

Diagnostic and Therapeutic Approaches to Isolated Trapezium Fractures: A Case-Based Review of Current Evidence

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Abstract: Isolated trapezium fractures are uncommon carpal injuries that may be overlooked because of their relatively low frequency, subtle clinical presentation, and anatomical relationship with the thumb carpometacarpal joint. Accurate diagnosis requires appropriate interpretation of clinical findings and imaging, while treatment selection depends on fracture morphology, displacement, articular involvement, and functional requirements. This review critically synthesizes the provided case reports and literature describing isolated trapezium and closely related carpal fractures. The analysis emphasizes diagnostic recognition, fracture characterization, treatment decision-making, and functional considerations. The available literature demonstrates that isolated trapezium fractures can present in diverse morphological patterns, including coronal and comminuted configurations, and that delayed or inadequate recognition may compromise assessment of the articular surface and thumb function. Panigrahi et al. provide an important case-based framework for recognizing an isolated coronal trapezium fracture and integrating radiological assessment with treatment planning (Panigrahi et al., 2015). Other reports contribute evidence regarding isolated trapezium injury in sporting activity and comminuted fracture patterns, while reports of trapezoid fractures provide useful comparative information concerning rare carpal injuries. Overall, the evidence supports a structured diagnostic approach based on mechanism, physical examination, targeted imaging, fracture morphology, and joint involvement. Management should be individualized rather than determined solely by the rarity of the injury. The principal limitation of the current evidence base is its reliance on case reports and small clinical series, restricting the strength of comparative treatment conclusions.

Keywords: Trapezium fracture; Isolated carpal fracture; Coronal fracture; Comminuted fracture; Thumb carpometacarpal joint; Diagnostic imaging; Conservative treatment; Surgical management; Case-based review.

1. Introduction:

The trapezium is a clinically important component of the radial carpus because of its relationship with the first metacarpal and the functional mechanics of the thumb. Consequently, an isolated fracture of this bone represents a relatively specialized injury in which diagnostic accuracy is important not only for fracture

identification but also for evaluation of potential articular disruption. The rarity of isolated trapezium fractures creates a practical diagnostic challenge: clinicians may initially attribute radial-sided hand pain to more common injuries, potentially delaying specific investigation of the trapezium. Case-based literature illustrates that isolated fractures can occur in different

anatomical configurations and clinical circumstances (Arabzadeh and Vosoughi, 2021; Ouchrif et al., 2016).

The morphological diversity of trapezium fractures is particularly relevant to diagnosis. Panigrahi et al. described an isolated coronal fracture of the trapezium, demonstrating that a fracture pattern confined to the trapezium may require deliberate radiological assessment to establish the diagnosis (Panigrahi et al., 2015). Arabzadeh and Vosoughi subsequently reported an isolated comminuted trapezium fracture, emphasizing the possibility of substantial fragmentation even when the injury is described as isolated (Arabzadeh and Vosoughi, 2021). These observations suggest that the term “isolated trapezium fracture” should not be interpreted as a single uniform pathological entity; rather, it encompasses different fracture architectures with potentially different diagnostic and therapeutic implications.

The clinical relevance of these injuries is also illustrated by the report of an isolated trapezium fracture in a cyclist, in which the injury was considered in relation to a specific sporting context (Ouchrif et al., 2016). This reinforces the importance of considering mechanism of injury and occupational or athletic demands when evaluating patients with localized hand symptoms. The diagnostic process should therefore integrate clinical history, examination, and imaging rather than relying on any single component.

The present review aims to construct a clinically oriented framework for evaluating isolated trapezium fractures using only the supplied literature. The specific objectives are to synthesize the reported fracture patterns, analyze diagnostic considerations, examine therapeutic approaches, identify recurring evidence gaps, and establish a practical model for case-based decision-making. Because the available literature consists predominantly of case reports and limited series, the review emphasizes evidence interpretation rather than attempting to establish definitive treatment superiority.

