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Case Series

Orthopaedics Section

Surgical Management of Neglected Lunate Injuries: A Series of Three Cases on Proximal Row Carpectomy

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ABSTRACT

Neglected lunate injuries, including fractures and dislocations, can lead to severe complications such as Avascular Necrosis (AVN) (Kienböck's disease), chronic carpal instability, and Scapholunate Advanced Collapse (SLAC) wrist. These conditions often result in persistent pain, functional impairment, and progressive arthritis. Proximal Row Carpectomy (PRC) has emerged as a reliable, motion preserving surgical option for managing advanced lunate pathology, especially in resource limited settings. This case series evaluates the clinical and functional outcomes of PRC in patients with neglected or chronic lunate injuries. The case series reports on three patients (two males, one female; age range: 18-56 years) with chronic lunate collapse of varying aetiologies, including two with neglected lunate fractures and one with advanced Kienböck's disease (Stage III). All patients presented with persistent wrist pain, restricted motion, and imaging evidence of lunate fragmentation or AVN. Surgical intervention involved excision of the scaphoid, lunate, and triquetrum, with preservation of the radioscaphocapitate ligament, allowing capitate articulation with the lunate facet of the radius. Postoperatively, patients underwent structured physiotherapy focusing on Range Of Motion (ROM) and grip strength restoration. All three patients reported significant pain relief within 6-8 weeks postoperatively, with mean Visual Analog Score (VAS) improving from 8 preoperatively to approximately 2.5 at final follow-up. Functional wrist motion was preserved at 50-60% of the contralateral side, with dorsiflexion ranging from 30° to 40° and palmar flexion from 35° to 45°. Radial and ulnar deviation were maintained within functional limits. Grip strength, although reduced compared to the unaffected hand, allowed return to daily activities without major limitations. Radiological evaluation confirmed stable radiocapitate articulation without progressive degenerative changes during the follow-up period. PRC is an effective, economical, and technically straightforward option for neglected lunate injuries, offering a good balance between pain relief and preservation of wrist mobility. While early diagnosis remains essential to prevent irreversible damage, PRC provides favourable outcomes even in delayed presentations, provided that severe radiocapitate arthritis is absent. Larger studies with long-term follow-up are warranted to validate these findings.

Keywords: Avascular necrosis, Carpal instability, Neglected wrist fractures, Wrist surgery

INTRODUCTION

Lunate injuries, if undiagnosed or untreated, can lead to severe functional impairment and long-term complications. The lunate plays a pivotal role in wrist biomechanics, acting as a central axis for flexion and extension. Neglected lunate fractures or dislocations may result in AVN (Kienböck's disease), chronic carpal instability, and SLAC wrist, causing debilitating pain and restricted hand function [1,2]. Kienböck's disease, marked by lunate necrosis due to vascular compromise, is often exacerbated by repetitive microtrauma and anatomical factors such as negative ulnar variance [2]. Chronic instability arises from ligament insufficiency due to untreated lunate dislocations, leading to progressive pain and dysfunction [3,4]. SLAC wrist, stemming from scapholunate ligament disruption, progresses to degenerative arthritis and further impairs function [1].

Management of advanced lunate collapse includes revascularisation procedures, though their long-term outcomes remain inconsistent [2,5]. Limited carpal fusions, such as scaphotrapeziotrapezoid or scaphocapitate fusion, provide stability but compromise motion [6]. Total wrist arthrodesis relieves pain but sacrifices mobility [1,6]. PRC has gained favour for its technical simplicity and cost-effectiveness in chronic lunate injuries. It involves removal of the scaphoid, lunate, and triquetrum, allowing the capitate to articulate with the lunate fossa of the radius. PRC preserves 60-80% of wrist motion and up to 100% of grip strength, offering superior functional outcomes compared with other options [1,5,7-9], except in advanced capitolunate arthritis or capitate malalignment [1,5,10].

This case series presents three patients with delayed diagnoses of chronic lunate injuries, successfully managed by PRC. Unique attention was given to preserving critical ligaments, particularly the radioscaphocapitate ligament. The series highlights PRC as an underutilised yet optimal intervention in chronic presentations, demonstrating excellent postoperative pain relief and functional recovery in real-world, delayed-diagnosis settings.

