Kienbock's disease and scapholunate dissociation after acute wrist trauma

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Introduction

Scapholunate dissociation is well-known to result from acute wrist trauma [9], or in some cases from chronic crystalline synovitis [1, 6]. The etiology of Kienbock's disease, or osteonecrosis of the lunate bone, remains unclear, and is likely multifactorial. Trauma may be contributory, although variations in lunate and radial morphology, ulnar-negative variance, lunate vascular pattern, disruption of venous outflow, and systemic conditions such as autoimmune disease and sickle cell anemia have all been associated [5, 12]. Both conditions have been studied extensively as independent pathologies, without any defined relationship.

We present a case of Kienbock's disease accompanied by scapholunate dissociation precipitated by a single traumatic event and followed by simultaneous progression. Both conditions have a variety of treatment options and remain controversial, reflecting a lack of prevailing reliably effective and durable surgical procedures, a lack of high-level evidence, and an uncertain natural history [5, 7, 8, 12]. The combination of these conditions presented unique concerns and was ultimately treated successfully with proximal row carpectomy.

Case Report

A 51-year-old right-hand-dominant female house cleaner fell from an exercise ball onto her outstretched dorsiflexed

right wrist. She had immediate pain and swelling which she treated with ibuprofen, ice, and bracing. Five weeks later she presented to clinic. Physical exam demonstrated tenderness over the scapholunate interval. Wrist range of motion included flexion 60°, extension 60°, pronation 75°, and supination 60°, all limited by pain. Watson's test elicited pain and slight scaphoid subluxation without clunk. She denied any history of right wrist symptoms or trauma. X-rays showed a widened scapholunate interval, slightly increased density of the lunate, and 1-mm ulnar-positive variance (Fig. 1). MRI arthrogram showed a partial volar scapholunate ligament tear and slight marrow edema in the ulnar portion of the lunate, possibly suggestive of bone contusion or ulnocarpal impaction, without fracture line or avascular necrosis (Fig. 2). She was placed in a short-arm cast.

At 3 months post-injury, the cast was removed, and she continued to have pain. She was placed in a removable brace. At 5 months post-injury, x-rays showed lunate sclerosis with fragmentation consisting of a coronal split of the volar one third of the bone (Fig. 3). Pain was tolerable until 11 months post-injury, at which time she returned. X-rays showed progression of the scapholunate dissociation with rotatory displacement of the scaphoid (Fig. 4). Wrist range of motion included flexion 30°, extension 45°, pronation 90°, and supination 90°. Grip strength was 45 lb with the injured dominant right and 65 lb with the left.

Proximal row carpectomy was performed. Lunate necrosis and scapholunate ligament tear were confirmed intraoperatively by direct visualization of a sclerotic avascular lunate and absent interosseous ligament tissue. There were no complications. Postoperatively, she was placed in a short-arm cast for 4 weeks, followed by a removable brace for another 4 weeks. At that time, she reported no pain and had returned to work at near full capacity. Wrist range of motion included flexion 30°, extension 60°, pronation 90°, and supination 90°. Grip strength was 60 lb with the injured dominant right and 65 lb with the left. At 14 months, she reported by telephone that she continued to do well.

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Fig. 1 PA view of right wrist at 5 weeks post-injury

Discussion

To our knowledge, Kienbock's disease and scapholunate dissociation resulting from isolated trauma and progressing simultaneously has not been previously described. One prior report [2] describes six patients with both conditions, although there were significant differences from our case. In three of the six cases, the conditions were diagnosed at widely varying intervals (8 months, 1 year, and 7 years), with insufficient data given to speculate on chronicity or causality. In the remaining three cases, the conditions were diagnosed together, although the time from initial trauma is not stated or unknown, including a patient for whom no trauma was actually recalled and was only inferred by radial and ulnar post-traumatic changes. Furthermore, five of the six patients were heavy laborers, which raises the possibility of multiple and cumulative trauma. With regard to radiographic data, all six cases in that series involved ulnar-negative variance, which has been independently associated

Fig. 2 T2-weighted MRI of right wrist at 5 weeks post-injury

Fig. 3 Lateral view of right wrist at 5 months post-injury

with Kienbock's, regardless of trauma. Lastly, only one patient had MRI performed, which makes evaluation of any pre-existing avascular changes difficult.

