Wrist arthroscopy and MRI for the evaluation of scapholunate and lunotriquetral ligaments tear in Kienbock's disease

Haytham Abdel-Moneim

Department of Orthopaedic Surgery, Faculty of Medicine, Fayoum University, Fayoum, Egypt

Correspondence to Haytham Abdel-Moneim, MD, C4B Hay Arabyia, Nineteenth Street, 5th Settlement, New Cairo, Cairo, Postal code 11765, Egypt. Tel (office) (002)24098802; fax: +20 225 293 292; e-mail: haa08@fayoum.edu.eg

Received 2 April 2019
Accepted 22 April 2019

The Egyptian Orthopaedic Journal 2019, 54:21–25

Purpose
The principal intrinsic wrist interosseous ligaments of the wrist are the scapholunate ligament (SLL) and the lunotriquetral ligament (LTL). Injuries to the wrist ligaments are common and can lead to chronic wrist pain. To our knowledge, the incidence of associated intrinsic wrist ligament pathology in Kienbock's disease has not been previously described. Herein, we used wrist arthroscopy and MRI for the evaluation of SLL and LTL injury in 40 patients with Kienbock's disease.
Patient and methods
The study was based on 40 patients with Kienbock's disease (stages II, IIIa, and IIIb), 17 women and 23 men. Their age ranged from 13 to 46 years (mean, 31 years and 6 months). All patients underwent MRI followed by wrist arthroscopy for the diagnosis of SLL and/or LTL tear.
Results
The incidence of isolated SLL tear and combined SLL and LTL tear of the 40 patients with Kienbock's disease included in this study was 27.5 and 7.5% as evaluated with MRI, respectively, and 35 and 15% as evaluated with wrist arthroscopy, respectively. According to Geissler arthroscopic classification, 75% of SLL injury were of grade I, while 25% were of grade III. Moreover, 50% of the patients with ligamentous injury reported a history of trauma with a mean of 4.4 months interval between the trauma and first presentation.
Conclusion
This study had proved that Kienbock's disease is associated with tear of SLL and/or LTL in a significant number of patients among the study group. However, it was difficult to distinguish between the degenerative and traumatic ligament tears.

Keywords:
Kienbock's disease, MRI, scapholunate and lunotriquetral ligaments tear, wrist arthroscopy

Egypt Orthop J 54:21–25

1110-1148

Introduction

The diverse and complicated functioning of the human wrist provides a unique and complex challenge for the physician. Evaluation of wrist injuries requires knowledge of structural as well as functional anatomies [1].

The wrist is supported by multiple ligamentous structures including the intrinsic carpal ligament, extrinsic ligaments, and triangular fibrocartilage complex [2]. The principal intrinsic interosseous ligaments are the scapholunate ligament (SLL) and the lunotriquetral ligament (LTL), which demonstrate a higher yield strength than the extrinsic ligaments and often fail through avulsion at their attachment sites [3].

Injuries to the wrist ligaments are common and can lead to chronic wrist pain and carpal instability and may result in scapholunate advanced collapse of the wrist [4]. Kienböck believed that traumatic rupture of the ligaments and vessels around the lunate produced lunate fracture with subsequent collapse [5].

During the past two decades, imaging has had an important role in the evaluation of intrinsic and extrinsic wrist ligaments and the triangular fibrocartilage disk (TFC). MRI [6], MR arthrography [7], and computed tomographic (CT) arthrography [8] can help provide satisfactory evaluations of these structures and have replaced triple-injection wrist arthrography. Wrist arthroscopy is considered the reference standard, and it has seen considerable growth since the original description of the techniques developed for viewing the anatomy of the wrist [9].

Herein, we used wrist arthroscopy and MRI for the evaluation of intrinsic wrist ligaments tear mainly SLL and LTL in 40 patients with Kienbock's disease.

Patients and methods

The study was based on 40 patients with Kienbock's disease, 17 women and 23 men. Ethical approval was obtained for the study, and informed consent was obtained from all patients included in this study. The study was conducted in Fayoum University Hospital from January 2012 to November 2015. Sixteen patients were complaining of right-sided and 24 patients of left-sided Kienbock's disease. According to Stahl [10] classification of Kienbock's disease, 10 patients were of stage II, 16 patients were of stage IIIa, and 14 patients were of stage IIIb. Their age ranged from 13 to 46 years (mean, 31 years and 6 months).

