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RADIAL WRIST PAIN: A NARRATIVE REVIEW OF CONSERVATIVE AND SURGICAL TREATMENT STRATEGIES

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ABSTRACT

Radial wrist pain is a prevalent musculoskeletal complaint with a complex etiology involving soft tissue injury, degenerative changes, and fractures, particularly of the distal radius. This narrative review evaluates the efficacy, risks, and indications for conservative and surgical interventions by synthesizing data from over 12 clinical and systematic studies published between 2010 and 2024. Conservative treatment encompassing immobilization, NSAIDs, and physical therapy demonstrates substantial benefits in mild and non-displaced injuries, especially among elderly and pediatric patients. Surgical interventions, including arthroscopy, ligament reconstruction, and partial trapeziectomy, have shown improved outcomes in chronic, traumatic, or refractory cases. Specific advantages of minimally invasive techniques, such as 3A TFCC repair and percutaneous fixation, are highlighted. Treatment plans must consider age, functional demand, cost-effectiveness, and patient-specific pathology. The findings support a personalized and staged treatment approach for optimal recovery. Additionally, arthroscopic advancements have enabled more precise ligament reconstructions with less postoperative stiffness. Surgical techniques continue to evolve with the adoption of augmented reality guidance and intraoperative 3D imaging, promising even better alignment and outcomes.

KEYWORDS

Radial Wrist Pain, Conservative Treatment, Surgical Intervention, Distal Radius Fracture, TFCC, Arthroscopy

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Introduction

Radial-sided wrist pain represents a multifactorial clinical problem affecting a broad demographic, from young athletes to elderly patients with degenerative conditions. The radial aspect of the wrist includes structures such as the distal radius, scaphoid, scapholunate ligament, and the triangular fibrocartilage complex (TFCC), each of which can contribute to pain presentations. Epidemiological data suggest that distal radius fractures are among the most common upper limb injuries, especially in postmenopausal women due to osteoporosis. Moreover, chronic wrist pain is increasingly associated with overuse syndromes, particularly in occupations involving repetitive hand motions.

Diagnosis is challenging due to the anatomical complexity and overlapping clinical signs. Imaging tools such as radiography, ultrasound, and MRI have improved the accuracy of diagnosis, with clinical decision-making tools. Treatment options are generally divided into conservative and surgical approaches, the choice of which depends on patient age, injury severity, and activity demands. This review synthesizes current knowledge to guide evidence-based treatment planning across various patient subgroups.

Methods

This review followed a narrative approach to synthesize evidence regarding conservative and surgical treatment strategies for radial-sided wrist pain in adults. A systematic literature search was conducted across PubMed and Embase from January 2010 to March 2025. Search terms included’radial wrist pain', ’distal radius fracture', ’TFCC tear', ’arthroscopy', ’immobilization', and’pediatric wrist trauma'. Inclusion criteria comprised peer-reviewed articles in English, focusing on human subjects aged 12 years and older. We selected randomized controlled trials, systematic reviews, cohort studies, and large case series that specifically assessed treatment outcomes.

The primary outcome measures included pain reduction (measured by VAS or equivalent), functional scores (e.g., DASH, PRWE), range of motion, complication rates, and patient satisfaction. The review followed a PICO framework: Population (patients with radial wrist pain), Intervention (conservative or surgical treatment), Comparison (alternative strategy), and Outcome (clinical efficacy, safety). A total of 12 studies were selected after full-text screening and quality appraisal.

Results

Among conservative methods, wrist splinting and casting were the most commonly reported, particularly for conditions like minimally displaced distal radius fractures and early-stage TFCC lesions. In the SWIFFT trial, Dias et al. [2] demonstrated no significant benefit of surgical fixation over plaster casting for undisplaced scaphoid fractures. Similarly, manual reduction with small splints in pediatric distal radius injuries showed comparable outcomes to internal fixation.

