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SCAPHOID FRACTURES AND NONUNIONS: CONTEMPORARY PERSPECTIVES ON DIAGNOSIS AND MANAGEMENT

Orthopaedics

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ABSTRACT

Scaphoid fractures remain one of the most common injuries of the carpus, frequently affecting young and active individuals. Owing to the scaphoid's unique anatomy and precarious blood supply, delayed union, nonunion, and avascular necrosis pose significant treatment challenges. Early and accurate diagnosis is essential, as missed fractures may progress to collapse and degenerative arthritis. This article reviews the current understanding of scaphoid vascularity, classification, diagnostic algorithms, and evolving treatment options for both acute fractures and established nonunions. Special attention is given to the role of advanced imaging modalities and the comparative efficacy of vascularized versus non-vascularized bone grafting.

KEYWORDS

Scaphoid fracture, Nonunion, Vascularized bone graft, MRI, Wrist injuries

INTRODUCTION

The scaphoid bone is the most frequently fractured carpal bone, typically resulting from falls on an outstretched hand or forced wrist dorsiflexion. Its clinical relevance lies in the high incidence of complications associated with delayed or missed diagnosis. The incidence of avascular necrosis (AVN) following scaphoid fracture has been reported between 13% and 50%, particularly in fractures involving the proximal pole. Timely recognition and appropriate management are therefore critical to prevent long-term disability.

Vascular Anatomy And Healing Challenges

The scaphoid receives its primary blood supply from branches of the radial artery, which enter predominantly through the dorsal ridge and course retrograde toward the proximal pole. As a result, the proximal fragment is highly susceptible to ischemia following fracture. Healing is slow, averaging 3–6 months in proximal pole fractures, and nonunion occurs in approximately 5–10% of cases.

Classification Systems

Several Classification Systems Aid In Guiding Management:

- **Russe And Mayo Classifications:** Based on anatomical fracture orientation.
- **Herbert Classification:** Distinguishes stable (Type A) from unstable (Type B) acute fractures, delayed unions (Type C), and established nonunions (Type D).

Despite concerns about interobserver reliability, these systems remain widely used in clinical practice.

Diagnosis

Early diagnosis is often challenging, as plain radiographs may be inconclusive. Clinical findings include tenderness in the anatomical snuffbox, pain with longitudinal thumb compression, and reduced wrist motion.

- **Conventional Approach:** Immobilization in a cast with repeat radiographs after 2 weeks.
- **Advanced Imaging:** MRI has emerged as the gold standard, with near 100% sensitivity and specificity. Bone scintigraphy remains highly sensitive but less specific. CT is particularly useful for assessing fracture healing, malunion, and planning surgical intervention.

Management Of Acute Scaphoid Fractures

Stable, nondisplaced fractures may be managed with cast immobilization. However, immobilization often extends up to 12 weeks, particularly for proximal fractures, which may result in joint stiffness and delayed return to function.

Operative fixation using percutaneous screw placement has gained favor, offering higher union rates, faster recovery, and earlier return to work. Randomized trials demonstrate comparable long-term outcomes between casting and surgery, but surgical fixation provides earlier functional recovery without increasing complication rates.

Scaphoid Nonunions

Nonunion is one of the most feared complications of scaphoid fractures, occurring in up to 10% of all cases. Nonunions may result in chronic pain, carpal malalignment, and progressive degenerative arthritis if left untreated. Several factors influence the likelihood of nonunion, including fracture displacement, proximal pole involvement, compromised vascularity, and delayed diagnosis.

Management Strategies Depend On The Type Of Nonunion And The Presence Or Absence Of Arthritis:

- Stable fibrous nonunions (Mack-Lichtman type I) may be treated with bone grafting, with or without hardware.
- Unstable nonunions (type II) often require open reduction, internal fixation, and structural bone grafting to restore carpal alignment.
- Nonunions with early arthritis (type III) may necessitate additional procedures such as radial styloidectomy or partial scaphoid excision.
- Advanced cases (types IV and V) with midcarpal or pancarpal arthritis may require salvage surgery, such as four-corner fusion, proximal row carpectomy, or total wrist arthrodesis.

Bone grafting remains central to nonunion treatment. Nonvascularized grafts from the iliac crest or distal radius are effective in many waist nonunions. However, vascularized bone grafts, such as those based on the 1,2-intercompartmental supraretinacular artery (1,2-ICSRA), demonstrate superior outcomes in proximal pole and AVN-associated nonunions. Union rates approach 70–90% with vascularized grafts, compared to 40–50% with conventional grafting. Nonetheless, factors such as smoking, female sex, and carpal collapse may adversely affect union.

Salvage procedures are reserved for cases with significant degenerative arthritis. In such scenarios, pain relief and wrist stability are prioritized over motion preservation.

CONCLUSION

Scaphoid fractures and their complications remain a significant challenge. Advances in imaging have improved diagnostic accuracy, while surgical fixation offers earlier recovery and high union rates. In nonunion, vascularized bone grafting is often required, particularly in proximal pole and AVN cases. A structured diagnostic and treatment algorithm is essential to optimize functional outcomes and prevent long-term disability.

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