Case 1

A 56-year-old male presented with persistent pain in the left wrist for three weeks following a slip-and-fall injury. Initially, he sought treatment at an external hospital, where a fracture of the left wrist was diagnosed. A below-elbow slab was applied for two weeks, but despite this, he continued to experience worsening pain and restricted wrist movements, prompting further evaluation. On clinical examination, he exhibited tenderness over the distal radioulnar joint, along with bony irregularity in the distal radius. Wrist movements were severely restricted, with dorsiflexion limited to 0-10 degrees and minimal palmar flexion. However, there was no Distal Neurovascular Deficit (DNVD) noted. Preoperative imaging, including X-rays [Table/Fig-1a], revealed a fractured and collapsed lunate, while Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) imaging [Table/Fig-1b,c] confirmed the presence of a crumbled lunate structure, indicative of loss of vasculature with fracture and secondary carpal instability. Given these findings, the patient was diagnosed with a neglected lunate fracture complicated by progressive AVN, resulting in chronic wrist instability and pain. Due to the poor prognosis for lunate salvage, PRC was planned

as the definitive surgical intervention. The procedure was performed using a dorsal approach to access the carpal bones. The proximal row of carpal bones, including the scaphoid, lunate, and triquetrum, was excised, allowing the capitate to articulate with the lunate facet of the distal radius, forming a stable radiocapitate joint. Soft tissue balancing was performed meticulously to optimise wrist stability. Following surgery, the wrist was immobilised in slight extension to facilitate proper healing. Postoperatively, the patient experienced significant pain relief within six weeks, with the VAS for pain improving from 8 (preoperative) to 2.6 (postoperative). Wrist mobility showed considerable improvement, preserving dorsiflexion of 35-40°, palmar flexion of 40-45°, radial deviation of 10-12°, and ulnar deviation of 15-20°, approximately 50-60% of normal wrist motion, though grip strength remained reduced compared with the unaffected side. The patient was gradually introduced to strengthening exercises after two months to enhance functional recovery. At the final 6-8 week follow-up, he was able to resume daily activities with minimal discomfort.

[Table/Fig-1]: (a) Preoperative X-ray showing fractured and collapsed lunate. (b) CT scan demonstrating lunate fragmentation and carpal misalignment. (c) MRI revealing Avascular Necrosis (AVN) of the lunate.

Case 2

An 18-year-old male presented with intermittent pain and stiffness in the right wrist for the past 10 months. The patient reported a history of falling from a tree as a child, sustaining an initial wrist injury that was managed with traditional bandaging techniques for approximately six weeks. Over time, the patient experienced intermittent episodes of pain, which progressively led to restricted wrist movement and functional limitations in daily activities. On clinical examination, the patient exhibited tenderness over the distal radioulnar joint, aggravated on deep palpation. Wrist ROM was significantly restricted and painful. However, there was DNVD noted. Preoperative X-rays [Table/Fig-2a] showed a dislocated lunate, while CT and MRI [Table/Fig-2b,c] confirmed chronic lunate dislocation and carpal instability. Given the chronicity of the condition and the irreversible nature of lunate degeneration, PRC was planned to restore function and alleviate pain. The same approach as for the previous patient was followed. The capitate was aligned with the lunate facet of the distal radius, creating a radiocapitate articulation to preserve wrist motion and stability. Soft-tissue balancing was performed to optimise joint stability, and the wrist was immobilised in slight extension to promote proper healing. Postoperative outcome and rehabilitation: At six weeks, the patient reported significant pain relief and improved wrist mobility following PRC. Clinically, ROM was preserved: dorsiflexion 20-30°, palmar flexion 30-30°, radial deviation 8-10°, and ulnar deviation 12-15°, allowing approximately 40-50% of normal wrist function, though grip strength remained slightly weaker compared with the unaffected side. By the three-month follow-up, the patient demonstrated progressive functional improvement, enabling him to perform daily activities with minimal difficulty. Wrist flexion and extension movements were regained, though with expected limitations due to the loss of the proximal carpal row. Gradual strengthening exercises were introduced to enhance grip strength and wrist stability.

