RESEARCH PAPER

Functional and Radiological Outcome of Management of Intra-Articular Distal Radius Fractures by Volar Locking Plate Fixation

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ABSTRACT
This study evaluates the functional and radiological outcomes of intra-articular distal radius fractures managed with volar locking plate fixation. These fractures pose significant challenges due to articular involvement and instability. Volar plating offers stable fixation, enabling early mobilization and maintenance of anatomical alignment. Functional outcomes were assessed alongside radiological parameters to determine overall effectiveness. The findings demonstrate that volar locking plate fixation achieves satisfactory restoration of wrist anatomy, good functional recovery, and favorable radiological results, supporting its role as an effective treatment modality for these complex fractures.
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INTRODUCTION

Fractures of the distal radius represent one of the most common skeletal injuries encountered in adult orthopaedic practice and frequently involve the articular surface, making restoration of wrist anatomy and function a central therapeutic goal. The distal radius plays a critical role in load transmission across the wrist joint, forearm rotation, and coordinated hand movements; disruption of its articular congruity can therefore result in long-term functional impairment if inadequately managed. Contemporary understanding emphasizes that optimal outcomes depend not only on fracture union but also on accurate restoration of radial height, inclination, volar tilt, and joint surface alignment, which together influence wrist biomechanics and grip strength [1].

Intra-articular distal radius fractures are particularly challenging because of comminution, metaphyseal instability, and the risk of post-traumatic arthritis. Advances in fixation techniques have shifted management toward stable internal fixation, allowing early mobilization and improved functional recovery. Volar plating systems and locking compression plates have gained prominence by providing angular stability, maintaining reduction in osteoporotic and comminuted bone, and minimizing secondary displacement [2]. Comparative clinical studies have demonstrated superior radiological parameters and functional scores with volar plating when contrasted with conservative or less stable fixation methods [3].

The integration of functional outcome measures with radiological assessment has further refined evaluation

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strategies, highlighting that anatomical restoration correlates strongly with patient-reported wrist function and activity levels [4]. This evolving evidence base underscores the importance of systematic assessment of both functional and radiological outcomes following plating of intra-articular distal radius fractures, forming the foundation for focused clinical research in this domain.

Brief Overview

Intra-articular distal radius fractures constitute a distinct subset of wrist injuries characterized by disruption of the radiocarpal joint surface, often accompanied by metaphyseal comminution and instability. These fractures are clinically significant due to their propensity to impair wrist motion, grip strength, and overall hand function if anatomical restoration is inadequate. The condition affects a broad age spectrum, with bimodal distribution—high-energy trauma in younger adults and low-energy falls in the elderly—each presenting unique management challenges [5]. In older individuals, osteoporotic bone quality further complicates fracture stability and fixation, increasing the risk of loss of reduction with conservative treatment.

Classification systems such as the AO/OTA classification identify intra-articular fractures as type C injuries, emphasizing complete articular involvement and the need for precise reduction. Surgical stabilization using plating techniques has therefore become central to management, aiming to restore joint congruity and allow early mobilization. Although evidence from other intra-articular fracture models, such as distal femur fractures, reinforces the principle that stable fixation correlates with improved functional and radiological outcomes, the distal radius poses additional demands due to its complex biomechanics and role in fine motor activity [6].

Recent clinical studies focusing specifically on distal radius fractures treated with volar-locking plates have reported favorable union rates, maintenance of radiological alignment, and satisfactory functional recovery at mid- to long-term follow-up [7]. Indian institutional studies have echoed these findings, demonstrating that open reduction and internal fixation with locking volar plates offers reliable restoration of anatomy and function in intra-articular distal radius fractures [8].

Clinical Relevance

The clinical relevance of intra-articular distal radius fractures lies in their direct impact on wrist function, upper limb utility, and overall quality of life. The wrist is essential for activities requiring precision, strength, and coordination; therefore, residual deformity or joint incongruity following fracture healing can result in chronic pain, stiffness, reduced grip strength, and functional disability. Intra-articular involvement further increases the risk of post-traumatic osteoarthritis, making accurate reduction and stable fixation clinically imperative. Evidence from other intra-articular fracture models has demonstrated that the quality of fixation and restoration of articular anatomy significantly influence both radiological alignment and long-term functional outcomes, reinforcing the importance of appropriate surgical strategy selection [9].

In the context of distal radius fractures, volar locking plate fixation has emerged as a widely adopted technique due to its ability to provide stable fixation while permitting early mobilization. However, adjunctive techniques such as arthroscopic assistance have been explored to enhance reduction accuracy. Randomized controlled data indicate that while arthroscopy may improve visualization, it does not consistently translate into superior functional or radiographic outcomes when compared to standard volar plating alone, emphasizing the need to evaluate the true clinical benefit of advanced interventions [10].

Patient factors such as age and bone quality further influence treatment relevance. In elderly patients, alternative fixation methods like external fixation may offer acceptable outcomes in select cases, highlighting the ongoing debate regarding optimal management strategies and the necessity for context-specific outcome evaluation [11].

Burden (Global, National, Regional)

Distal radius fractures constitute a substantial component of the global musculoskeletal injury burden, accounting for a significant proportion of upper-limb fractures presenting to emergency and orthopaedic services. The burden is amplified when fractures extend into the articular surface, as intra-articular distal radius fractures are associated with higher rates of functional limitation, prolonged rehabilitation, and increased healthcare utilization. Globally, surgical management using volar locking plates has expanded due to consistent evidence demonstrating reliable restoration of radiological parameters such as volar tilt, radial height, and articular congruity, which are critical for favorable wrist mechanics [12].

At the national level, distal radius fractures represent a frequent indication for operative intervention in adult trauma care. Indian studies have highlighted a rising incidence related to road traffic injuries in younger populations and low-energy falls in older adults, resulting in a diverse clinical spectrum. Functional and radiological outcome analyses from Indian centres have shown that volar locking compression plating provides stable fixation with satisfactory union rates and meaningful improvement in wrist function, reducing long-term disability and dependence [13]. These findings underscore the growing surgical workload and resource implications for orthopaedic departments.

Regionally, tertiary and referral hospitals encounter a steady inflow of dorsally displaced and intra-articular distal radius fractures requiring operative management. Prospective institutional studies have demonstrated that timely open reduction and volar plate fixation not only improves patient-reported outcomes but also minimizes complications related to malunion and stiffness, thereby

reducing the socioeconomic impact of prolonged morbidity [14].

Current Gaps in Diagnosis / Knowledge

Despite advances in surgical techniques and implant design, several gaps persist in the diagnosis, decision-making, and outcome assessment of intra-articular distal radius fractures. One major area of uncertainty relates to optimal treatment selection across different patient subgroups, particularly the elderly. Randomized studies comparing conservative management with volar plating in older patients have reported variable functional advantages with surgery, raising questions about the consistency of benefit when weighed against surgical risks and rehabilitation demands [15]. This variability highlights the absence of universally accepted criteria to guide individualized treatment decisions based on fracture pattern, functional demand, and bone quality.

Another important gap lies in the limited integration of cost-effectiveness and functional outcomes in routine clinical decision-making. Comparative analyses between operative fixation using volar locking plates and nonoperative management have demonstrated differences not only in clinical outcomes but also in financial burden and resource utilization. However, such studies often originate from healthcare systems with differing economic structures, limiting direct applicability to local practice settings and underscoring the need for region-specific outcome data [16].

Furthermore, alternative fixation modalities such as intramedullary nailing have been explored as less invasive options for intra-articular distal radius fractures. Randomized trials comparing intramedullary devices with palmar locking plates have shown comparable outcomes in select fracture patterns, yet lack long-term functional correlation and standardized radiological benchmarks [17]. Collectively, these gaps emphasize the need for systematic evaluation of functional and radiological outcomes following plating to refine evidence-based management strategies.

Need for the Study

The need for focused evaluation of intra-articular distal radius fractures arises from the persistent variability in fracture patterns, fixation strategies, and reported outcomes despite advances in plating technology. Complex fracture configurations, particularly multi-fragmentary intra-articular injuries, often require individualized surgical approaches to achieve stable fixation and anatomical restoration. Studies evaluating combined palmar and dorsal plating have demonstrated encouraging radiological alignment and functional recovery in selected complex fractures; however, such approaches increase surgical exposure and may not be universally applicable across all clinical settings [18]. This underscores the necessity to critically appraise simpler, widely used plating techniques with standardized outcome measures.

Recent developments in implant design, including variable-angle volar rim plates, aim to address challenges related to distal fragment capture and subchondral support in complex intra-articular fractures. While early functional outcomes with these implants appear favorable, existing literature remains limited in terms of comparative evaluation and correlation between radiological restoration and patient-reported functional recovery [19]. Additionally, technical factors such as plate positioning have been shown to significantly influence tendon-related complications, maintenance of reduction, and overall clinical outcomes, highlighting the importance of meticulous surgical technique [20].

Given these considerations, there is a clear need for systematic assessment of functional and radiological outcomes following plating of intra-articular distal radius fractures using validated scoring systems. Such evaluation is essential to generate clinically relevant evidence that can guide implant selection, surgical planning, and postoperative expectations within routine orthopaedic practice.

Figure 1: Preoperative imaging of a comminuted intra-articular distal radius fracture showing a dorsal free fragment. (a) Anteroposterior and (b) lateral radiographs. (c) Sagittal CT image. (d) Three-dimensional CT reconstruction.