2. LITERATURE REVIEW

The provided literature demonstrates that rare carpal fractures can be characterized by considerable heterogeneity in anatomical pattern and clinical context. Panigrahi et al. reported an isolated coronal

fracture of the trapezium, providing a representative example of a fracture configuration that can remain anatomically confined to the trapezium (Panigrahi et al., 2015). The importance of this report lies in its case-based demonstration that an apparently localized hand injury can contain a specific fracture morphology requiring targeted radiological interpretation.

Arabzadeh and Vosoughi expanded the spectrum of reported isolated trapezium injury by describing a comminuted fracture (Arabzadeh and Vosoughi, 2021). From a structural perspective, comminution increases the complexity of fracture assessment because the clinician must consider not simply whether the trapezium is fractured, but how its fragments affect anatomical continuity and potentially the articular configuration. The contrast between coronal and comminuted patterns illustrates why a morphology-based diagnostic approach is preferable to a generic diagnosis of “trapezium fracture.”

The report by Ouchrif et al. adds a sport-related clinical context through its description of an isolated trapezium fracture in a cyclist (Ouchrif et al., 2016). Although a single case cannot establish a general relationship between cycling and fracture morphology, it demonstrates the importance of mechanism and activity-specific history in the diagnostic process. The patient's functional demands may also influence the consequences of residual symptoms and therefore become relevant when considering treatment.

The remaining provided publications concern fractures of the trapezoid rather than the trapezium. Bousselmame et al. described trapezoid fractures, while Francès et al. reported an isolated trapezoid fracture (Bousselmame et al., 2000; Francès et al., 2022). Beekhuizen et al. presented a series concerning uncommon trapezoid fractures (Beekhuizen et al., 2020). These studies cannot be treated as direct evidence for the treatment of isolated trapezium fractures. Nevertheless, they provide contextual evidence regarding the broader diagnostic problem of uncommon carpal fractures. Their inclusion supports the theoretical position that rare carpal injuries require anatomical precision and deliberate diagnostic evaluation rather than assumptions based on prevalence.

A central gap emerges from the provided literature: the

evidence is predominantly case-based, with limited capacity to compare diagnostic techniques or treatment strategies systematically. There is insufficient evidence within the supplied references to establish a universally preferred therapeutic algorithm or to calculate comparative outcomes across fracture patterns. Therefore, the strongest defensible position is that diagnosis and treatment should be individualized according to fracture morphology, anatomical involvement, and functional requirements.

3. METHODOLOGY

3.1 Review Design and Evidence Framework

This study adopts a structured narrative review methodology based exclusively on the six references supplied for analysis. No external publications, databases, or additional evidence were incorporated. The methodological objective was not statistical meta-analysis, because the available material does not provide a sufficiently homogeneous set of comparative studies. Instead, the references were analyzed according to four principal domains: fracture morphology, diagnostic strategy, therapeutic decision-making, and clinical implications.

A case-based evidence framework was developed to organize the literature. In the first stage, each reference was categorized according to whether it directly concerned the trapezium or provided contextual evidence concerning another rare carpal fracture. Direct evidence included reports of isolated, coronal, or comminuted trapezium fractures, whereas the trapezoid studies were treated as comparative contextual literature. This distinction prevents indirect evidence from being incorrectly presented as direct evidence for trapezium management.

3.2 Diagnostic Framework

The proposed diagnostic framework begins with clinical suspicion. A patient presenting with localized radial-sided hand pain following trauma should be assessed according to mechanism, site of tenderness, functional limitation, and activity requirements. The literature does not justify a single clinical symptom as diagnostic; rather, the case reports support an integrated approach in which persistent or anatomically specific symptoms prompt targeted imaging (Ouchrif et al., 2016; Panigrahi et al., 2015).

The second component is radiological characterization.

Detection of the fracture should be followed by determination of its morphology. A coronal fracture, such as that described by Panigrahi et al., represents a substantially different structural configuration from a comminuted fracture described by Arabzadeh and Vosoughi (Panigrahi et al., 2015; Arabzadeh and Vosoughi, 2021). Accordingly, the diagnostic endpoint should not merely state that a fracture exists; it should characterize the fracture sufficiently to inform management.

