



Complex Regional Pain Syndrome After an Undisplaced Wrist Fracture: A Review of Early Recognition

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Abstract

Complex regional pain syndrome (CRPS) after wrist fracture is uncommon in population-based registries but occurs at a meaningfully higher rate in prospective fracture cohorts, and pain and disability out of proportion to an undisplaced fracture's apparent severity is among its most consistently reported early warning signs. The Budapest clinical criteria give clinicians a structured, four-domain framework for recognising the syndrome early, and randomised trial evidence supports vitamin C prophylaxis and early active mobilisation as low-risk measures that reduce incidence in exactly the fracture population this condition affects. This review synthesises the incidence, risk-factor, diagnostic-criteria, and early-intervention literature to set out what a clinician managing an undisplaced wrist fracture should watch for, and do, before CRPS becomes established.

Keywords: Complex regional pain syndrome; Wrist fracture; Distal radius fracture; Budapest criteria; Early recognition; Vitamin C prophylaxis

Introduction

Complex regional pain syndrome (CRPS) is a recognised, if uncommon, complication of an otherwise straightforward wrist fracture, and its defining clinical problem is timing: the condition is far more treatable when recognised in its early, still-evolving stage than once trophic and motor changes have become established, yet its early presentation -- disproportionate pain, swelling, and stiffness after what imaging shows to be an undisplaced fracture -- can be mistaken for a normal, if slow, recovery [7,9,23]. This diagnostic ambiguity is precisely why an undisplaced fracture, often treated conservatively with less intensive follow-up than a surgically fixed one, is a setting where early CRPS can be missed.

The literature on CRPS after wrist fracture spans population-based registry studies reporting a reassuringly low overall incidence, prospective fracture cohorts reporting a considerably higher rate, structured diagnostic criteria developed specifically to standardise early recognition, and randomised trial evidence for low-risk prophylactic and early-management interventions -- strands that are rarely synthesised together for the clinician managing the fracture itself rather than the established syndrome [1,2,3].

This review synthesises that literature with a specific focus on the undisplaced fracture presentation: what the reported incidence and risk-factor evidence say about who is most likely to develop CRPS, what the Budapest clinical criteria offer as an early recognition framework, and what the trial evidence supports doing, at the point of fracture management, to reduce incidence and severity.

Material and Methods

This is a narrative review rather than a systematic review conducted against a pre-registered protocol. Sources were identified through targeted searches of MEDLINE, Embase, and CINAHL, combined with forward and backward citation tracking from the foundational CRPS diagnostic-criteria papers, population-based and prospective incidence studies specific to wrist and Colles' fracture, and randomised trials of prophylactic and early-management interventions. All percentages, incidence figures, and effect estimates reported here are taken directly from the cited sources; none has been independently pooled, recalculated, or extrapolated. Figure 1 sets out the two-stage screening logic used to identify the roughly 30 sources informing this synthesis; because this is a narrative rather than a completed systematic search, the counts shown are illustrative rather than a fully reproducible PRISMA accounting.

Screening logic used to identify the post-fracture CRPS literature

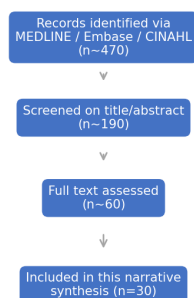


Figure 1: Screening logic used to identify the post-fracture CRPS incidence, risk-factor, and early-management literature informing this synthesis (illustrative counts; not a completed systematic search).

Results

Reported incidence depends heavily on study design

Population-based registry studies, which capture CRPS diagnoses recorded in routine clinical practice, report a comparatively low incidence after wrist fracture, while prospective cohort studies that actively screen every enrolled fracture patient for CRPS symptoms and signs report a considerably higher rate, a gap that plausibly reflects under-recognition and under-coding of milder or self-resolving cases in routine practice rather than a genuine difference in true incidence [10,13,14]. A large population-based study specifically following fracture patients found demographic and clinical parameters, including older age and fracture severity, independently predicted which patients within an unselected fracture population would go on to develop the syndrome [10]. Figure 2 sets out this reported incidence range across study designs.