Source: https://link.springer.com/article/10.1186/s40001-020-00470-x

Diagnostic / Management Tools

Accurate diagnosis and effective management of intra-articular distal radius fractures rely on a structured integration of clinical evaluation, imaging modalities, and appropriate fixation techniques. Standard diagnostic work-up includes detailed clinical assessment of wrist deformity, swelling, neurovascular status, and associated injuries, supplemented by radiographic evaluation to define fracture morphology and articular involvement. Plain radiographs remain the primary imaging tool, while advanced imaging aids in identifying comminution and guiding surgical planning. From a management perspective, locking compression plate systems have become a cornerstone in treating comminuted intra-articular distal radius fractures due to their ability to provide stable fixation and maintain reduction, even in compromised bone quality [21].

The selection of a specific treatment modality is influenced by fracture pattern, patient factors, and surgeon expertise. Comparative institutional evaluations have demonstrated that open reduction and internal fixation using plating techniques offers superior restoration of radiological parameters and improved functional outcomes when compared with conservative methods in unstable intra-articular fractures [22]. These findings support the role of surgical fixation as a reliable tool for achieving early mobilization and functional recovery.

Within operative management, the choice between dorsal and volar plating continues to be an area of clinical consideration. Radiographic and functional evaluations have shown that low-profile volar plates generally provide comparable or improved outcomes with reduced extensor tendon complications when compared to dorsal plating, reinforcing their preferential use in routine practice [23]. Together, these diagnostic and management tools form the framework for systematic evaluation of treatment outcomes in intra-articular distal radius fractures.

Reporting / Classification Systems

Standardized reporting and classification systems are essential for the consistent evaluation and comparison of outcomes in intra-articular distal radius fractures. The AO/OTA fracture classification remains the most widely accepted system, categorizing complete intra-articular injuries as type C fractures and further subclassifying them based on complexity and comminution. This framework allows uniform communication of fracture severity, facilitates treatment planning, and enables meaningful comparison of outcomes across studies. Comparative analyses focusing on AO C3-type distal radius fractures have demonstrated that fracture classification directly influences healing patterns and long-term functional outcomes, particularly when different plating approaches are employed [24].

In addition to fracture classification, structured reporting of surgical technique and outcome measures has gained prominence. Arthroscopic-assisted volar plating has been evaluated as a method to enhance visualization of the articular surface and detect associated soft tissue injuries. However, pooled evidence from meta-analytical data suggests that while arthroscopy may aid intraoperative assessment, it does not consistently confer superior functional outcomes compared to conventional volar plating, reinforcing the need for standardized outcome reporting rather than procedural variation alone [25].

The Frykman classification categorizes distal radius fractures into eight types based on involvement of the radiocarpal and distal radioulnar joints and the presence of ulnar styloid fracture. By emphasizing articular disruption and ulnar column injury, it highlights factors influencing radiological alignment and functional outcome after distal radius fractures [26].

The Melone classification describes intra-articular distal radius fractures based on four principal fragments—radial shaft, radial styloid, dorsal medial, and volar medial (lunate facet). It highlights the critical role of medial column reconstruction in restoring radiocarpal congruity, stability, and functional outcome in complex intra-articular fractures managed surgically [18].

Equally important is the correlation between radiological alignment and patient-centered outcomes. Studies assessing parameters such as volar tilt, radial inclination, and ulnar variance have established that accurate radiological restoration is closely linked to functional recovery and patient-perceived wrist performance. This relationship underscores the importance of integrating validated functional scoring systems with radiological assessment to ensure comprehensive and reproducible outcome reporting [26].

Literature Support

The existing body of literature provides substantial support for operative management of intra-articular distal radius fractures, while also highlighting variability in outcomes based on fixation modality and fracture characteristics. Comparative studies evaluating external fixation versus plating have demonstrated that although external fixation may achieve acceptable fracture union, plating techniques generally offer superior restoration of articular congruity and improved functional outcomes, particularly in unstable intra-articular fractures [27]. These findings reinforce the growing preference for internal fixation when anatomical reduction is a priority.

Dorsal plating has historically been utilized for specific fracture patterns, especially those with dorsal comminution. Functional and radiological assessments of dorsal plating techniques have shown satisfactory alignment and union; however, concerns related to extensor tendon irritation and hardware prominence persist, limiting its widespread application [28]. Subsequent comparative analyses between dorsal and volar plating have indicated that volar approaches often provide comparable or better functional recovery with a lower complication profile, making them a more versatile option in routine clinical practice [29].

Further supporting this trend, large outcome-based studies evaluating volar angular stable locking plates have reported favorable early radiological outcomes, stable maintenance of reduction, and acceptable complication rates. Early complication profiling has emphasized the importance of implant design and surgical technique in minimizing tendon-related issues and ensuring consistent outcomes [30]. Collectively, these studies establish a robust evidence base supporting systematic evaluation of functional and radiological results following plating in intra-articular distal radius fractures, thereby justifying focused clinical investigation in this area.

Rationale of the Study

Intra-articular distal radius fractures pose a significant clinical challenge due to their complexity, propensity for articular incongruity, and potential to cause long-term functional impairment if inadequately managed. Although plating techniques—particularly volar locking plate fixation—are widely used, variability persists in reported functional recovery, radiological restoration, and complication profiles across different patient populations and fracture patterns. Furthermore, the correlation between radiological alignment and functional outcome remains an area requiring consistent, context-specific evaluation using validated assessment tools.

Most available evidence originates from heterogeneous study designs, varied fixation methods, and differing follow-up protocols, which limits the direct applicability

of outcomes to routine clinical practice. There is a clear need for prospective evaluation that simultaneously assesses radiological parameters and functional recovery over defined follow-up intervals, allowing a comprehensive understanding of treatment effectiveness. Additionally, systematic documentation of postoperative stiffness and complications is essential to refine patient counseling and postoperative rehabilitation strategies.

Therefore, this study is designed to evaluate the functional and radiological outcomes of intra-articular distal radius fractures managed by plating using standardized scoring systems and radiographic assessment. The findings are expected to provide clinically relevant data that can guide surgical decision-making, optimize patient outcomes, and contribute meaningful evidence to existing orthopaedic literature, thereby strengthening management protocols in similar clinical settings.

REVIEW OF LITERATURE

Intra-articular fractures represent a complex spectrum of musculoskeletal injuries in which disruption of the joint surface directly influences long-term function, alignment, and load transmission across the affected joint. Across orthopaedic trauma practice, plating has emerged as a preferred strategy for managing intra-articular fractures due to its ability to restore anatomical alignment, maintain reduction, and permit early mobilization. Evidence from other intra-articular fracture models, such as proximal tibial plateau fractures, has demonstrated that accurate radiological restoration achieved through plating is closely associated with improved functional outcomes, reinforcing the principle that joint congruity is central to post-injury recovery [31].

Within the wrist, intra-articular distal radius fractures pose unique challenges because of the complex biomechanics of the radiocarpal joint and the high functional demands placed on the hand. Loss of articular congruence, radial height, or volar tilt can lead to persistent pain, stiffness, reduced grip strength, and early degenerative changes. Contemporary fixation techniques have therefore focused on stable internal fixation that can reliably support comminuted fragments and preserve joint alignment throughout the healing phase. Clinical evaluations of volar plate fixation in intra-articular distal radius fractures have reported consistent fracture union with satisfactory functional recovery, highlighting the effectiveness of this approach in maintaining reduction and facilitating rehabilitation [32].

Functional outcome assessment has gained increasing importance alongside radiological evaluation, as patient-perceived recovery often reflects subtle deficits not apparent on imaging alone. Studies assessing distal radius fractures treated with volar plating have shown meaningful improvement in wrist motion and daily activity performance, emphasizing the relevance of combining objective radiographic parameters with validated functional scores [33]. More recent advances in implant design, including variable-angle locking plates, have further enhanced fragment fixation in complex intra-articular patterns. Clinical series evaluating these implants have demonstrated favorable radiological alignment and functional outcomes, supporting their role in modern fracture management [34].

Together, these observations form the foundation for systematic evaluation of functional and radiological outcomes following plating of intra-articular distal radius fractures.

Intra-articular distal radius fractures involve disruption of the radiocarpal joint surface and represent a clinically important subset of wrist injuries due to their potential to compromise joint congruity and wrist biomechanics. These fractures commonly arise from high-energy trauma in younger adults and low-energy falls in older individuals, resulting in varied fracture morphology, degrees of comminution, and instability. The involvement of the articular surface differentiates these injuries from extra-articular fractures and necessitates precise anatomical reduction to prevent long-term complications such as stiffness, chronic pain, and post-traumatic osteoarthritis. Prospective comparative studies have demonstrated that patient age influences fracture characteristics and recovery patterns, although stable internal fixation can yield satisfactory functional outcomes across age groups when reduction is adequately maintained [35].

Classification of intra-articular distal radius fractures is most commonly performed using the AO/OTA system, which categorizes these injuries as type C fractures with increasing complexity from C1 to C3. This classification aids in treatment planning and prognostication by reflecting the extent of articular involvement and comminution. Management strategies have evolved substantially, with plating techniques gaining preference over conservative methods due to their ability to provide rigid fixation and allow early mobilization. Comparative evaluations of dorsal-only versus combined volar and dorsal plating in complex AO type C fractures have shown that fixation strategy significantly influences radiological alignment and functional recovery, underscoring the need for appropriate implant selection based on fracture pattern [36].

Figure 2: Serial radiographs and functional outcome following volar locking plate fixation of distal radius fracture.
(a) Pre-operative radiograph, (b) immediate postoperative radiograph, (c) 6-week follow-up, (d) 12-week follow-up, (e) dorsiflexion, (f) palmar flexion.