The third component is assessment of anatomical and functional significance. Because the trapezium participates in the thumb-related carpal architecture, the clinician should determine whether the fracture configuration has implications for joint congruity and thumb mechanics. The available literature supports this principle conceptually, although the supplied references do not provide enough standardized quantitative data to define universally accepted thresholds for instability or displacement.

3.3 Therapeutic Decision Model

A morphology-based therapeutic model can be constructed from the available evidence. First, fractures should be assessed for structural complexity. A relatively simple fracture pattern may permit consideration of nonoperative management when anatomical stability and functional expectations are favorable. Conversely, comminution or clinically important displacement may increase the need for operative consideration. The comminuted case described by Arabzadeh and Vosoughi illustrates why morphology is central to treatment selection (Arabzadeh and Vosoughi, 2021).

Second, joint-related considerations should influence decision-making. Fractures involving an articular region require careful assessment because anatomical incongruity may have greater functional significance than a fracture that remains structurally stable. The coronal fracture described by Panigrahi et al. is particularly relevant as a case-based example of the importance of defining fracture orientation before selecting treatment (Panigrahi et al., 2015).

Third, patient-specific functional requirements should be incorporated. The cyclist case reported by Ouchrif et al. demonstrates that the clinical context of an injury may be relevant to its evaluation and functional

consequences (Ouchrif et al., 2016). A treatment strategy that is technically acceptable radiologically may not have equivalent practical implications for patients whose occupations or sporting activities place substantial demands on the thumb and hand.

3.4 Comparative Interpretation of Rare Carpal Fractures

The trapezoid reports were used as comparative evidence rather than direct therapeutic evidence. Beekhuizen et al. described a series of uncommon trapezoid fractures, while Boussemame et al. and Francès et al. also addressed trapezoid injury (Beekhuizen et al., 2020; Boussemame et al., 2000; Francès et al., 2022). Their relevance lies in demonstrating that uncommon carpal fractures represent a broader diagnostic category in which recognition may be complicated by rarity.

The methodological limitation of this comparative approach is that anatomical differences between the trapezium and trapezoid prevent direct transfer of treatment conclusions. Therefore, these reports were interpreted only for diagnostic principles applicable to rare carpal injuries, such as the importance of anatomical localization and deliberate fracture characterization.

4. RESULTS

The synthesis identified four principal findings. First, isolated trapezium fractures demonstrate meaningful morphological heterogeneity. The supplied evidence includes a coronal fracture, a comminuted fracture, and an isolated fracture associated with cycling activity (Panigrahi et al., 2015; Arabzadeh and Vosoughi, 2021; Ouchrif et al., 2016). This variation indicates that the diagnostic label alone provides insufficient information for treatment planning. Fracture architecture must be established before therapeutic decisions are made.

Second, the literature supports a case-driven diagnostic model rather than reliance on generalized assumptions about common hand trauma. Panigrahi et al. demonstrated the clinical relevance of identifying an isolated coronal trapezium fracture, while Arabzadeh and Vosoughi demonstrated a different morphological presentation through a comminuted injury (Panigrahi et al., 2015; Arabzadeh and Vosoughi, 2021). The diagnostic implication is that persistent or anatomically localized symptoms should encourage targeted

investigation when a routine assessment does not adequately explain the clinical picture.

Third, treatment selection appears to be primarily morphology-dependent. The supplied evidence does not establish a universal operative or nonoperative protocol. Instead, the logical therapeutic sequence is to determine fracture stability, displacement, comminution, and potential joint involvement before selecting management. The evidence therefore favors individualized treatment rather than a one-size-fits-all algorithm.

Fourth, rare carpal fracture literature reinforces the importance of anatomical specificity. The trapezoid studies describe another group of uncommon carpal injuries and demonstrate that rarity itself can create a diagnostic challenge (Boussemame et al., 2000; Beekhuizen et al., 2020; Francès et al., 2022). However, these studies should not be interpreted as direct evidence regarding trapezium treatment. Their principal contribution to the present analysis is methodological: uncommon carpal fractures require precise anatomical diagnosis before treatment evidence can be appropriately applied.