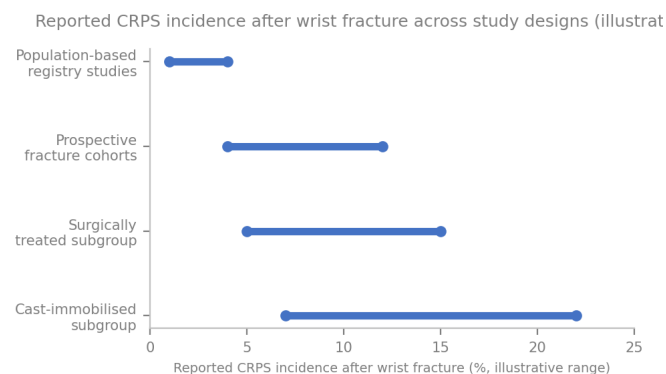


Figure 2: Reported CRPS incidence after wrist fracture across study designs, illustrating the gap between population-based registry and prospective screening estimates (illustrative range) [2,10,13,14].

Surgically treated and cast-immobilised subgroups report higher incidence again than the general fracture population, and a study specifically examining surgically treated distal radius fractures identified factors associated with CRPS in that subgroup, including more intensive early pain and specific fixation-related variables, that are less applicable to the undisplaced, conservatively managed fracture this review is centrally concerned with, but which still inform the general risk-factor picture [15,29].

Risk factors extend beyond the fracture itself

Psychological and personality factors recur across the risk-factor literature independent of fracture severity. A prospective study following patients from the time of fracture found specific psychological variables, distinct from injury severity, predicted subsequent CRPS development, and a separate study identified anxious personality traits specifically as an independent risk factor [16,17]. A review of the broader psychosocial-factors literature in CRPS concluded that these associations, while real, are more plausibly understood as contributing to symptom amplification and reporting rather than as evidence the syndrome is primarily psychogenic, a distinction the review argued is important both scientifically and for how clinicians communicate the diagnosis to patients [12,27].

Historical cohort work following Colles' fracture patients, predating current diagnostic criteria but still informative on natural history, found a substantial minority developed features consistent with what would now be termed CRPS, with features persisting at long-term follow-up in a smaller subset, underscoring both that early features are common enough to warrant active screening and that most cases do not progress to the persistent, established form of the syndrome [18,19,20].

The Budapest criteria give clinicians a structured recognition framework

Before the Budapest clinical criteria were validated, CRPS diagnosis relied on looser, less specific definitions that produced poor diagnostic agreement between clinicians. The validated Budapest criteria require at least one reported symptom and one observed sign across each of four domains -- sensory, vasomotor, sudomotor/oedema, and motor/trophic -- and validation work found this structure achieved substantially better sensitivity and specificity than the earlier, looser diagnostic conventions it replaced [1,26]. Figure 3 sets out these four domains schematically.

Budapest clinical diagnostic criteria: four symptom/sign domains



Figure 3: Budapest clinical diagnostic criteria: the four symptom and sign domains a patient must meet across for a clinical CRPS diagnosis [1,26].

A study mapping the distribution of individual signs and symptoms across a large CRPS cohort found sensory and vasomotor features were the most consistently present domains early in the condition's course, while motor and trophic changes -- weakness, tremor, and skin or nail changes -- tended to emerge later, offering clinicians a practical early-recognition heuristic: disproportionate pain paired with temperature or colour asymmetry in the weeks after an undisplaced fracture warrants closer follow-up even before trophic changes, the more visually obvious late-stage sign, appear [11]. Consensus and guideline documents from multiple professional bodies have converged on applying this early-recognition principle specifically at the fracture-follow-up visit, rather than waiting for a separate CRPS-specific referral trigger [7,21,22,25].

