management of TFCC or ECU injury in tennis players turned up in this review, and no tennis-specific study of structured conservative rehabilitation protocols did either - the conservative-management evidence here is drawn largely from general athletic populations rather than tennis players. That is a meaningful gap, since the biomechanical demands of tennis strokes are sport-specific and may not generalize cleanly from other overhead or racquet-sport contexts.

Recovery timelines and outcomes vary considerably by treatment pathway, injury history, and patient age [24, 25] - a standardized, one-size-fits-all return-to-play timeline is unlikely to fit this injury group well.

Injury prevention evidence, though still limited for tennis specifically, points toward practical directions consistent with the biomechanical loading mechanisms implicated in ulnar-sided wrist injury. Workload monitoring with wearable sensors and individualized grip-size fitting have each been shown to reduce upper-extremity overuse symptoms in tennis players [27, 28] - low-cost, readily implementable interventions. But these strategies were evaluated mostly against general upper-extremity or elbow outcomes rather than wrist-specific ones, and no study identified here directly tested whether they reduce TFCC or ECU pathology - a clear opening for future prevention research. Taken as a whole, the findings support a clinical approach that favors conservative management first-line where appropriate, reserves surgery for cases that fail nonoperative care, and treats workload management and equipment fitting as practical, evidence-supported preventive measures, while recognizing that the evidence base remains mostly observational, retrospective, and drawn from small patient cohorts.

5. Conclusions

Ulnar-sided wrist injury - TFCC tears and ECU instability - is a mechanistically plausible and clinically meaningful consequence of the wrist and forearm loading patterns generated by modern topspin-oriented tennis technique. The anatomical vulnerability of the TFCC and ECU subsheath to combined forearm rotation and wrist deviation lines up with the kinematic profile of Western and semi-Western grip strokes, helping to explain mechanistically why these grip styles show more ulnar-sided injury than classical Eastern-grip technique. Even so, the evidence remains correlational, and peak biomechanical load alone does not fully explain the injury patterns observed - grip style should be treated as one contributing factor among several, not the sole determinant of risk.

Clinically, MRI findings in the ulnar wrist should be interpreted cautiously in tennis players, given how much imaging abnormalities overlap between symptomatic and asymptomatic individuals; diagnosis should still rest on combining clinical history and examination with imaging rather than on imaging findings alone. Both conservative and surgical management offer favorable outcomes when appropriately indicated, supporting a treatment approach where conservative care stays first-line and surgery is reserved for cases that fail nonoperative treatment. Workload monitoring and individualized equipment fitting offer further, practical ways to reduce upper-extremity overuse risk, though dedicated wrist-specific prevention research in tennis is still needed. More broadly, the evidence behind these management and prevention strategies remains mostly observational and drawn from small, heterogeneous patient cohorts. Tennis-specific research - on structured conservative rehabilitation protocols, wrist-specific prevention interventions, and the longitudinal relationship between grip technique and injury onset in particular - would strengthen what clinicians managing this population have to work with.

Disclosure

All authors have read and agreed to the published version of the manuscript.

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