Source:
volar_plating_in_distal_end_radius_fractures_and.8 (1).pdf [3]

The choice between volar and dorsal locking plates has been extensively debated, with complication profiles playing a major role in decision-making. Studies comparing these approaches have reported lower tendon-

related complications and comparable functional outcomes with volar plating, contributing to its widespread adoption in clinical practice [37]. Alternative fixation methods such as percutaneous Kirschner wire fixation have been used for select fracture patterns; however, comparative analyses indicate inferior functional stability and higher risk of secondary displacement in complex intra-articular fractures when compared to plate fixation [38]. Collectively, these factors define the clinical landscape of intra-articular distal radius fractures and frame the need for outcome-based evaluation of plating techniques.

The clinical relevance of intra-articular distal radius fractures is rooted in their substantial impact on wrist biomechanics, hand function, and patient quality of life. As the wrist plays a pivotal role in load transmission and fine motor activity, disruption of the articular surface can lead to persistent pain, reduced range of motion, diminished grip strength, and functional limitations in daily activities. Complex fracture patterns involving comminution and instability further increase the risk of suboptimal outcomes if anatomical restoration is not achieved. Recent clinical series evaluating combined dorsal and volar locking plate osteosynthesis in complex distal radius fractures have demonstrated that precise reconstruction of the articular surface is associated with improved radiological alignment and favorable functional recovery, highlighting the importance of stable fixation in such injuries [39].

Advances in volar locking plate design have expanded the armamentarium available to surgeons, allowing tailored fixation for marginal and distal fragments. Retrospective cohort analyses comparing commonly used volar locking plates have shown that implant selection can influence functional outcomes, particularly in fractures involving the volar rim or marginal fragments, where secure subchondral support is critical [40]. These findings emphasize that clinical relevance extends beyond fracture union to include implant biomechanics and their interaction with fracture morphology.

Institutional studies assessing volar plate fixation for intra-articular distal radius fractures have consistently reported meaningful improvement in functional scores and wrist motion, reinforcing the role of plating in restoring hand function and facilitating early return to activity [41]. Additionally, evaluations of locking compression plates have confirmed their ability to maintain reduction and achieve satisfactory radiological parameters, which correlate with patient-reported functional outcomes [42]. Together, these observations underscore the clinical importance of systematically evaluating both functional and radiological results following plating in intra-articular distal radius fractures.

Intra-articular distal radius fractures contribute substantially to the global burden of upper limb injuries, owing to their high incidence and potential for long-term functional impairment. These fractures frequently demand operative management because involvement of the articular surface predisposes patients to stiffness, chronic pain, and post-traumatic degenerative changes if anatomical reduction is not achieved. Globally, increasing emphasis has been placed on techniques that enhance articular visualization and fixation accuracy, including arthroscopic-assisted reduction combined with internal fixation. Outcome studies have demonstrated that such approaches can yield satisfactory radiological alignment and functional recovery, reflecting the growing complexity and resource utilization associated with managing these injuries [43].

At the national level, distal radius fractures represent a common indication for both conservative and operative treatment in orthopaedic practice. Randomized controlled trials comparing internal plate fixation with nonoperative methods in displaced complete articular fractures have shown superior functional and radiological outcomes with surgical fixation, reinforcing the shift toward operative management in unstable patterns. This transition has implications for healthcare infrastructure, rehabilitation services, and economic burden, as surgically treated patients often require structured follow-up and physiotherapy to optimize recovery [44].

Regionally, tertiary and referral centres frequently manage complex intra-articular fractures of the upper limb, including distal radius and distal humerus injuries, which share similar challenges in restoring joint congruity and function. Prospective outcome studies of dual plating in intra-articular fractures of adjacent joints highlight the broader burden of intra-articular trauma on orthopaedic services, emphasizing the need for standardized treatment protocols and outcome assessment [45]. Within the distal radius specifically, fracture subtypes such as volar Barton fractures represent a notable regional workload, with plating shown to provide reliable functional recovery and radiological stability when timely intervention is undertaken [46]. Collectively, these findings underscore the substantial and multifaceted burden of intra-articular distal radius fractures across global and local healthcare settings.

Despite considerable advances in implant technology and surgical technique, important gaps remain in the diagnosis, treatment selection, and outcome interpretation of intra-articular distal radius fractures. One persistent area of uncertainty concerns the management of comminuted articular fractures in older patients, where bone quality, fracture complexity, and functional expectations intersect. Prospective evaluations of volar plating in elderly patients have demonstrated satisfactory radiological restoration and functional recovery; however, variability in outcome measures and follow-up duration limits the ability to draw uniform conclusions regarding long-term joint preservation and functional durability [47]. This highlights the need for consistent assessment frameworks that integrate radiological and patient-reported outcomes.

Another gap relates to the extrapolation of evidence across fracture subtypes. While systematic reviews and meta-

analyses have robustly evaluated treatment strategies for extra-articular distal radius fractures, comparable high-level synthesis for intra-articular patterns remains limited. Differences in fracture biomechanics and instability mean that conclusions drawn from extra-articular fracture management cannot be reliably applied to intra-articular injuries, underscoring a deficiency in fracture-specific evidence to guide decision-making [48].

Additionally, the relationship between radiological correction and functional improvement is not always straightforward. Studies evaluating corrective osteotomy for distal radius malunion using fixed-angle volar locking plates have shown that radiological realignment does not invariably translate into proportional functional gains, suggesting that factors such as soft tissue adaptation and joint cartilage status play a significant role in recovery [49]. Furthermore, reports describing good to excellent functional outcomes following volar locking plate fixation often lack standardized radiological correlation or stratification by fracture complexity, limiting interpretability and external validity [50].

Collectively, these gaps emphasize the need for prospective, structured evaluation of both functional and radiological outcomes in intra-articular distal radius fractures, using validated tools and defined follow-up intervals to strengthen evidence-based clinical practice.

The management of intra-articular distal radius fractures continues to evolve; however, clear consensus regarding the relationship between radiological restoration and functional recovery remains lacking. Prospective evaluations have demonstrated that although acceptable radiological alignment is often achieved following surgical fixation, the extent to which these parameters translate into meaningful functional improvement varies across patient populations and fracture patterns [51]. This inconsistency underscores the need for structured studies that simultaneously assess radiological indices and validated functional outcomes over defined follow-up periods.

Randomized controlled trials comparing volar locking plates with alternative fixation strategies, such as augmented external fixation, have reported differences in functional recovery, complication rates, and rehabilitation timelines. While volar locking plates frequently demonstrate favorable early function and stability, variability in outcomes suggests that implant choice alone does not determine success and that fracture morphology and surgical technique significantly influence results [52]. In elderly patients with comminuted intra-articular fractures, emerging strategies such as distraction plating have shown promise in maintaining alignment, yet data remain limited and largely confined to small cohorts, highlighting the need for comparative outcome evaluation [53].

Institutional studies assessing newer implant designs, including variable-angle locking compression plates, have reported encouraging functional outcomes; however, heterogeneity in assessment tools and follow-up protocols restricts the generalizability of these findings [54]. Consequently, there is a clear requirement for a prospective, methodologically robust study that evaluates both functional and radiological outcomes of intra-articular distal radius fractures treated by plating. Such evidence is essential to refine surgical decision-making, optimize patient counseling, and establish contextually relevant outcome benchmarks within routine orthopaedic practice.

Effective management of intra-articular distal radius fractures requires a structured diagnostic approach combined with selection of fixation techniques that can reliably restore articular congruity and permit early functional rehabilitation. Diagnostic evaluation begins with detailed clinical assessment and standard radiographic imaging to delineate fracture morphology, displacement, and comminution. These findings guide selection of management strategies aimed at achieving stable fixation while minimizing complications. Over time, a variety of operative tools have been developed to address the diverse spectrum of distal radius fracture patterns.

Intramedullary fixation has been explored as a minimally invasive alternative to plate fixation, particularly for select fracture configurations. Systematic evaluations of fixed-angle intramedullary devices have demonstrated acceptable radiological outcomes and fracture union; however, concerns persist regarding their ability to control complex intra-articular fragments and maintain reduction in highly comminuted fractures [55]. Consequently, their use remains limited to carefully selected cases rather than routine application in intra-articular injuries.

Dorsal spanning plates and dorsal plate osteosynthesis have also been employed, especially in fractures with extensive comminution or dorsal instability. Radiographic outcome analyses of dorsal spanning plates have shown reliable maintenance of alignment in complex fracture patterns, particularly in non-elderly patients; however, the need for secondary procedures for plate removal and the risk of extensor tendon complications remain notable limitations [56]. Larger radiological series evaluating dorsal plate osteosynthesis have further highlighted its effectiveness in achieving alignment, while also emphasizing variability in outcomes depending on fracture complexity and plate positioning [57].

Volar locking anatomical plates have emerged as a widely accepted management tool due to their biomechanical stability, lower soft tissue morbidity, and ability to support early mobilization. Clinical evaluations of unstable distal radius fractures treated with volar locking plates have reported consistent maintenance of reduction and favorable functional recovery, reinforcing their role as a primary fixation method in contemporary practice [58]. Collectively, these diagnostic and management tools form the framework for outcome-based evaluation of intra-articular distal radius fracture treatment.

Standardized reporting and classification systems play a pivotal role in ensuring consistency, comparability, and interpretability of outcomes in distal radius fracture management. Accurate classification of fractures allows uniform communication regarding fracture severity, guides treatment selection, and facilitates meaningful comparison across clinical studies. Although multiple systems exist, the AO/OTA classification remains the most widely adopted, categorizing distal radius fractures based on articular involvement and comminution. This framework is particularly relevant for intra-articular fractures, where treatment outcomes are closely linked to the extent of joint surface disruption and stability achieved following fixation.

Beyond fracture classification, systematic reporting of radiological parameters is essential for outcome evaluation. Parameters such as radial height, radial inclination, volar tilt, and articular step-off provide objective measures of anatomical restoration. Comparative observational studies assessing these radiological outcomes across different fixation methods have demonstrated that volar locking plate fixation more consistently restores and maintains these parameters compared with percutaneous fixation or cast immobilization, highlighting the importance of standardized radiographic reporting in outcome assessment [59]. Such structured radiological evaluation enables correlation with functional recovery and long-term joint health.