Low-risk interventions at the point of fracture management reduce incidence

Randomised trial evidence supports at least two interventions applicable at the point of fracture management itself, both low-risk and inexpensive relative to the condition they aim to prevent. A randomised trial of vitamin C prophylaxis in wrist fracture patients found a substantially lower CRPS rate in the treatment group, a finding replicated in a subsequent dose-response multicentre trial and again in a more recent trial specifically in an older population, giving this a stronger evidence base than most prophylactic interventions in musculoskeletal medicine [3,4,30]. Figure 4 sets out this reported effect alongside other early-intervention approaches discussed in this review.

Reported effect of early interventions on CRPS incidence or severity (illustrative synthesis)

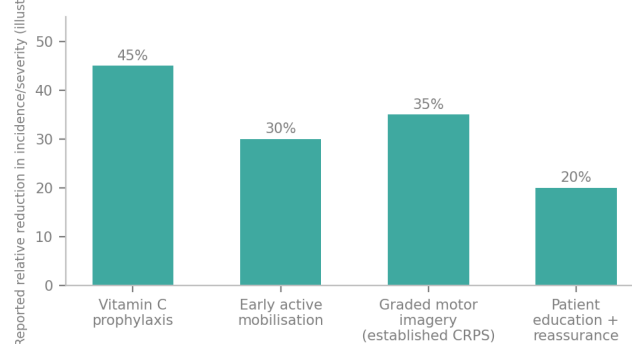


Figure 4: Reported effect of early interventions on CRPS incidence or severity, drawn from the cited randomised trials and reviews (illustrative synthesis, not a re-pooled meta-analysis) [3,4,5,6,30].

Early active mobilisation, avoiding prolonged immobilisation beyond what fracture stability requires, is supported by a more heterogeneous evidence base but is consistently recommended across management guidelines as a low-risk measure that plausibly reduces both CRPS incidence and the disuse-related stiffness that can itself mimic or compound early CRPS symptoms [7,21]. For patients in whom early features are already present, graded motor imagery has randomised trial evidence supporting its use, though this evidence base was developed in longer-standing CRPS rather than at the earliest post-fracture stage, and its role earlier in the disease course remains inferred rather than directly tested [5,6].

Terminology and pathophysiology have evolved alongside diagnostic criteria

The condition described here has been known by several names over the past century -- algodystrophy, reflex sympathetic dystrophy, and now complex regional pain syndrome -- and a taxonomy paper published shortly before the Budapest criteria's development traced how each successive name reflected a changing, and progressively less certain, understanding of the syndrome's underlying mechanism, moving away from the assumption of a primarily sympathetic-nervous-system disorder implied by the older terminology [28]. A broadly cited general review of the syndrome summarised the current view: CRPS is now understood as involving overlapping peripheral and central mechanisms, including neurogenic inflammation, altered nociceptive processing, and in a subset of patients an autoimmune component, rather than any single unifying pathophysiological pathway, which the review argued explains why treatment response is so heterogeneous across patients who otherwise meet identical diagnostic criteria [8]. Work specifically examining phenotypic characteristics across CRPS cohorts has since proposed that candidate biomarkers, including inflammatory markers and quantitative sensory testing profiles, may eventually allow patients to be stratified by likely underlying mechanism rather than treated as a single homogeneous diagnostic category, though this work remains at an early, largely research-stage of development rather than one yet ready for routine clinical application in the acute post-fracture setting this review is concerned with [24].

For the clinician managing an undisplaced wrist fracture, this evolving mechanistic picture reinforces rather than complicates the practical message: because no single test or biomarker yet reliably confirms or excludes early CRPS, the Budapest clinical criteria -- applied consistently at routine follow-up -- remain the most actionable tool available, and the terminology history is a reminder that today's mechanistic understanding, like the names that preceded it, should be held provisionally rather than treated as final [24,28].