At presentation, a history was taken and clinical examination of the wrist was performed including examination of the contralateral wrist. Plain radiography (PA-lateral) and MRI examination were done for all patients. Thereafter, all patients underwent diagnostic wrist arthroscopy.

MRI and image analysis

All patients underwent MRI of the wrist in coronal, sagittal, and axial planes on a 3Philips Intera 1.0T (Model: Gyroscan Intera, Type: 1.0 Tesla, Philips Medical system, Made in Holland). The patients were scanned in the prone position with the elbow extended overhead, and the hand pronated and positioned in the center of the wrist coil at the scanner isocenter (Superman position), and the affected wrist extended into the MR scanner beyond the patient's head.

MR examinations were read by the same musculoskeletal radiologist, of proper experience in reading musculoskeletal MR examinations. The images were reviewed to detect any tear of SLL and/or LTL. Positive findings were described. On completion, MRI reports were correlated with arthroscopy results.

Wrist arthroscopy

The patient was placed supine with the procedure undertaken under general anesthesia. Traction was then applied to the upper limb; the arm was suspended via finger traps, and countertraction was applied using weight of ~10 lb, which was attached to a sling that was wrapped over the tourniquet of the limb. The three to four portal was created by blunt dissection down to the capsule once a skin incision has been made.

Routine diagnostic arthroscopy was performed with a 30°, 2.7 mm arthroscope through the standard 3–4 and 6R portals. The arthroscope was moved from the radial to the ulnar side of the wrist inspecting the articular surface of the radius, triangular fibrocartilage complex, and ligament integrity. Midcarpal arthroscopy was performed in all patients. Interosseus ligaments were inspected and examined by a probe for the detection of any ligamentous injury. All positive findings were reported.

Poor man arthrogram was done by injecting saline into the radiocarpal joint during visualization of the midcarpal joint for detecting S-L and L-T ligament tears.

Results

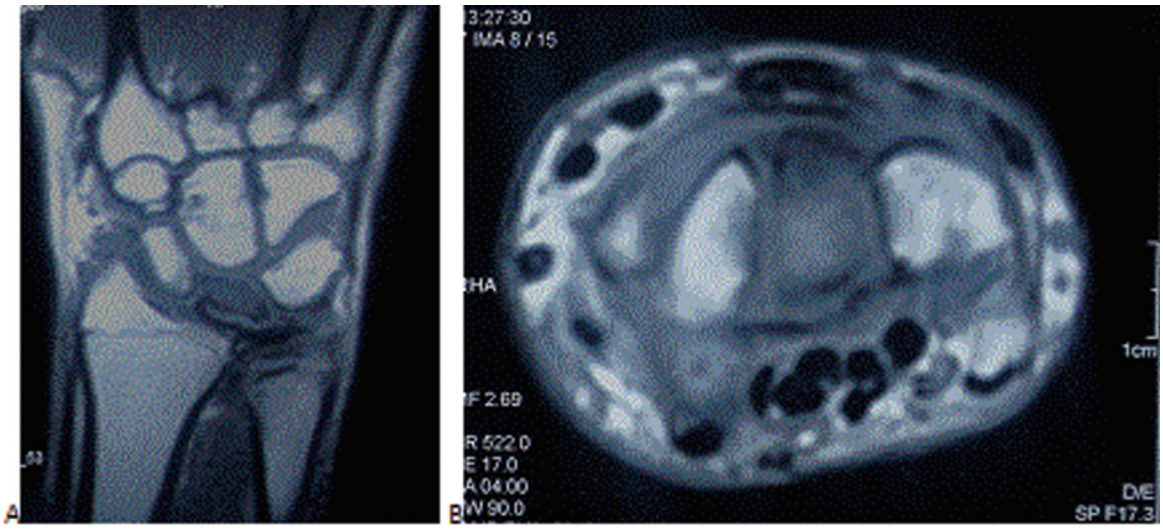
MRI examination of the intrinsic wrist ligaments in the 40 patients with Kienbock's disease (stages, II, IIIa, and IIIb) included in this study showed that 11 patients had S-L ligament tear (five patients in stage IIIa and six patients in stage IIIb), three patients had combined S-L and L-T ligament tears (one patient in stage IIIa and two patients in stage IIIb) and 26 patients had normal S-L and L-T ligaments (Figs 1, 2).