Our patient was a non-heavy laborer, with an ulnar-positive wrist, absence of avascular necrosis on early MRI, and a single well-defined trauma with known time course including documented progression of disease. Therefore,

Fig. 4 PA view of right wrist at 11 months post-injury

our case gives the most direct and compelling evidence of isolated trauma precipitating both Kienbock's and scapholunate dissociation. We are unable to absolutely rule out the possibility of pre-existing conditions or predispositions, as this would require pre-injury evaluation. Perhaps a large prospective study with serial pre-injury and post-injury imaging in an at-risk population such as athletes or heavy laborers would be helpful. Another possibility is that scapholunate widening may be a normal variant or congenital condition, as suggested in a study of bilateral wrist x-rays [11]. However, contralateral x-rays in our patient demonstrated normal scapholunate gap and angle. Furthermore, there is no known relationship of normal variant or congenital widening with progressive Kienbock's or scapholunate dissociation.

With regard to pathoanatomy and pathophysiology, we believe that the fall most likely caused the partial ligament injury, as seen on MRI, as well as vascular disruption of the lunate without fracture. In some cases, this vascular compromise is transient [13], although in our case it progressed to avascular necrosis. Anatomic considerations suggest that the initial partial tear of the scapholunate ligament may have been accompanied by a tear of the closely associated radioscapolunate ligament, which carries vasculature to the lunate [10, 14]. We further speculate that these conditions may have acted synergistically. Scapholunate instability may have created abnormal forces on the lunate, preventing revascularization, while lunate degeneration may have weakened the bony attachment of the ligament, leading to progressive instability, from partial to complete tear. These hypotheses warrant further investigation.

Initially, surgical treatment for scapholunate ligament tear without arthritis may include direct ligament repair, tenodesis, capsulodesis, bone-tissue-bone ligament reconstruction, or interosseous fixation. Later stages, known as scapholunate advanced collapse (SLAC wrist), may be treated with limited fusion (e.g., four-corner or capitulate), proximal row carpectomy, or total fusion. In our patient, several of the above procedures involving hardware in the lunate, such as for suture anchor, screw, or pin placement, might have risked failure as the lunate collapsed.

Surgical treatment for early Kienbock's may include joint-leveling (radial shortening, ulnar lengthening, capitate shortening), core decompression, and vascularized bone grafting. Later stages may still be treated with joint-leveling or vascularized bone grafting, or similarly to SLAC wrist, with limited fusion (e.g., scaphotrapeziotrapezoid or scaphocapitate), proximal row carpectomy, or total fusion. In our patient, several of the above procedures would have left the scaphoid dissociated, likely allowing further radioscapoid degeneration.

Proximal row carpectomy (PRC) was therefore selected as the most reliable and expedient procedure for both conditions, although it is typically reserved for more advanced stages with arthritic changes, and has shown disparate results for either condition alone. Stern showed that PRC for scapholunate dissociation resulted in poor outcomes [4], while PRC for Kienbock's was reliable and durable at an average of 10 years [3]. Although it may have been possible in our patient to first restore lunate integrity with joint-leveling or bone grafting, followed by another reconstructive procedure for the ligament injury, this would have committed the patient to at least two major procedures, each requiring perhaps months of healing time and immobilization, with uncertain chance of success at either procedure.

Surgeons should be aware of the potential concurrence of these conditions after wrist trauma (similar to ligament injuries accompanying distal radius fractures), remain vigilant for their radiographic signs including evidence of progression, and consider the implications of both when formulating a treatment plan. This case report may help establish the mechanism of injury, guide treatment, and prompt further pathoanatomic and pathophysiologic investigations.

Conflict of Interest The authors declare that they have no conflicts of interest, commercial associations, or intent of financial gain regarding this research.

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