Functional outcome reporting further complements radiological assessment, as patient-centered recovery may not always parallel imaging findings. Randomized trials evaluating immobilization strategies in distal radius fractures have underscored the role of validated functional scoring systems in capturing differences in wrist motion, strength, and daily activity performance that may not be evident radiographically [60]. Similarly, comparative analyses of operative techniques, including dorsal distraction plating, external fixation, and volar plating, rely on uniform reporting standards to accurately interpret differences in outcomes and complication profiles [61].

Studies comparing external fixation with volar plating have emphasized that consistent classification and outcome reporting are crucial to discerning true treatment-related differences rather than methodological variability [62]. Collectively, these reporting and classification systems form the foundation for reliable evaluation of functional and radiological outcomes, reinforcing their essential role in structured clinical research on distal radius fractures.

The contemporary literature provides robust support for systematic evaluation of both radiological and functional outcomes in the management of intra-articular distal radius fractures. Long-term follow-up studies have demonstrated that radiological restoration achieved at the time of fracture union has a sustained influence on wrist function years after injury. Evidence indicates that parameters such as volar tilt, radial inclination, and articular congruity are strongly associated with patient-reported functional outcomes even at extended follow-up, emphasizing that early anatomical correction has lasting clinical significance [63]. These findings reinforce the importance of meticulous surgical technique and objective radiological assessment in outcome-based fracture management.

Dorsal wrist plating continues to be reported as an effective fixation strategy for select intra-articular fracture patterns, particularly those with predominant dorsal comminution. Recent clinical reports have shown that dorsal plating can achieve satisfactory articular reduction and functional recovery when applied appropriately, although careful consideration of implant placement and soft tissue handling is required to minimize extensor tendon complications [64]. Such studies contribute to the broader understanding of fixation options and highlight the necessity of individualized treatment planning based on fracture morphology.

Comparative evaluations of multiple treatment modalities, including conservative management, external fixation, and internal fixation with plates, have further clarified the advantages of stable internal fixation in complex intra-articular fractures. Functional outcome analyses across these modalities consistently demonstrate superior wrist motion, grip strength, and activity performance in patients managed with operative fixation, particularly plating techniques, when compared to nonoperative approaches [65]. These comparative data support the growing preference for plating in unstable intra-articular injuries.

Additionally, reviews focusing on internal radiocarpal distraction plating have expanded the evidence base for managing highly comminuted fractures. While distraction plating offers reliable alignment maintenance in select cases, literature emphasizes its role as a specialized technique rather than a universal solution [66]. Collectively, existing studies underscore the relevance of structured functional and radiological outcome assessment, providing a strong evidence foundation for focused clinical research in intra-articular distal radius fractures.

Optimal management of intra-articular distal radius fractures remains a subject of ongoing evaluation because functional recovery depends on multiple interrelated factors, including fracture reduction quality, stability of fixation, rehabilitation protocols, and patient-specific characteristics. Despite advances in surgical techniques, variability persists in postoperative wrist motion, strength, and patient-reported outcomes, underscoring the need for structured outcome assessment. Rehabilitation-focused literature has emphasized that functional recovery following distal radius fractures is closely linked to early stability and restoration of joint mechanics, rather than fracture union alone, highlighting the importance of fixation strategies that permit timely mobilization [67].

Several clinical studies evaluating volar locking plate fixation in intra-articular distal radius fractures have

reported favorable functional outcomes; however, these findings are often influenced by heterogeneity in fracture patterns, outcome measures, and follow-up duration. While improvements in wrist range of motion and daily activity performance have been demonstrated, inconsistency in correlating these functional gains with radiological parameters limits the generalizability of results [68]. This highlights the need for prospective studies that concurrently evaluate functional scores and radiographic alignment using standardized protocols.

Comparative investigations between volar plating and alternative fixation methods, such as bridging external fixation, have further revealed differences in stability, complication rates, and functional recovery. Although both techniques can achieve fracture union, volar plating has been associated with earlier functional improvement and better maintenance of articular congruity in many intra-articular fracture patterns [69]. Additionally, for complex AO type C3 fractures, debates persist regarding the optimal surgical approach, with studies comparing dorsal and volar plating reporting varied outcomes depending on fracture morphology and reduction strategy [70].

Given these considerations, a focused evaluation of functional and radiological outcomes following plating of intra-articular distal radius fractures is warranted. Such analysis is essential to clarify the relationship between anatomical restoration and functional recovery, guide surgical decision-making, and refine treatment strategies to achieve consistent and clinically meaningful outcomes in routine orthopaedic practice.

Previous Studies

Kumar BV et al. (2025) conducted a prospective observational study to evaluate the correlation between radiological outcomes and functional recovery in patients with treated distal radius fractures. The study was carried out in a tertiary orthopaedic care setting and included 60 adult patients with distal radius fractures who had completed a minimum follow-up of six months. Fractures were classified using the AO classification system, and patients were divided into three equal groups based on treatment modality: conservative management with cast, external fixation, and plate fixation.

Radiological outcomes were assessed using Sarmiento et al.'s modification of Lidström's scoring system, while functional outcomes were evaluated with the Modified Mayo Wrist Scoring System. Statistical analysis included Pearson's correlation coefficient and simple linear regression to determine the predictive value of radiological parameters on functional outcomes. Analysis of Variance (ANOVA) was used to compare demographic variables, fracture types, and outcome scores across treatment groups.

The majority of patients achieved excellent or good radiological and functional outcomes. No statistically significant differences were observed in age, follow-up duration, or functional scores across fracture types or treatment methods. Radiological scores, however, differed significantly between treatment groups, with external fixation demonstrating poorer radiological outcomes compared to casting and plating. A strong inverse correlation was observed between radiological and functional scores ($r = -0.743$, $p < 0.001$). The regression model was statistically significant with an R^2 value of 0.552, indicating good predictive ability. The study concluded that plate fixation offers better anatomical restoration and facilitates early mobilization, and that radiological alignment shows a strong correlation with functional outcomes in distal radius fractures. [1]

Muhammad G et al. (2025) conducted a cross-sectional observational study to evaluate the radiological, functional, and clinical outcomes of volar plate fixation in patients with intra-articular distal radius fractures. The study was carried out at a tertiary care hospital in Quetta over a two-year period from August 2022 to August 2024. A total of 55 adult patients with displaced intra-articular distal radius fractures were included. Fractures were classified using the AO classification system, and all patients were treated surgically with volar locking plate fixation.

Functional outcomes were assessed using the Modified Mayo Wrist Score, while radiological union and complications were evaluated during follow-up visits at 2 weeks, 6 weeks, 3 months, and 6 months. The mean age of the study population was 37.2 ± 10.05 years, with AO type 23-C2 fractures being the most common fracture pattern, accounting for 41.8% of cases. Radiological union was achieved in 98.2% of patients, with a mean union time of 11.98 ± 1.64 weeks.

Functional assessment demonstrated favorable outcomes, with 67.2% of patients achieving good results and 27.2% achieving very good results. The complication rate was low, with reported complications including median nerve neuropathy in 1.8%, wound dehiscence in 3.6%, and superficial infection in 11% of cases. The authors concluded that volar plate fixation is an effective and reliable treatment modality for intra-articular distal radius fractures, providing high union rates, satisfactory functional recovery, and a low incidence of complications. [32]

Yalçın M et al. (2025) conducted a retrospective comparative study to evaluate the radiographic outcomes, functional recovery, and complication profile of dorsal-only plating versus combined volar and dorsal plating in the management of AO type C distal radius fractures. The study was carried out at a tertiary orthopaedic center and included 18 adult patients treated between 2021 and 2024. Based on the surgical approach used, patients were divided into two groups: Group A comprising 12 patients treated with dorsal-only plating, and Group B comprising 6 patients managed with combined volar and dorsal plating.

Radiographic assessment included evaluation of radial inclination, radial height, palmar tilt, and ulnar variance, comparing preoperative and postoperative alignment. Clinical evaluation focused on wrist range of motion, grip

strength, and functional outcome scores using the Quick DASH and Mayo Wrist Score. Postoperative complications such as extensor tendon irritation, implant removal, compartment syndrome, and reflex sympathetic dystrophy were systematically recorded.

The results demonstrated that both groups achieved significant improvement in radiographic parameters postoperatively, with no statistically significant difference between dorsal-only and combined plating in terms of alignment or joint congruity. Functional outcomes were largely comparable between groups; however, grip strength was significantly higher in the dorsal-only plating group ($p = 0.037$). Complications were more frequent in the combined plating group, including cases of compartment syndrome and reflex sympathetic dystrophy. The authors concluded that dorsal-only plating provides radiographic and functional outcomes comparable to combined volar/dorsal plating, with a lower complication rate, suggesting it as a reliable and less morbid treatment option for AO type C distal radius fractures. [36]

Iqbal MF et al. (2025) conducted a descriptive observational study to evaluate the functional outcomes of distal radius fractures treated with volar locking plate fixation and to analyze factors influencing recovery. The study was carried out at the Department of Orthopaedic Surgery, Ghurki Trust Teaching Hospital, Lahore, over a six-month period from December 2024 to May 2025. A total of 80 adult patients with displaced distal radius fractures were enrolled using consecutive sampling. All patients underwent open reduction and internal fixation with a volar locking plate through the Henry approach.

Functional outcomes were assessed at three months postoperatively using the Mayo Wrist Scoring System. Based on scores, patients were categorized into good-to-excellent (≥80) and fair-to-poor (<80) outcome groups. The study also evaluated the influence of effect modifiers including age, gender, diabetes status, smoking, body mass index, and fracture type on functional recovery, using the Chi-square test for statistical analysis.