Arthroscopic examination of the intrinsic wrist ligaments of the same 40 patients showed that 14 patients had S-L ligament tear (six patients in stage IIIa and eight patients in stage IIIb), six patients had combined S-L and L-T ligaments tears (two patients in stage IIIa and four patients in stage IIIb), and 20 patients had normal S-L and L-T ligaments (Figs 3, 4).

The incidence of isolated SLL tear and combined SLL and LTL tears of the 40 patients with Kienbock's disease included in this study was 27.5 and 7.5% as evaluated with MRI, respectively, and 35 and 15% as evaluated with arthroscopy, respectively. According to Geissler [11] arthroscopic classification of carpal instability, 75% of SLL injury in this study were of grade I (attenuation/hemorrhage of interosseous ligament as seen from the radiocarpal joint and no incongruency of carpal alignment in the midcarpal space), while 25% were of grade III (incongruency/step-off of carpal alignment is seen in the radiocarpal and midcarpal space, and the probe may be passed through the gap between carpals). Moreover, 50% of the patients with ligamentous injury reported a history of trauma with a mean of 4.4 months interval between the impact of trauma and first presentation.

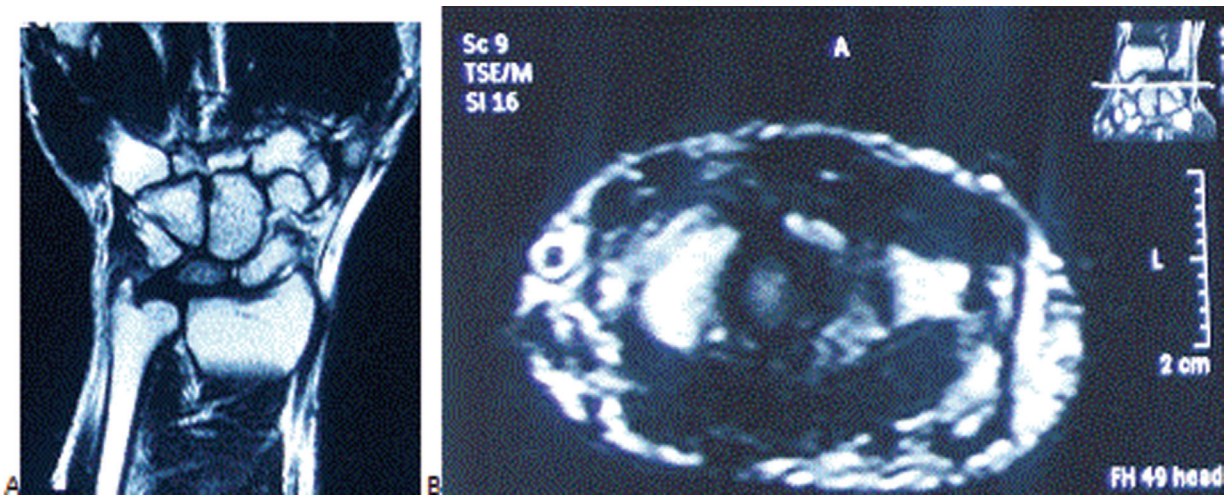
Two complications were reported among our study group; one patient developed a ganglion at one of his portal sites and three patients developed a hypertrophic scar at their portal sites.

Figure 1



(a) Coronal and (b) axial MRI wrist of a patient with Kienbock's disease, and scapholunate ligament tear.

Figure 2



(a) Coronal and (b) axial MRI wrist of a patient with Kienbock's disease and scapholunate and lunotriquetral ligament tear.