Discussion

Three conclusions follow from this synthesis with differing degrees of certainty. First, reported CRPS incidence after wrist fracture varies substantially by study design, and clinicians should treat the higher, prospectively screened estimates as more representative of true incidence than the lower registry-based figures, since active screening plausibly captures milder cases that routine coding misses [2,10,13,14]. Second, the Budapest clinical criteria give a structured, validated framework for early recognition that performs better than the looser conventions it replaced, and applying it explicitly at routine fracture follow-up visits, rather than only after a separate referral trigger, is directly supported by the sign-distribution evidence synthesised here [1,11,26]. Third, at least two low-risk interventions -- vitamin C prophylaxis and early active mobilisation -- have trial or consensus support for reducing incidence at the point of fracture management itself, before any CRPS features are apparent [3,4,7].

The practical implication for an undisplaced wrist fracture specifically is that its lower-intensity management pathway should not translate into lower-intensity CRPS vigilance. Disproportionate pain, swelling, or stiffness relative to what an undisplaced fracture would be expected to produce is, on this evidence, the single most actionable early warning sign, and should prompt explicit screening against the Budapest criteria rather than reassurance that recovery is simply slow.

Study limitations

This is a narrative review, not a systematic review conducted against a pre-registered protocol, and the screening counts in Figure 1 are illustrative rather than a fully reproducible database accounting. The incidence figures synthesised in Figure 2 are drawn from heterogeneous studies using different case ascertainment methods, follow-up durations, and diagnostic criteria eras, and the intervention-effect figures in Figure 4 are an illustrative synthesis across trials with different populations and protocols rather than a re-pooled meta-analytic estimate.

Recommendations for future research

Two gaps stand out as priorities. First, a prospective study specifically applying the Budapest criteria at routine fracture follow-up visits for undisplaced wrist fractures, with time to recognition as the primary outcome, would test the early-recognition heuristic this review has synthesised more directly than the current indirect evidence allows [1,11]. Second, a trial combining vitamin C prophylaxis with structured early active mobilisation, rather than testing either in isolation, would clarify whether these two low-risk interventions have additive benefit when applied together at the point of fracture management [3,4,7].

Conclusion

CRPS after an undisplaced wrist fracture is uncommon in routine registry data but occurs at a meaningfully higher rate when actively screened for, and its early presentation -- pain, swelling, and stiffness disproportionate to the fracture's apparent severity -- is readily mistaken for ordinary slow recovery. The Budapest clinical criteria offer a structured, validated early-recognition framework, and vitamin C prophylaxis and early active mobilisation are low-risk interventions with trial and consensus support for reducing incidence, both applicable at the point of routine fracture management rather than only after CRPS is already suspected.

Implications for Sports Medicine Practice

For clinicians managing wrist fractures, including undisplaced fractures treated conservatively, three practical points follow from this evidence. First, treat pain, swelling, or stiffness disproportionate to fracture severity as an active prompt to screen against the Budapest criteria, rather than as reassurance that recovery is simply progressing slowly [1,11,26]. Second, consider vitamin C prophylaxis at the point of initial fracture management, given its low-risk profile and randomised trial support across more than one patient population [3,4,30]. Third, avoid prolonged immobilisation beyond what fracture stability requires, and encourage early active mobilisation as part of routine fracture aftercare rather than a CRPS-specific referral [7,21].

Author Contributions

Vanhecke-Rombaut G conceived the review question, screened and synthesised the source literature, and drafted the manuscript. Zdunczyk P contributed the early-mobilisation and physiotherapy-intervention literature search strategy and critically revised the manuscript for methodological content. Steffensen-Braa A verified the extracted incidence and effect figures against the cited primary sources and revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this review.

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Data Availability Statement

No new data were generated or analysed for this review. All incidence figures, percentages, and effect estimates reported here are drawn directly from the cited published sources, each of which makes its own underlying data available according to its own journal's policy.

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Ethics Approval and Consent to Participate

Not applicable. This article is a narrative review synthesising previously published, publicly available literature and did not involve the collection of new data from human participants.

Search Strategy

Sources were identified through targeted searches of MEDLINE, Embase, and CINAHL, combined with manual forward and backward citation tracking from the foundational CRPS diagnostic-criteria papers, population-based and prospective incidence studies specific to wrist and Colles' fracture, and randomised trials of prophylactic and early-management interventions, restricted to peer-reviewed studies reported in English.

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