The mean age of the study population was 36.4 ± 12.7 years, with males constituting 83.8% of cases. Overall, 75% of patients achieved good-to-excellent functional outcomes at three months. Younger patients (<40 years), non-diabetics, and non-smokers showed significantly better functional recovery ($p < 0.05$). Gender, BMI, and fracture type did not demonstrate a statistically significant association with outcome. The authors concluded that volar locking plate fixation provides stable anatomical reduction, facilitates early rehabilitation, and results in a high rate of satisfactory functional outcomes in distal radius fractures. [50]

Bhosale JP et. al., (2025) conducted a retrospective observational study to compare radiological outcomes of extra-articular distal end radius fractures treated by volar locking plate fixation versus percutaneous Kirschner wire fixation with cast application. The study was carried out at Symbiosis Medical College for Women, Pune, Maharashtra, and included 81 adult patients aged over 18 years who were treated for extra-articular distal radius fractures between January 2021 and December 2023. Fractures were classified as AO type 2R3A2 and 2R3A3.

Patients were divided into two treatment groups: 37 patients underwent closed reduction followed by percutaneous K-wire fixation and cast immobilization, while 44 patients were managed with open reduction and internal fixation using a volar locking plate through the Henry approach. Radiological outcomes were assessed at three months postoperatively using digital radiographs analyzed via the Picture Archiving and Communication System. The primary parameters evaluated were radial height, radial inclination, and volar tilt.

Statistical analysis was performed using SPSS version 20, with significance set at $p < 0.01$. The mean age was higher in the K-wire group (54.72 years) compared to the volar plating group (42.59 years). The study demonstrated that volar plating resulted in significantly better restoration of all radiological parameters compared to K-wire fixation ($p < 0.001$), indicating a lower likelihood of malunion. The authors concluded that volar locking plate fixation provides superior radiological outcomes compared to percutaneous K-wiring and casting in extra-articular distal radius fractures. [59]

Emet A et al. (2024) conducted a prospective observational study to evaluate the influence of volar fixed-angle plate positioning on radiological parameters and functional outcomes in patients with distal radius fractures treated surgically. The study included 58 patients with 64 distal radius fractures, with a mean age of 46.9 years, and a mean follow-up duration of 24.9 months. Patient demographics, fracture characteristics, surgical details, and postoperative radiographic data were systematically collected.

Immediate postoperative anteroposterior and lateral wrist radiographs were analyzed to assess volar tilt, radial inclination, and radial height as indicators of fracture reduction. During final follow-up, clinical assessment included wrist flexion and extension range of motion and functional evaluation using the Mayo Wrist Score. Additionally, technical parameters such as the distance of the plate from the joint line and the angle between the plate and the radial shaft were measured to determine their relationship with functional outcomes.

Statistical analysis demonstrated a significant association between radial inclination and plate–shaft angle with Mayo Wrist Scores at a 99% confidence interval. Radial height also showed a positive association at a 90% confidence interval. Logistic regression analysis revealed that increased radial inclination significantly improved the likelihood of achieving a good-to-excellent Mayo Wrist Score (OR = 1.28, $p = 0.004$). Plate distance from the joint line showed a marginally positive association, while an increased plate–shaft angle was negatively associated with functional outcomes, remaining significant on multivariate analysis.

The study concluded that radial inclination, plate position relative to the joint line, and plate–shaft alignment are critical determinants of functional recovery following volar fixed-angle plating of distal radius fractures, emphasizing the importance of precise implant placement for optimal clinical outcomes. [20]

Eldadamouny ME et al. (2024) conducted a quasi-experimental interventional study to evaluate the functional and radiological outcomes of arthroscopic-assisted reduction and fixation in patients with intra-articular distal radius fractures. The study was carried out at a tertiary orthopaedic center and included 26 patients who fulfilled predefined inclusion criteria. The rationale for using an arthroscopic-assisted approach was to allow direct visualization of the articular surface, assess associated ligamentous injuries, and remove intra-articular loose fragments, thereby potentially improving fracture reduction and functional recovery.

All patients underwent standardized preoperative evaluation, arthroscopic-assisted fracture reduction and fixation, followed by structured postoperative care and scheduled follow-up assessments. Functional outcomes were assessed using range of motion measurements, Disabilities of the Arm, Shoulder, and Hand (DASH) score, and Patient-Rated Wrist Evaluation (PRWE) score at multiple time points up to 12 months. Radiological parameters and associated intra-articular injuries were also documented.

The results demonstrated significant improvement in wrist range of motion over time, with flexion increasing from 42.81° ± 11.81° at six weeks to 54.23° ± 14.95° at 12 months, and extension improving from 56.88° ± 13.28° to 68.38° ± 13.43° ($p < 0.001$). DASH and PRWE scores showed marked reduction in disability and wrist-related symptoms over follow-up. Chronic illnesses and associated injuries such as triangular fibrocartilage complex tears negatively influenced outcomes, while age, ulnar variance, and palmar tilt showed significant correlations with functional scores. The authors concluded that arthroscopic-assisted reduction and fixation yields favorable functional and radiological outcomes in intra-articular distal radius fractures, while emphasizing the need for further comparative and long-term studies. [43]

Panat R et al. (2024) conducted a prospective randomized controlled observational study to assess the surgical and functional outcomes of dorsal distraction plating in the management of intra-articular comminuted distal end radius fractures in elderly patients. The study was carried out over a period of three years and included 50 patients diagnosed with AO classification type C intra-articular distal radius fractures, characterized by extensive metaphyseal–diaphyseal comminution. All patients were treated using radio-metacarpal distraction plating, and a minimum follow-up of six months was ensured for outcome evaluation.

Clinical and functional assessment focused on fracture union, wrist range of motion, implant-related issues, and postoperative complications. Functional outcomes were finally evaluated using the Disabilities of the Arm, Shoulder, and Hand (DASH) score. The mean fracture union time was 8.65 ± 0.93 weeks, and implant removal was performed at an average of 8.75 ± 0.85 weeks. All patients achieved full wrist range of motion following implant removal, with maintained articular congruity.

Complications were minimal, with superficial infection reported in 6.67% of patients and complex regional pain syndrome in 6.67%. No cases of tendon irritation, neuropraxia, wrist or finger stiffness, nonunion, malunion, or implant failure were observed. Functional assessment demonstrated excellent or good outcomes in all patients, with 20% achieving excellent results and 80% achieving good results based on DASH scores. The authors concluded that distraction plating is a reliable and effective option for managing complex intra-articular comminuted distal radius fractures in elderly patients, providing stable fixation, early functional recovery, and a low complication rate. [53]

Brauns J and Vandesande W (2024) conducted a prospective single-surgeon study to evaluate the functional and radiological outcomes of dorsal wrist plating in the management of intra-articular distal radius fractures with dorsal displacement. The study included 20 patients with partially or completely intra-articular distal radius fractures characterized by dorsal rim avulsion or dorsal Barton's type fragments. All patients underwent open reduction and internal fixation using dorsal wrist plating. Of these, 17 patients completed a minimum follow-up of 12 months, with a mean follow-up duration of 17 months, and were included in the final analysis.

Functional outcomes were assessed using range of motion measurements, grip strength, key pinch strength, Mayo Wrist Score, and Disabilities of the Arm, Shoulder and Hand (DASH) score. Radiological evaluation focused on articular congruity, radial inclination, palmar tilt, and radial shortening. The total wrist range of motion achieved was 92% of the contralateral side. Mean grip strength was 24.6 kg and key pinch strength was 6.9 kg, compared to 29.5 kg and 7.4 kg on the non-operated side. The mean Mayo Wrist Score was 89.7, while the mean DASH score was 4.5, indicating excellent functional recovery.

Radiologically, articular step-off was observed in only two patients (1–2 mm). Radial inclination was restored in all cases, and palmar tilt was either anatomically or acceptably restored without significant radial shortening. No major complications such as infection, tendon rupture, complex regional pain syndrome, or nonunion were reported. The authors concluded that dorsal wrist plating is a safe and reliable technique for intra-articular distal radius fractures with dorsal displacement, providing satisfactory anatomical restoration and functional outcomes. [64]

Verma A et al. (2023) conducted a prospective observational study to evaluate the functional and radiological outcomes of intra-articular fractures of the

distal end of the radius managed with open reduction and internal fixation using a locking distal radius volar plate. The study was carried out at a tertiary orthopaedic care center and included 35 patients with clinico-radiologically confirmed intra-articular distal radius fractures. All enrolled patients were followed up for a minimum duration of six months after surgical intervention.

The study focused on unstable intra-articular fracture patterns in which closed reduction techniques were inadequate to restore and maintain articular congruity and radiological parameters. All patients underwent open reduction followed by fixation with a volar locking plate. Postoperative evaluation included both functional and radiological assessment during follow-up visits, and the collected observations were systematically documented.

Functional outcomes were primarily assessed using the Quick Disabilities of the Arm, Shoulder, and Hand (Quick DASH) score, while radiological assessment focused on maintenance of reduction and restoration of wrist alignment parameters. The results demonstrated that 88.6% of patients achieved excellent to good functional outcomes based on Quick DASH score grading. Importantly, there was no significant loss of radiographic reduction during the follow-up period, and patients exhibited a sustained improvement in wrist range of motion over time.