Discussion

To our knowledge, the incidence of associated intrinsic wrist ligament pathology with Kienbock's disease has not been previously described. The incidence of isolated SLL tear and combined SLL and LTL tear of the 40 patients with Kienbock's disease included in this study was 27.5 and 7.5% as evaluated with MRI, respectively, and 35 and 15% as evaluated with arthroscopy, respectively. Some authors reported that with regard to pathoanatomy and pathophysiology, the fall most likely causes 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, although it may progress to avascular necrosis [12]. Anatomic considerations suggest that the initial partial tear of the SLL may have been accompanied by a tear of the closely associated radio-SLL, which carries vasculature to the lunate [13]. These conditions may have acted synergistically. SL 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 [14]. In the current study, 75% of SLL injury were of Geissler grade I and 25% were grade III as detected by arthroscopy. Moreover, 50% of the patients with ligamentous injury among this study group reported a history of trauma with a mean of 4.4 months interval between the impact of trauma and first presentation. Actually, it was difficult to distinguish between the degenerative and traumatic ligament tears associated with Kienbock's disease in this series, but we

Figure 3

Wrist arthroscopy showing scapholunate ligament tear in a patient with Kienbock's disease.

Figure 4

Wrist arthroscopy showing lunotriquetral ligament tear in a patient with Kienbock's disease.

think that at least those with a frank history of wrist trauma might have developed traumatic SLL and LTL tears which could be part of the etiology of Kienbock's disease. Thereby, we believe that these hypotheses warrant further investigations, including the pathogenesis of the ligament tear associated with Kienbock's disease, their manifestations, and their proper management.

The SLL comprises three bands, of which the dorsal is mechanically the most important, followed by the volar and central bands. The volar band is less prone to injury. The third and less relevant central band, a membranous portion, is frequently perforated in adult individuals without clear consequence for wrist biomechanics. For this reason, communication between the radiocarpal and midcarpal compartments during fluoroscopic or MR arthrograms does not necessarily represent a symptomatic finding or reflect a traumatic tear of the ligament [3]. Thereby, the poor man arthrogram, which we used during wrist arthroscopy in this trial by injecting saline into the radiocarpal joint during visualization of the midcarpal joint, seems to be moderately accurate for detecting S-L and L-T ligament tears. Moreover, as the patients included in this trial sustained Kienbock's disease which is a painful condition by itself, it was difficult to detect whether the associated ligament injuries were symptomatic or not.

The dorsal band of SLL is easily seen on the axial-plane and coronal-plane images of MRI. By arthroscopy, the normal SLL is a continuous thin band bridging the chondral margins of the lunate and the scaphoid. The insertion in the hyaline cartilage should not be mistaken for a tear. The low sensitivities for the SLL and LTL in MRI are largely due to their small structure, within what is already a small joint. Conventional coronal imaging of the LTL has proven problematic and the distinction between volar, middle and dorsal components can be quite difficult [3]. This range could be partly due to the wide variations in practice, such as the resolution of the scanner used, the thickness of the sections used, the use of dedicated surface coil, and the radiologist's experience [15]. The accuracy of these findings is controversial [16]. Thereby, we used wrist arthroscopy in this study to increase the accuracy of the diagnosis.

Tears of the dorsal component or complete tears (disruption of all three components) are also more frequently symptomatic and secondary to trauma [17]. However, history of frank trauma was reported only in four patients with ligament injuries among this study group.

However, there is a debate about whether widening of the SL interval implies an associated injury of the extrinsic ligaments or not [18]. This widening was a constant arthroscopic finding in nearly all cases with SLL tear in this series. A similar rationale is applied to the volar component, except that it may demonstrate intermediate signal intensity in normal cases [19].

The LTL is also composed of three components, but the volar band is the most relevant for stability. The whole extension of the ligament and its tears may be difficult to detect; the presence of a step-off between the lunate and the triquetrum, central tears of the TFC, and findings compatible with ulnocarpal abutment warrant careful LTL examination [20]. The LTL has been more difficult to evaluate from an imaging standpoint, using nonvisualization or alterations in the ligament morphology as a sign of ligament tear [21]. Tears can be categorized as either of full thickness or partial thickness [2].

The limitations of this study was the small number of patients, no control group, and no MRI arthrography.