[Table/Fig-2]: (a) Intraoperative image showing dorsal approach exposure. (b) Excision of the proximal carpal row. (c) Postoperative X-ray showing successful articulation of the capitate with the lunate facet of the radius.

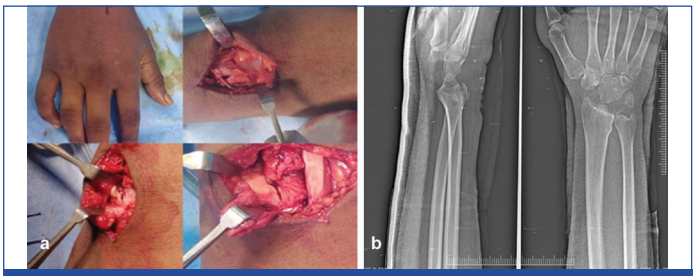
Case 3

A 44-year-old female presented with a three month history of left wrist pain that was progressively worsening. The pain was associated with restricted wrist movement and was aggravated by activity but partially relieved with medication. The patient expressed difficulty performing daily activities due to pain and stiffness. On clinical examination, there was no visible swelling, but tenderness was present over the lunate region. Passive dorsiflexion of the middle finger produced pain, suggesting lunate pathology. Wrist ROM was restricted and painful, but sensation and distal pulses were intact, confirming the presence of AVN of the lunate consistent with Kienböck's disease.

Preoperative X-ray [Table/Fig-3a] demonstrated hyperintensity of the lunate, while MRI [Table/Fig-3b,c] confirmed bone marrow oedema and necrosis, characteristic of late-stage AVN. Based on the imaging findings and persistent pain with functional impairment, the patient was diagnosed with Kienböck's disease (Stage III). Given the irreversibility of lunate necrosis, PRC was chosen as the definitive surgical treatment to relieve pain and restore function.

The procedure was performed using a dorsal approach to excise the proximal carpal row, allowing the capitate to articulate with the lunate facet of the distal radius, thus creating a stable radiocapitate joint. At the six week follow-up, the patient reported significant pain relief, with the VAS score improving from moderate to mild pain [Table/Fig-4]. Wrist mobility improved to dorsiflexion 30-35°, palmar flexion 35-40°, radial deviation 8-10°, and ulnar deviation 12-15°, representing approximately 70-80% of the normal range. However, grip strength remained slightly weaker compared with the unaffected side. The postoperative X-ray and CT/MRI confirmed proper alignment and articulation of the capitate with the radius, with no signs of instability or hardware complications [Table/Fig-5a-e]. Intraoperative and final imaging: By the three month follow-up, the patient could perform daily activities comfortably, and strengthening exercises were introduced to enhance grip strength and wrist stability.

[Table/Fig-3]: (a) Preoperative X-ray (AP and Lateral view) showing increased lunate density. (b) MRI revealing Avascular Necrosis (AVN) of the lunate with marrow changes. (c) Coronal MRI section demonstrating lunate collapse and altered signal intensity.



[Table/Fig-4]: (a) Intraoperative image showing dorsal approach exposure. (b) Postoperative X-ray showing realignment and stable articulation.

[Table/Fig-5]: (a) Patient performing wrist flexion-extension at six weeks follow-up post procedure; (b) Postoperative wrist X-ray (AP and lateral views) showing lunate collapse correction and stable radiocapitate articulation following Proximal Row Carpectomy (PRC); (c) and (d) shows the sagittal and axial MRI cuts of the wrist demonstrating degenerative changes and chronic instability. MRI reveals marrow oedema in the distal radius (ulnar side), lunate, capitate, scaphoid, and proximal hamate, with medial distal radius depression, subchondral cysts, and sclerosis. Findings are suggestive of AVN of the lunate with associated cartilage thinning, radiocarpal and DRUJ effusion, and TFCC complex hyperintensity. Associated features include proximal lunate defect, dorsal triquetral fracture fragment, radiocarpal arthritis, joint effusion, and signs of chronic wrist; (e) shows the 6 week old follow up post op anteroposterior and lateral x rays of the patient.