The authors concluded that volar plate fixation is a reliable and effective treatment modality for intra-articular distal radius fractures, offering stable fixation, optimal anatomical restoration, and satisfactory functional recovery with minimal complications. The study supports the use of volar locking plates as a favorable option in the management of unstable intra-articular distal radius fractures. [8]

Shaikh SA et al. (2023) conducted a randomized controlled trial to compare the clinical and radiological outcomes of conservative management with plaster cast versus volar plate fixation in elderly patients with dorsally displaced distal radius fractures. The study was carried out at Jinnah Postgraduate Medical Centre over a five-year period from February 2015 to April 2020. Patients aged more than 60 years and less than 75 years, presenting with isolated, closed, unilateral, dorsally displaced distal radius fractures, were included. Participants were randomized into two treatment groups—casting or volar plating—using a computer-generated algorithm stratified by age and AO/OTA fracture classification.

The primary outcome measure was the Patient Rated Wrist Evaluation (PRWE) score, while secondary outcomes included wrist range of motion, grip strength, Mayo Wrist Score, and Quick Disabilities of the Arm, Shoulder, and Hand (Quick DASH) score. Patient satisfaction was assessed using the SF-12 questionnaire, and postoperative complications were documented. Follow-up assessments were conducted at six months and one year.

The results demonstrated no statistically significant difference in clinical or patient-reported outcomes between the two treatment groups at both follow-up intervals. However, radiological parameters were significantly inferior in the casting group, and the incidence of complications was higher compared to the volar plating group. Despite these differences, patient satisfaction levels were comparable. The authors concluded that both casting and volar plating are effective in achieving satisfactory functional outcomes in elderly patients, although volar plating offers better radiological alignment and fewer complications. [15]

Naik A et al. (2023) conducted a prospective observational study to evaluate the functional outcomes of different treatment modalities used for intra-articular fractures of the distal end of the radius in adults. The study was carried out at the Department of Orthopaedics, Kalinga Institute of Medical Sciences, Bhubaneswar, over a two-year period from October 2017 to September 2019. A total of 124 patients with 126 intra-articular distal radius fractures who met predefined inclusion and exclusion criteria were enrolled.

Patients underwent various treatment interventions, including conservative management and surgical fixation, based on fracture characteristics and clinical judgment. All cases were followed up for 12 months with regular clinical and radiological evaluations. Functional outcomes were assessed using standardized functional grading and pain scoring systems, while radiological outcomes were evaluated based on fracture union status.

The majority of patients belonged to the 20–40 years age group, followed by those aged 61–80 years, reflecting a bimodal age distribution. Grip strength was significantly better in the surgically treated group, reported in 79.2% of patients. Mode of treatment showed a statistically significant association with wrist movements, including palmar flexion ($p = 0.015$), supination ($p = 0.025$), and pronation ($p < 0.001$), favoring surgical management. Patients treated with plating experienced significantly less pain compared to other modalities ($p = 0.012$). The mean functional score in the surgical group was 19.8.

The authors concluded that surgical management, particularly plating, offers superior functional recovery, improved range of motion, reduced pain, and a lower risk of malunion, thereby contributing to better prognosis and quality of life in patients with intra-articular distal radius fractures. [22]

Rani B and Singh AK (2023) conducted a prospective analytical comparative study to evaluate and compare the radiological and functional outcomes of volar plating versus dorsal plating in the management of dorsally displaced distal radius fractures. The study was carried out at a tertiary care hospital and included 30 patients presenting to the orthopaedic outpatient department and emergency services. Fractures were classified using both AO/OTA and Frykman classification systems, ensuring standardized assessment of fracture patterns.

Patients underwent open reduction and internal fixation using either volar or dorsal plating techniques. Postoperative radiological outcomes were assessed using Lidström scoring, while functional outcomes were evaluated during follow-up, focusing on wrist range of motion and overall functional recovery. Statistical analysis was performed with a significance level set at $p = 0.05$ and a confidence level of 80%.

The results showed that acceptable fracture reduction was achieved in all patients postoperatively. In the dorsal plating group, Lidström scoring demonstrated excellent reduction in 7 patients and good reduction in 9 patients. In the volar plating group, 5 patients achieved excellent reduction and 8 patients achieved good reduction, with one patient showing fair reduction due to dorsal collapse. The difference in radiological outcomes between the two groups was not statistically significant ($p = 0.5314$). Functionally, all patients in both groups achieved good to excellent outcomes at final follow-up. However, patients treated with volar plating demonstrated better wrist range of motion compared to those managed with dorsal plating.

The authors concluded that both volar and dorsal plating yield satisfactory radiological and functional outcomes, though volar plating may offer an advantage in achieving improved wrist mobility. [29]

Amin TK et al. (2023) conducted a prospective observational study to evaluate the radiological and functional outcomes of intra-articular proximal tibial plateau fractures treated with plate fixation. The study was carried out at a tertiary orthopaedic institute and included 53 adult patients admitted between June 2018 and May 2020. All fractures were classified according to the Schatzker classification system, and patients were treated surgically using proximal tibial periarticular locking plates. A minimum follow-up period of six months was maintained for outcome assessment.

Clinical outcomes were assessed using the Knee Society Score, which includes both knee score and functional knee score components. Radiological evaluation focused on fracture union, articular reduction, and limb alignment. The average knee score achieved was 89.30 (range 79–93), while the mean functional knee score was 97.92 (range 75–100). Based on Knee Society Score grading, 96.23% of patients demonstrated excellent outcomes, and 3.77% showed good outcomes, indicating a high rate of favorable functional recovery. Radiological union was observed at an average of 14 weeks postoperatively.

Postoperative complications were noted in 9 patients, though the majority achieved stable fixation and satisfactory alignment without major adverse outcomes. The authors concluded that fixation of intra-articular proximal tibial plateau fractures with locking compression plates provides biological and stable fixation, ensures accurate articular reduction, and maintains limb alignment even in complex fracture patterns. Overall, plating was found to yield excellent to good functional and radiological outcomes in the management of intra-articular proximal tibial plateau fractures. [31]

Arora S et al. (2022) conducted a prospective observational study to evaluate the functional and radiological outcomes of intra-articular distal radius fractures treated with volar variable angle locking plates (VALCP). The study included 28 adult patients with intra-articular distal radius fractures who underwent surgical fixation using a volar variable angle locking plate. The mean age of the patients was 33.24 ± 11.74 years (range 22–64 years), and the mean follow-up duration was 12.18 ± 2.64 months.

Radiological assessment focused on key wrist alignment parameters including volar tilt, radial inclination, radial length, and ulnar variance, evaluated on radiographs obtained at six weeks and six months postoperatively. Functional assessment was performed at regular intervals—two weeks, six weeks, three months, and six months—using standardized clinical evaluation, with the final functional outcome measured at six months using the Gartland and Werley scoring system.

The results demonstrated a consistent and progressive improvement in functional parameters, with significant gains observed within the first 12 weeks following surgery. Radiological indices remained well maintained throughout follow-up, with no significant deterioration noted at six months. According to Gartland and Werley scores, 75% of patients achieved excellent outcomes, 14.28% good, 7.14% fair, and 3.57% poor results. Complications were minimal and included one case of superficial infection, one case of screw impingement requiring implant removal, and one case of complex regional pain syndrome.

The authors concluded that volar variable angle locking plate fixation facilitates early rehabilitation and provides stable radiological alignment with favorable functional outcomes in intra-articular distal radius fractures. [34]

Patel S et al. (2022) conducted a prospective observational study to assess the functional and radiological outcomes of comminuted intra-articular distal radius fractures treated with locking compression plates (LCPs). The study was carried out in a tertiary care orthopaedic setting and included 30 patients (18 males and 12 females) diagnosed with comminuted intra-articular distal radius fractures. All patients underwent open reduction and internal fixation using locking compression plates and were followed up at regular intervals of 3, 6, 12, and 24 weeks postoperatively.

Functional outcomes were evaluated using the Modified Mayo Wrist Score, while radiological outcomes were assessed using Lindström criteria, focusing on maintenance of volar tilt and radial inclination. Radiological assessment demonstrated satisfactory maintenance of reduction, with no loss of tilt or inclination greater than two degrees even after three months. Functionally, patients across all age groups showed early

improvement in wrist range of motion and daily activity performance.

At six months follow-up, patients reported minimal to no pain and were able to return to their pre-injury occupational activities with little difficulty. Compared to early postoperative assessment at three weeks, improvements at six months included a 15% increase in range of motion, 7.8% improvement in work status, and a 56% increase in grip strength. The study highlighted that although long-term outcomes may be comparable across treatment modalities, LCP fixation offers earlier functional recovery and stable anatomical restoration in comminuted intra-articular distal radius fractures.

The authors concluded that locking compression plates provide reliable fixation with a lower complication risk, improved pain control, and faster functional rehabilitation, making them a favorable option for managing complex distal radius fractures. [21]

Shihab Z et al. (2022) performed a systematic review and meta-analysis to compare the outcomes of arthroscopic-assisted volar locking plate (VLP) fixation versus fluoroscopic-assisted VLP fixation in the management of distal radius fractures. The study synthesized evidence from published literature to determine whether arthroscopy provides additional radiological or functional benefits when used as an adjunct during volar plating.

A comprehensive literature search was conducted across multiple databases, including Medline, EMBASE, Scopus, and Cochrane, covering publications from inception until May 2020. Six eligible studies involving a total of 280 patients met the inclusion criteria. A random-effects meta-analysis was employed to evaluate effect sizes. Outcomes assessed included postoperative radiographic parameters such as articular gap, step-off, radial inclination, volar tilt, and ulnar variance; procedural variables including operative time, detection of associated soft tissue injuries, and complications; and functional outcomes such as wrist range of motion, visual analog scale pain score, Disabilities of the Arm, Shoulder, and Hand (DASH) score, Patient-Rated Wrist Evaluation (PRWE) score, Mayo Clinic wrist score, and grip strength.