Studies by Hemmati et al. and Karantana et al. [3] emphasized that NSAIDs and corticosteroid injections offered symptom relief in tendinopathies and tenosynovitis, although effects were often temporary. For more chronic cases, surgical interventions such as arthroscopic synovectomy, ligamentoplasty, or 3A TFCC reconstruction yielded favorable functional outcomes and pain reduction, particularly in active adults. Atzei et al. [4] described arthroscopic TFCC repair as a promising minimally invasive approach with a short rehabilitation window.

In pediatric populations, percutaneous Kirschner wire fixation and minimally invasive osteotomy for Monteggia fractures restored anatomic alignment with low complication rates. In contrast, elderly patients benefited from non-operative strategies, especially when comorbidities increased surgical risks. The DART study highlighted that elderly patients treated with casting had similar long-term outcomes to those treated surgically for distal radius fractures.

Overall, surgical techniques showed clear benefits in structural injuries, such as nonunion scaphoid fractures or irreparable ligament damage. Newer methods such as percutaneous fixation without grafting or external fixator-assisted correction are gaining popularity due to reduced morbidity and comparable outcomes.

Further analysis of the literature reveals targeted outcomes for specific pathologies. Chang et al. [8] supported the efficacy of surgical intervention in chronic TFCC lesions among high-demand patients, emphasizing restored wrist stability and a reduction in long-term disability.

In sports populations, Schöffl et al. [7] identified a high incidence of ligament injuries in climbers, advocating for early imaging and tailored management strategies. Moritomo et al. [6] argued for percutaneous pinning in unstable distal radius fractures, highlighting reduced complication rates compared to traditional ORIF techniques.

Treatment in Pediatric and Elderly Populations

Derksen et al. [10] argue that refraining from closed reduction in select distal radius fractures can minimize iatrogenic damage and unnecessary procedures in emergency settings.

Additionally, Abihssira et al. [11] emphasized that arthroscopic ligamentoplasty in younger patients with early trapeziometacarpal arthritis offers superior joint preservation and functional outcomes compared to open methods.

Pediatric patients with wrist injuries often benefit from conservative approaches due to high bone remodeling potential. Wang et al. [12] demonstrated that external fixator-assisted ulnar osteotomy in missed Monteggia fractures restored normal function in children with minimal complication rates. Manual reduction with traditional small splints has also been shown to be effective in non-complex distal radius fractures. In contrast, elderly patients frequently present with osteoporotic bone and comorbidities that limit surgical options. The DART study and subsequent analyses confirm that non-operative treatment of distal radius fractures yields comparable outcomes to surgical fixation in older populations. Patient preference, functional expectations, and fall risk should guide treatment planning in this cohort.

Advances in Arthroscopic Techniques

Arthroscopy has revolutionized the diagnosis and management of wrist pathology. Atzei et al. [4] introduced the 3A technique for all-inside arthroscopic reconstruction of irreparable TFCC tears, showing significant improvements in grip strength and pain scores. Yang et al. [1] emphasized the role of arthroscopic synovectomy in early inflammatory monoarthritis, which offers rapid symptom relief with minimal joint

trauma. Arthroscopic partial trapeziectomy combined with ligamentoplasty, as described by Abihssira et al. [11], preserved thumb mobility and reduced pain in younger patients with trapeziometacarpal arthritis. Such minimally invasive techniques reduce recovery time, risk of infection, and postoperative stiffness, making them increasingly preferred.

Partial wrist denervation, as described by Haugstvedt et al. [5], may alleviate chronic pain in complex wrist pathologies where reconstructive surgery is not viable.

Moritomo et al. [6] supported percutaneous pinning in unstable distal radius fractures, citing lower complication rates compared to ORIF.

Schöffl et al. [7] highlighted that ligament injuries are prevalent in rock climbers, underscoring the need for high-resolution imaging and early intervention.

Chang et al. [8] demonstrated that surgical treatment of chronic TFCC injuries restores wrist stability and reduces long-term disability in high-demand patients.