DISCUSSION

Kienböck's disease, AVN of the lunate bone, remains a difficult problem in orthopaedics, especially when it is not diagnosed early or left untreated. This condition usually occurs due to poor blood supply to the lunate, combined with mechanical stress and anatomical factors such as negative ulnar variance and poor vascular connections within the bone [11,12]. Repeated minor injuries to the wrist and position-related changes in blood flow can also worsen the condition over time [12].

The disease progresses to advanced stages such as Lichtman stage IIIA or IIIB, where there is collapse or fragmentation of the lunate, and surgery is usually required. The aim of surgery is to reduce pain while maintaining wrist movement. Among the different procedures available, PRC is one of the preferred methods. In PRC, the scaphoid, lunate, and triquetrum bones are removed, allowing the capitate bone to articulate with the distal radius. This technique is well-known for preserving wrist function and providing good pain relief [13].

Our present case series aligns closely with the findings of Croog AS and Stern PJ, who reported that PRC is effective even in advanced cases of Kienböck's disease [13]. All three of our patients presented late with chronic symptoms: two with neglected lunate fractures and one with advanced Kienböck's disease; all achieved substantial pain relief, improved grip strength, and return to daily activities after PRC, mirroring their results. Similarly, chim and moran et al., documented favourable outcomes in chronic and delayed cases, supporting our observation that PRC remains a viable option beyond early disease stages [14].

One of our patients had mild degenerative changes in the capitate-radial joint at presentation but still demonstrated good functional recovery. This is comparable to the report by Wagner et al., who emphasised that preserving key stabilising ligaments, such as the radioscaphocapitate ligament, can lead to successful outcomes even in the presence of early degenerative changes [9]. In contrast to the findings of Bain GI and Begg M, who reported superior long-term outcomes when PRC was performed in early-stage disease before significant collapse or arthritis, our series shows that delayed cases can still achieve satisfactory results if the capitotradial articulation is preserved and there is no severe radiocapitate arthritis [15]. This represents a notable difference, as most published series emphasise early intervention for optimal results.

Emerging techniques, such as customised 3D-printed lunate implants [16], aim to restore anatomy rather than excise the proximal row. While promising, these methods are currently expensive and lack robust long-term data, making PRC a more accessible and cost-effective solution in our setting. Compared with limited wrist arthrodesis, which often restricts movement more, PRC provides a better balance between pain relief and wrist mobility [12,17]. In our series, as in prior literature, some reduction in ROM and grip strength persisted postoperatively; however, this did not prevent patients from performing most daily activities comfortably.

In summary, our series adds to existing evidence that PRC is a simple, cost-effective, and reliable option for carefully selected patients, even in the setting of neglected or chronic lunate pathology. The outcomes in our patients closely parallel those reported in earlier studies, with pain relief and functional recovery as common findings; the main contrasting feature being the successful results achieved despite delayed presentation. Nevertheless, the small sample size and relatively short follow-up are limitations. Larger prospective studies with longer follow-up could help refine surgical decision-making in neglected lunate injuries.

Clinical implications and future directions: The findings from our case series further establish PRC as a viable and effective treatment for advanced Kienböck's disease. The decision to opt for PRC should be guided by careful evaluation of patient-specific factors,

including age, functional demands, and the severity of lunate collapse. Patients with severe capitolunate arthritis or misalignment of the capitate relative to the radius may not be ideal candidates, whereas those seeking pain relief with preserved wrist mobility benefit significantly from PRC [12,13]. Given its technical simplicity and motion preserving advantages, PRC remains a practical choice in both high-resource and limited-resource settings. However, further research should explore its long-term functional outcomes in comparison with other reconstructive procedures.

CONCLUSION(S)

Neglected lunate injuries leading to Kienböck's disease and chronic wrist instability are difficult to manage. In our three cases, PRC provided significant pain relief, fair wrist motion (approximately 50-60%), and acceptable grip strength. Compared with limited wrist fusion and bone grafting, PRC offered a better balance between pain relief and mobility. The procedure is technically simple and cost-effective, making it suitable even in resource limited settings. Although long-term outcomes require further study, PRC remains a dependable option for advanced lunate collapse, especially when preserving wrist movement is important.

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