The analysis demonstrated a statistically significant improvement in postoperative articular step-off favoring arthroscopic-assisted VLP fixation. Arthroscopy also enabled better identification of associated intra-articular soft tissue injuries and was associated with improved wrist extension. However, arthroscopic-assisted procedures required a longer operative time. No significant differences were observed between the two techniques in most other radiographic parameters, complication rates, or overall functional outcomes.

The authors concluded that arthroscopic-assisted VLP fixation is a useful adjunct for optimizing intra-articular reduction and addressing concomitant soft tissue injuries, though considerations regarding operative time, cost, and technical expertise remain important. Further high-quality studies were recommended to clarify its impact on long-term functional outcomes. [25]

Arora S et al. (2022) conducted a prospective observational study to evaluate the functional and radiological outcomes of intra-articular distal radius fractures treated with volar variable angle locking plates (VALCP). The study included 28 adult patients with intra-articular distal radius fractures managed surgically using VALCP. The mean age of the patients was 33.24 ± 11.74 years (range 22–64 years), and the mean follow-up duration was 12.18 ± 2.64 months (range 6–20 months).

Radiological evaluation was performed using standard wrist radiographs obtained at 6 weeks and 6 months postoperatively, assessing volar tilt, radial inclination, radial length, and ulnar variance. Functional assessment was carried out at 2 weeks, 6 weeks, 3 months, and 6 months, with the final functional outcome measured at 6 months using the Gartland and Werley scoring system.

The study demonstrated a consistent and progressive improvement in functional parameters, with statistically significant gains occurring within the first 12 weeks following surgery. Radiological indices were well maintained throughout the follow-up period, with no significant loss of reduction at 6 months. According to the Gartland and Werley score, 75% of patients achieved excellent outcomes, 14.28% good, 7.14% fair, and 3.57% poor results. Complications were minimal, including one superficial infection managed conservatively, one case of screw impingement requiring implant removal, and one case of complex regional pain syndrome that resulted in a poor functional outcome.

The authors concluded that fixation with volar variable angle locking plates allows early rehabilitation, maintains stable radiological alignment, and results in favorable functional outcomes in intra-articular distal radius fractures. [34]

Huang YM et al. (2022) conducted a retrospective cohort study to compare functional outcomes following fixation of marginal distal radius fractures using two commonly employed volar locking plate designs. The study was performed at a tertiary orthopaedic center and reviewed patients treated between January 2015 and December 2018. Marginal distal radius fractures were defined as fractures in which the most distal horizontal fracture line lay within 10 mm of the lunate fossa joint line. A total of 42 patients met the inclusion criteria, with 21 patients treated using the Synthes 2.4 mm locking compression plate (LCP) and 21 patients treated with the Acumed Acu-Loc volar locking plate (VLP).

Primary outcome measures included postoperative wrist range of motion, grip strength, and patient-reported pain scores. Secondary outcomes assessed patient satisfaction, subjective hand function, Mayo Wrist Score, and the need for secondary procedures related to hardware complications. The study addressed the clinical dilemma of plate positioning in marginal distal radius fractures,

where crossing the watershed line may be necessary but increases the risk of flexor tendon irritation.

Results demonstrated that patients treated with the Acu-Loc VLP had significantly better postoperative wrist range of motion ($p = 0.016$) and grip strength ($p = 0.014$) compared to the Synthes LCP group. The Mayo Wrist Score was also significantly higher in the Acu-Loc group ($p = 0.006$). Although implant-related complications remain a concern with volar plating, the authors concluded that appropriate placement of the Acu-Loc VLP yields superior functional outcomes and higher patient satisfaction in marginal distal radius fractures when compared with the Synthes 2.4 mm LCP. [40]

Patidar A et al. (2022) conducted a prospective case series to evaluate the functional and radiological outcomes of distal end radius fractures treated with volar locking compression plate fixation. The study was carried out at CRGH associated with R.D. Gardi Medical College, Ujjain, and included 48 patients (32 males and 16 females) who underwent open reduction and internal fixation using a volar approach. Fractures were classified according to the Frykman classification system, and patients were selected based on predefined inclusion and exclusion criteria.

All surgeries were performed under tourniquet control and appropriate anaesthesia. Functional outcomes were assessed using the Green and O'Brien scoring system, while radiological outcomes were evaluated using the Lidström classification. The distribution of fractures showed a predominance of Frykman type IV fractures, followed by types VI, V, VII, and III. Road traffic accidents were the most common mode of injury (52.1%), followed by falls (47.9%). The average time to clinico-radiological union was 8 weeks, and the longest follow-up duration was 6 months. Early wrist mobilisation was initiated, with an average mobilisation time of 8 days postoperatively.

Functional assessment revealed excellent outcomes in 22 patients, good outcomes in 20 patients, and fair outcomes in 6 patients based on Green and O'Brien scores. Radiologically, 26 patients achieved excellent, 18 good, and 4 fair outcomes according to Lidström criteria. The authors concluded that volar plating provides stable fixation, minimizes postoperative wrist stiffness and loss of reduction, and results in satisfactory functional and radiological outcomes, thereby improving patient compliance in distal end radius fractures. [42]

Kibar B (2021) conducted a retrospective observational study to evaluate the clinical and radiological outcomes of complex four-part intra-articular distal radius fractures treated using a combined palmar and dorsal plating approach. The study included 20 patients (8 males and 12 females) with a mean age of 47 ± 12.1 years, treated between May 2016 and January 2019. All fractures were classified as AO type 2R3-C3, representing highly complex intra-articular injuries, and further categorized using the Melone classification, with fractures distributed across types 1 to 4. The mean follow-up duration was 21 ± 7.5 months.

All patients underwent open reduction and internal fixation using a volar anatomically locked plate combined with low-profile 2-mm dorsal plates, addressing multiple fracture components including the radial styloid, dorsal and volar medial facets, and shaft. Radiological union was achieved in all cases. Functional outcomes were assessed using the DASH score, Visual Analog Scale (VAS) for pain, Mayo Wrist Score, wrist range of motion, and grip strength.

The mean DASH score was 10 ± 9, and the mean VAS score was 2.1 ± 0.9, indicating low residual disability and pain. According to the Mayo Wrist Score, outcomes were excellent in 5 patients, good in 6, satisfactory in 6, and poor in 3 patients. Mean grip strength reached 78% of the contralateral side, and functional wrist motion was satisfactorily restored across planes. The authors concluded that a dual plating strategy offers stable fixation, allows early mobilization, and provides acceptable functional and radiological outcomes in complex four-part intra-articular distal radius fractures. [18]

AIM & OBJECTIVES

Aim

To evaluate functional & radiological outcome of management of intra-articular distal radius fracture by plating.

Objectives

Primary Objectives

To assess radiological outcome

To asses functional recovery

Secondary Objective

To assess percentage of patient who develop wrist stiffness

MATERIALS & METHODS

Study: Prospective study

Study area: Department of Orthopaedic, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Chengalpattu District, Tamil Nadu.

Study population: Radiologically confirmed cases of intra-articular distal radius fractures between the ages of 16–60 years who presented to our OPD/casualty and were willing to become subjects in this study.

Duration of Study – 18 Months

- 16 Months – Data collection
- 1 Month – Data analysis
- **1 Month – Report writing**

Sample size calculation

Sample size calculation was based on a previous study. The proportion of fundamental outcome of volar locking

plates of internal fixation with plating and fixation with plate and K-wire fixation was 85% and 15%, with a 5% level of significance and 80% power. The total sample size was 35, including a 10% non-response rate.

Inclusion criteria:
- 16 to 60 years
- AO 'C' fractures
- Unacceptable reduction after at least one attempt at closed reduction

Exclusion criteria:
- Skeletal immaturity
- Severe open or delayed fracture where ORIF was contraindicated
- Delay of >14 days after injury
- Isolated radial styloid
- Unwilling patients

Radiological investigations: X-ray, MRI, CT scan

Study variables:
Age

Gender

Side of injury

Mode of injury

Time interval between injury and surgery

Duration of postoperative period

Range of movements

Functional outcome using DASH score and Constant score

Postoperative complications

Ethical considerations:
Institutional Ethical Committee approval was obtained first.

Patients gave consent for the study.

Informed and printed consent was signed by the patient.

Patients were given a choice whether to participate or not in the study.

Privacy and confidentiality of the patients were maintained throughout the study.

Data collection:
Radiologically confirmed cases of intra-articular distal radius fracture were admitted.

All cases were operated on in our hospital.

Patients were given a choice to become subjects in the study.

A minimum of 6 months of postoperative follow-up was ensured.

A specified postoperative protocol was followed for all patients.

Outcome was measured using DASH score and Constant score at intervals of 6, 12, and 24 weeks.

Radiological assessment was done at intervals of 6, 12, and 24 weeks.

Data analysis:
- Data were entered systematically in MS-Excel.
- Continuous variables were assessed for normality of distribution using the Shapiro–Wilk test and were presented as mean ± standard deviation and range, as appropriate.
- Student's t-test was used for comparisons of continuous variables.
- Correlations between continuous variables were assessed using either the Pearson or Spearman correlation coefficient, as appropriate.
- Statistical analysis was done using SPSS software.
- In all the above tests, a p value of less than 0.05 was accepted as indicating statistical significance.

MATERIALS AND METHODS
Study methodology as described in the manuscript including patient selection, surgical technique, and follow-up protocol.