Although the reported complication rate of wrist arthroscopy is as much as 2% and includes injuries to the overlying tendons, nerves, and arteries and/or reflex sympathetic dystrophy [9], the complications reported among this study group included only ganglion or hypertrophic scar at the portal sites in three patients. Moreover, we could not detect whether wrist arthroscopy in Kienbock's disease stages II and III through the RC joint would interfere with the revascularization process or not.

Conclusion

Wrist arthroscopy was added to MRI to increase the accuracy of the diagnosis of intrinsic wrist ligaments injury in patients with Kienbock's disease. This study had proved that Kienbock's disease is associated with tear of SLL and/or LTL in a significant number of patients among the study group. However, it was difficult to distinguish between the degenerative and traumatic ligament tears.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References

1 Kathleen MC, Kristy MS. Wrist injuries. Emerg Med Rep 2011; 32:297–307.
2 Chabra A. Wrist ligament pathology: diagnosis and pitfalls. Radiographics 2012; 32:879–896.
3 Sampaio ML, Kolanko NM. MRI of the wrist. Appl Radiol 2014; Oct 9:10–19.
4 Taleisnik J. Current concepts review: carpal instability. J Bone Joint Surg Am 1988; 70:1262–1268.
5 Bain GI, Yeo CJ, Morse LP. Kienböck disease: recent advances in the basic science, assessment and treatment. Hand Surg 2015; 20:352–365
6 Behr B, Stadler J, Michaely HJ, Damert HG, Schneider W. MR imaging of the human hand and wrist at 7 T. Skeletal Radiol 2009; 38:911–917.
7 Berná-Serna JD, Martínez F, Reus M, Alonso J, Doménech G, Campos M. Evaluation of the triangular fibrocartilage in cadaveric wrists by means of arthrography, magnetic resonance (MR) imaging, and MR arthrography. Acta Radiol 2007; 48:96–103.
8 De Filippo M, Pogliacomi F, Bertellini A. MDCT arthrography of the wrist: Diagnostic accuracy and indications. Eur J Radiol 2010; 74:221–225.
9 De Smet L. Pitfalls in wrist arthroscopy. Acta Orthop Belg 2002; 68:325–329.
10 Stahl F. On lunatomalacia. A clinical and roentgenological study, specially on its pathogenesis and the late results of inmobilization treatment. Acta Chir Scand. 1947;Suppl 126:1–133.
11 Geissler WB. Arthroscopic management of scapholunate instability. J Wrist Surg 2013; 2:129–135.
12 White RE, Omer GE. Transient vascular compromise of the lunate after fracture-dislocation or dislocation of the carpus. J Hand Surg Am 1984; 9:181–184.
13 Lamas C, Carrera A, Proubasta I, Llusà M, Majó J, Mir X. The anatomy and vascularity of the lunate: considerations applied to Kienböck's disease. Chir Main 2007; 26:13–20.
14 Desmarais J, Soong M. Kienbock's disease and scapholunate dissociation after acute wrist trauma. Hand (N Y) 2013; 8:82–85.
15 Suraj J, Kenneth L, Subodh CD. Accuracy of direct magnetic resonance arthrography in the diagnosis of triangular fibrocartilage complex tears of the wrist. Int Orthop (SICOT) 2008; 32:251–253.
16 Spaans AJ, Minnen PV, Prins HJ. The value of 3.0-tesla MRI in diagnosing scapholunate ligament injury. J Wrist Surg 2013; 2:69–72.
17 Linkous MD, Pierce SD, Gilula LA. Scapholunate ligamentous communicating defects in symptomatic and asymptomatic wrists: characteristics. Radiology 2000; 216:846–850.
18 Theumann NH, Etechami G, Duvoisin B. Association between extrinsic and intrinsic carpal ligament injuries at MR arthrography and carpal instability at radiography: initial observations. Radiology 2006; 238:950–957.
19 Totterman SM, Miller RJ. Scapholunate ligament: normal MR appearance on three-dimensional gradient-recalled-echo images. Radiology 1996; 200:237–241.
20 Ringler MD. MRI of wrist ligaments. J Hand Surg Am 2013; 38:2034–2046.
21 Schweitzer ME, Brahme SK, Hodler J. Chronic wrist pain: spinecho and short tau inversion recovery MR imaging and conventional and MR arthrography. Radiology 1992; 182:205–211.