Meena et al. [9] provided a comprehensive overview of distal radius fracture classifications and management strategies, reinforcing the heterogeneity of radial-sided wrist pathologies.

Economic and Functional Outcomes

Multiple studies have assessed the cost-effectiveness and functional outcomes of conservative versus surgical treatments. Dias et al. [2] in the SWIFFT trial found that conservative management of scaphoid fractures was significantly less costly without compromising union rates or patient-reported function. The review by Karantana et al. [3] confirmed similar findings in distal radius fracture care, noting that percutaneous pinning did not confer a functional advantage over casting in older adults. Nonetheless, in highly active patients, faster return to work and sport often justifies the higher initial cost of surgical care. Treatment decisions must therefore weigh not only medical outcomes but also economic and quality-of-life impacts.

Discussion

The management of radial wrist pain must be individualized, as the etiology ranges from acute traumatic injuries to degenerative ligamentous pathologies. Our review highlights significant variation in outcomes depending on patient population, injury type, and intervention modality.

Randomized studies such as DRAFFT2 and the reviews by Karantana et al. [3] have consistently shown that conservative treatment of distal radius fractures in older adults results in functional outcomes similar to surgical fixation, with fewer complications.

In contrast, younger patients and high-performance individuals, including athletes benefit more from surgical intervention. Haddad et al. found that over 90% of athletes returned to baseline function after surgical management of wrist instability. This aligns with Chang et al. [8], who demonstrated superior grip strength and range of motion in patients undergoing surgical TFCC repair.

Ligamentous wrist injuries remain diagnostically challenging. When diagnosed early, dorsal capsulodesis and arthroscopic SL repair offer promising results..

Our findings confirm that arthroscopic interventions including synovectomy, ligamentoplasty, and partial denervation provide targeted, minimally invasive solutions. Atzei et al. [4] and Abihssira et al. [11] demonstrated favorable outcomes in both TFCC and thumb carpometacarpal instability cases.

Functional scores such as DASH and PRWE consistently improved across surgical groups managing ligamentous and TFCC pathologies. Moritomo et al. [6] advocated percutaneous pinning as a middle ground offering stability with reduced surgical trauma.

Ultimately, treatment should be guided by pathology, patient demand, and available resources. Pediatric fractures benefit from minimally invasive reductions and show high remodeling potential. Older adults tolerate casting well, but in chronic pain scenarios, partial denervation may be warranted.

Furthermore, Haugstvedt et al. [5] illustrated that partial wrist denervation can alleviate chronic pain in cases where reconstructive procedures are contraindicated or have failed.

It is also imperative to consider socioeconomic factors when formulating treatment plans. Access to physiotherapy, occupational therapy, or specialized surgical expertise varies widely across regions, influencing treatment outcomes. Consequently, contextualizing evidence-based recommendations within the healthcare infrastructure of the patient’s environment is key for equitable care delivery.

Emerging literature continues to reinforce the significance of shared decision-making in the management of radial wrist pain. Patients' occupational needs, lifestyle preferences, and tolerance for potential complications should be considered equally with radiological or clinical findings. Personalized care pathways

ensure that interventions, whether conservative or surgical, are more aligned with long-term satisfaction and functionality.

Furthermore, technological advancements such as dynamic ultrasound and high-resolution MRI allow for superior visualization of ligamentous and cartilaginous structures, particularly in ambiguous cases. The incorporation of these modalities into clinical protocols could reduce diagnostic delays and inappropriate interventions.

Radial wrist pain presents a unique diagnostic and therapeutic challenge due to its complex anatomical landscape and multifactorial etiologies. As such, there is an increasing emphasis on utilizing algorithm-based decision trees in clinical assessments to facilitate early identification of treatable causes. These tools integrate patient-reported outcomes with imaging findings, thereby enhancing diagnostic precision.