RESULTS

Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	16–20	6	17.1
	21–30	9	25.7
	31–40	3	8.6
	41–50	5	14.3
	51–60	12	34.3
Sex	Female	10	28.6
	Male	25	71.4
Variable	Category	Frequency (n)	Percentage (%)
Mode of Injury	Fall	13	37.1
	Road Traffic Accident (RTA)	7	20.0
	Sports activity	15	42.9

Side of Injury	Left	7	20.0
	Right	28	80.0
Duration of Illness Before Surgery	4–5 days	11	31.4
	6–9 days	12	34.3
	10–13 days	12	34.3
Parameter	Time Point	Mean ± SD (°)	Median (Min–Max) (°)
Flexion–Extension Arc	6 weeks	55.1 ± 8.31	54 (41–69)
	12 weeks	93.3 ± 10.52	93 (72–115)
	24 weeks	108.8 ± 10.32	109 (90–131)
Pronation–Supination Arc	6 weeks	118.7 ± 18.51	119 (90–152)
	12 weeks	145.8 ± 18.01	146 (115–184)
	24 weeks	164.7 ± 18.56	162 (130–206)
Parameter	Time Point	Mean ± SD	Median (Min–Max)
DASH Score	6 weeks	46.1 ± 11.50	43 (31–69)
	12 weeks	25.4 ± 8.96	23 (8–44)
	24 weeks	12.2 ± 4.58	12 (2–24)
Constant Score	6 weeks	48.9 ± 9.00	50 (29–66)
	12 weeks	63.1 ± 8.50	63 (46–82)
	24 weeks	76.9 ± 7.39	78 (61–94)

Time Point	No Complication n (%)	Wrist Stiffness n (%)
6 weeks	24 (68.6)	11 (31.4)
12 weeks	28 (80.0)	7 (20.0)
24 weeks	31 (88.6)	4 (11.4)

Time Point	Maintained Reduction / Articular Congruity n (%)	Minor Loss of Reduction (Managed Conservatively) n (%)
6 weeks	32 (91.4)	3 (8.6)
12 weeks	33 (94.3)	2 (5.7)
24 weeks	33 (94.3)	2 (5.7)

Parameter	Time	16–20 (n=6)	21–30 (n=9)	31–40 (n=3)	41–50 (n=5)	51–60 (n=12)	F (df1, df2)	p-value
Flexion–Extension Arc	6 wk	63.0 ± 2.45	63.3 ± 5.05	54.3 ± 0.58	51.8 ± 1.30	46.5 ± 4.03	36.5 (4,13.5)	<0.001
	12 wk	101.0 ± 3.58	104.0 ± 7.11	94.7 ± 1.53	90.6 ± 2.07	82.3 ± 5.88	21.9 (4,12.5)	<0.001
	24 wk	117.2 ± 3.37	118.6 ± 7.52	110.7 ± 3.51	106.8 ± 3.11	97.8 ± 5.01	23.7 (4,10.3)	<0.001
Pronation–Supination Arc	6 wk	134.3 ± 8.41	137.3 ± 12.39	119.7 ± 1.16	111.8 ± 3.11	99.4 ± 8.14	28.9 (4,13.3)	<0.001
	12 wk	155.0 ± 7.04	164.3 ± 14.05	148.7 ± 7.57	143.4 ± 6.03	127.7 ± 11.06	12.4 (4,10.3)	<0.001
	24 wk	183.8 ± 9.66	177.0 ± 17.48	159.0 ± 2.00	158.2 ± 10.83	150.0 ± 13.01	11.4 (4,12.9)	<0.001
Outcome	Time	16–20	21–30	31–40	41–50	51–60	F (df1, df2)	p-value
DASH	6 wk	35.83 ± 1.60	35.44 ± 3.28	43.00 ± 0.00	47.60 ± 1.95	59.25 ± 7.49	—	—
	12 wk	17.50 ± 2.26	16.78 ± 4.66	23.00 ± 0.00	28.20 ± 3.03	35.25 ± 4.60	—	—
	24 wk	8.33 ± 0.82	7.78 ± 3.03	11.67 ± 0.58	14.00 ± 1.23	16.92 ± 2.71	35.5 (4,12.3)	<0.001
Constant	6 wk	56.17 ±	57.44 ±	50.67 ±	46.40 ±	39.33 ±	24.3	<0.001

		3.55	5.36	0.58	1.52	5.57	(4,13.4)	
	12 wk	70.33 ± 3.93	71.11 ± 6.19	63.67 ± 0.58	60.00 ± 1.58	54.50 ± 4.62	21.5 (4,13.4)	<0.001
	24 wk	82.67 ± 4.18	83.33 ± 5.59	78.33 ± 0.58	75.60 ± 1.52	69.25 ± 4.50	15.9 (4,13.4)	<0.001

Age Group	6 Weeks NoStiffness / Stiffness	12 Weeks NoStiffness / Stiffness	24 Weeks NoStiffness / Stiffness
16–20 (n=6)	6 (100%) / 0 (0%)	6 (100%) / 0 (0%)	6 (100%) / 0 (0%)
21–30 (n=9)	9 (100%) / 0 (0%)	9 (100%) / 0 (0%)	9 (100%) / 0 (0%)
31–40 (n=3)	3 (100%) / 0 (0%)	3 (100%) / 0 (0%)	3 (100%) / 0 (0%)
41–50 (n=5)	4 (80%) / 1 (20%)	5 (100%) / 0 (0%)	5 (100%) / 0 (0%)
51–60 (n=12)	2 (16.7%) / 10 (83.3%)	5 (41.7%) / 7 (58.3%)	8 (66.7%) / 4 (33.3%)
Chi-square (df=4)	$\chi^2 = 23.6$, $p < 0.001$	$\chi^2 = 16.8$, $p = 0.002$	$\chi^2 = 8.66$, $p = 0.070$

Age Group	6 Weeks Maintained / Minor Loss	12 Weeks Maintained / Minor Loss	24 Weeks Maintained / Minor Loss
16–20 (n=6)	6 (100%) / 0 (0%)	6 (100%) / 0 (0%)	6 (100%) / 0 (0%)
21–30 (n=9)	9 (100%) / 0 (0%)	9 (100%) / 0 (0%)	9 (100%) / 0 (0%)
31–40 (n=3)	3 (100%) / 0 (0%)	3 (100%) / 0 (0%)	3 (100%) / 0 (0%)
41–50 (n=5)	4 (80%) / 1 (20%)	5 (100%) / 0 (0%)	5 (100%) / 0 (0%)
51–60 (n=12)	10 (83.3%) / 2 (16.7%)	10 (83.3%) / 2 (16.7%)	10 (83.3%) / 2 (16.7%)
Chi-square (df=4)	$\chi^2 = 3.52$, $p = 0.474$	$\chi^2 = 4.07$, $p = 0.397$	$\chi^2 = 4.07$, $p = 0.397$

Outcome	Time	Female (n=10)	Male (n=25)	F (df1, df2)	p-value
DASH Score	6 wk	50.9 ± 13.72	44.1 ± 10.16	2.00 (1,13.1)	0.180
	12 wk	28.2 ± 11.45	24.3 ± 7.75	0.99 (1,12.4)	0.339
	24 wk	13.7 ± 6.09	11.6 ± 3.82	0.99 (1,11.9)	0.340
Constant Score	6 wk	45.8 ± 11.58	50.1 ± 7.69	1.16 (1,12.3)	0.302
	12 wk	61.0 ± 11.49	63.9 ± 7.10	0.55 (1,11.9)	0.475
	24 wk	75.2 ± 10.65	77.5 ± 5.77	0.42 (1,11.2)	0.528

Sex	6 Weeks NoStiffness / Stiffness	12 Weeks NoStiffness / Stiffness	24 Weeks NoStiffness / Stiffness
Female (n=10)	5 (50%) / 5 (50%)	6 (60%) / 4 (40%)	8 (80%) / 2 (20%)
Male (n=25)	19 (76%) / 6 (24%)	22 (88%) / 3 (12%)	23 (92%) / 2 (8%)
Chi-square (df=1)	$\chi^2 = 2.24$, $p = 0.134$	$\chi^2 = 3.50$, $p = 0.061$	$\chi^2 = 1.02$, $p = 0.313$

Sex	6 Weeks Maintained / Minor Loss	12 Weeks Maintained / Minor Loss	24 Weeks Maintained / Minor Loss
Female (n=10)	9 (90%) / 1 (10%)	9 (90%) / 1 (10%)	9 (90%) / 1 (10%)
Male (n=25)	23 (92%) / 2 (8%)	24 (96%) / 1 (4%)	24 (96%) / 1 (4%)
Chi-square (df=1)	$\chi^2 = 0.04$, $p = 0.849$	$\chi^2 = 0.48$, $p = 0.490$	$\chi^2 = 0.48$, $p = 0.490$

Range of Motion Parameter	DASH Score – 6 Weeks	DASH Score – 12 Weeks	DASH Score – 24 Weeks	Constant–Murley Score – 6 Weeks	Constant–Murley Score – 12 Weeks	Constant–Murley Score – 24 Weeks
Wrist Flexion–Extension Arc – 6 Weeks	−0.961	−0.976	−0.959	0.982	0.976	0.949
Wrist Flexion–Extension Arc – 12 Weeks	−0.965	−0.984	−0.973	0.990	0.988	0.981

Wrist Flexion–Extension Arc – 24 Weeks	−0.939	−0.958	−0.942	0.947	0.958	0.947
Wrist Pronation–Supination Arc – 6 Weeks	−0.948	−0.967	−0.947	0.975	0.970	0.947
Wrist Pronation–Supination Arc – 12 Weeks	−0.927	−0.935	−0.917	0.947	0.938	0.936
Wrist Pronation–Supination Arc – 24 Weeks	−0.814	−0.842	−0.813	0.818	0.858	0.843

DISCUSSION

Discussion comparing the present study results with previously published literature on volar locking plate fixation for distal radius fractures.

CONCLUSION

Volar locking plate fixation provides stable fixation and satisfactory functional and radiological outcomes in intra-articular distal radius fractures.

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