The overall evidence pattern can therefore be summarized as a diagnostic-to-therapeutic pathway: clinical suspicion leads to targeted imaging, imaging establishes fracture morphology, morphology determines the level of structural concern, and structural assessment guides individualized treatment. The major limitation is the absence of sufficiently large comparative cohorts within the supplied literature. Consequently, findings should be interpreted as evidence-informed clinical principles rather than definitive treatment guidelines.

5. DISCUSSION

The central finding of this review is that isolated trapezium fracture management depends more on accurate characterization than on the generic diagnosis itself. This conclusion is supported by the variation between the coronal fracture described by Panigrahi et al. and the comminuted fracture reported by Arabzadeh and Vosoughi (Panigrahi et al., 2015; Arabzadeh and Vosoughi, 2021). These cases illustrate two different structural problems that may reasonably require different therapeutic considerations. A diagnostic system that identifies only the presence of a

trapezium fracture but does not characterize its morphology would therefore be incomplete.

The diagnostic challenge is partly related to the rarity of the condition. Infrequent injuries receive less routine clinical recognition than common fractures, increasing the importance of maintaining anatomical awareness. The cyclist case described by Ouchrif et al. demonstrates how a specific activity context may contribute to the clinical assessment of an isolated trapezium injury (Ouchrif et al., 2016). From a practical standpoint, mechanism should therefore be considered as a modifier of diagnostic probability rather than as proof of a particular fracture.

The literature also suggests an important distinction between fracture detection and fracture interpretation. Detection establishes that a fracture is present, whereas interpretation determines its configuration and potential functional relevance. Panigrahi et al.'s coronal fracture report is particularly useful in demonstrating the importance of defining fracture morphology rather than stopping at a nonspecific injury classification (Panigrahi et al., 2015). This distinction is central to treatment planning because anatomical stability, displacement, comminution, and joint-related considerations may alter management.

The inclusion of trapezoid fracture literature provides a broader perspective but also exposes an important evidentiary limitation. Beekhuizen et al., Bousselmame et al., and Francès et al. address uncommon trapezoid injuries rather than trapezium fractures (Beekhuizen et al., 2020; Bousselmame et al., 2000; Francès et al., 2022). These reports reinforce the general principle that rare carpal injuries can be diagnostically challenging, but their findings should not be directly generalized to trapezium treatment. This distinction strengthens rather than weakens the review because it prevents inappropriate extrapolation.

From a theoretical perspective, the evidence supports a morphology-centered model of care. Clinical examination generates suspicion; imaging confirms and characterizes the lesion; anatomical assessment determines potential functional consequences; and patient-specific demands inform final treatment selection. This model accommodates both relatively straightforward and complex fractures without

presuming that every isolated trapezium fracture requires surgery.

A major limitation is the low level of comparative evidence. Case reports are valuable for documenting rare injury patterns, but they cannot reliably determine treatment superiority, complication rates, or long-term functional outcomes across patient populations. The provided literature also lacks sufficient standardized outcome measures to permit quantitative comparison. Future research would benefit from multicenter case series, standardized fracture classifications, consistent imaging protocols, and validated functional outcome assessment.

6. CONCLUSION

Isolated trapezium fractures represent uncommon but clinically significant carpal injuries in which accurate anatomical diagnosis is essential. The available literature demonstrates considerable variation in fracture morphology, including coronal and comminuted configurations, and indicates that clinical context may influence diagnostic assessment (Panigrahi et al., 2015; Arabzadeh and Vosoughi, 2021; Ouchrif et al., 2016).

The evidence synthesized in this review supports a structured approach centered on clinical suspicion, targeted imaging, fracture characterization, assessment of structural and joint-related implications, and individualized treatment selection. The literature does not support a universal management strategy applicable to every isolated trapezium fracture. Instead, therapeutic decisions should reflect the specific anatomical and functional characteristics of each injury.

The principal contribution of this review is the integration of the available case-based evidence into a diagnostic and therapeutic framework while maintaining a clear distinction between direct trapezium evidence and contextual evidence from trapezoid fractures. Future studies should prioritize larger clinical series, standardized morphological classification, comparative treatment evaluation, and long-term functional outcomes. Such research would strengthen the evidence base required to move from case-based clinical reasoning toward reproducible management guidelines.

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