Conclusions

A patient-centered strategy that aligns with both evidence-based practice and individual expectations remains paramount. Moreover, integrating wearable technology for post-treatment monitoring could mark the next step in optimizing rehabilitation trajectories.

Radial wrist pain encompasses diverse conditions requiring a nuanced, evidence-based approach. Conservative management remains the first-line option in many low-demand cases and shows comparable efficacy to surgery for distal radius fractures in older patients. However, in high-demand individuals and cases of ligamentous instability or irreparable TFCC tears, arthroscopic and reconstructive surgical techniques yield superior outcomes in pain relief, function, and return to activity.

All therapeutic decisions must be individualized. Current evidence supports an algorithmic, pathology-specific strategy one that balances invasiveness, recovery time, patient age, and functional goals. While cost-effectiveness data favor non-operative approaches in older adults, surgical care remains indispensable in selected populations.

Future research should focus on high-quality randomized studies comparing modern arthroscopic techniques to traditional open procedures and long-term cost-effectiveness across patient demographics.

Furthermore, the integration of machine learning and AI-driven diagnostic tools shows promise in improving early identification of radial-sided wrist pathologies. Algorithms trained on large imaging datasets have achieved diagnostic accuracies comparable to experienced musculoskeletal radiologists. These tools could streamline triage and referral processes, ultimately reducing time to treatment and improving prognoses.

From a biomechanical standpoint, recent kinematic studies utilizing 3D motion analysis and dynamic MRI have revealed that subtle instabilities in the TFCC and scapholunate ligaments may go undetected in static imaging modalities. This has led to increased advocacy for incorporating dynamic assessments in the diagnostic process, particularly for athletes or manual laborers whose symptoms may only manifest under load or during specific movements.

In contrast, pediatric populations represent a demographic where growth plate preservation is critical. Intra-articular fractures involving the distal radius can have long-term consequences if not properly managed. Closed reduction and casting continue to serve as the gold standard, although newer data suggest that minimal fixation using bioresorbable pins may offer improved alignment in complex cases, without long-term interference with bone development.

Emerging evidence continues to support a tailored, patient-specific approach to radial wrist pain, particularly in populations with unique anatomical or physiological considerations. For example, elderly patients often present with comorbidities that complicate surgical interventions. A recent multicenter observational study noted that complications such as delayed wound healing and reduced bone mineral density significantly influence outcomes in older adults undergoing wrist surgeries. This reinforces the necessity of conservative care pathways in select geriatric patients, where the risk-benefit ratio does not favor aggressive surgical intervention.

Despite advances in management, several controversies persist. The threshold for operative intervention in partial TFCC injuries remains debated, as does the long-term efficacy of wrist denervation for chronic pain. There is also a paucity of longitudinal studies comparing modern arthroscopic procedures with traditional open techniques across various age groups. Future research should aim to standardize outcome measures, improve imaging interpretation accuracy, and evaluate the role of biologics in promoting soft tissue regeneration.

Rehabilitation and Return to Activity

Recent advancements in imaging technology have revolutionized the diagnosis of radial-sided wrist injuries. High-resolution MRI and 3D CT scans allow for precise delineation of soft tissue and osseous structures, aiding early detection of TFCC tears, occult fractures, and ligamentous disruptions. Studies emphasize the superiority of MRI arthrography in identifying partial tears and complex instabilities, guiding timely intervention. Ultrasound has also emerged as a cost-effective adjunct in dynamic assessment, especially in evaluating tendon subluxation or synovitis.

Advanced Imaging Techniques in Diagnosis

The radial side of the wrist plays a crucial role in maintaining stability, load distribution, and fine motor control. Structures such as the scaphoid, trapezium, and radial collateral ligament collectively contribute to the complex motion and load-bearing capacity of the wrist joint. Biomechanical studies highlight how disruptions in these elements either through fracture or ligamentous injury can significantly compromise grip strength, proprioception, and dexterity, particularly in activities involving radial deviation or weight bearing through the extended wrist.

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