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Ahmed Mohamed Zak
Orthopedic Surgery, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt,
drzakiortho@gmail.com

Abd El Hakim Abd Allah Massoud
Orthopedic Surgery, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Mohamed Amer Mohamed
Orthopedic Surgery, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

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ORIGINAL ARTICLE

Comparative Study between Arthroscopic and Radiological Findings in Staging of Kienbock's Disease

Ahmed M. Zaki *, Abd El Hakim A. Massoud, Mohamed A. Mohamed

Department of Orthopedic Surgery, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Abstract

Background: ***Avascular necrosis of the lunate, known as Kienbock's Disease, manifests as progressive wrist discomfort and atypical carpal motion. Kienbock disease possesses the capacity to result in significant wrist degeneration and impaired wrist function ultimately. Management of Kienböck's disease depends on the radiological stage of the disease.***

Aim and objectives: ***To assess the wrist arthroscopically in cases with Kienbock disease and compare the imaging and wrist arthroscopy findings in grading Kienbock's disease and in making the management decision.***

Patients and methods: ***This prospective study was conducted on ten cases of Kienbock's disease at Al-Azhar University Hospitals. Aiming to correlate radiographic stages and arthroscopic findings and determine whether this changes the surgical decision.***

Results: ***The classification of the disease can be changed according to the findings of imaging and arthroscopy. The classification based on x-ray changed after CT in 50% of the patients and after MRI in 30%. The classification based on imaging changed after arthroscopic assessment in only one patient. Management decisions changed in 30% of the patients after arthroscopic assessment.***

conclusion: ***Arthroscopic assessment is an effective method for staging wrist articular surface in Kienbock disease and in confirming the radiological classification of the disease also has a vital role in deciding the best way of management.***

Keywords: Kienbock's disease; Kienbock grading; Kienbock management; Arthroscopic assessment; Radiological assessment

1. Introduction

Progressive wrist pain and abnormal carpal motion are possible outcomes of Kienbock's Disease (KD), also known as avascular necrosis of the lunate. The wrist may deteriorate significantly and lose function due to Kienböck disease. An unknown combination of adverse vascular and anatomical variables likely led to lunate avascular necrosis. When an "at-risk" lunate is subjected to excessive loads and repeated mechanical stresses, it can lead to lunate fracture, fragmentation , osteonecrosis , and collapse.[1,2]

The diagnostic accuracy of KD has increased thanks to recent advances in radiography. Plain radiographs are the first line to assess and diagnose KD. These images allow for a broad assessment of degenerative change, sclerosis, and collapse in addition to assessing ulnar variation, lunate size and shape, radial inclination, and the radio scaphoid angle. CT-enables more precise diagnosis and staging of osseous and perilunate disorders. It is possible to identify an aberrant marrow signal utilizing MRI. Gadolinium hyperenhancement on magnetic resonance imaging is indicative of continued vascular perfusion. Schmitt's classification is what we utilize. [3,4]

For evaluating and treating KD wrists, arthroscopy is a useful technique. It is the gold standard for evaluating lunate and wrist articular surfaces and identifying peri-lunate ligament injuries. It helps in the debridement of articular surfaces and the treatment of synovitis.[5,6]

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* Corresponding author at: Orthopedic Surgery, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt.
E-mail address: drzakiortho@gmail.com (A. M. Zaki).

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The Bain and Begg classification grades the "functional" state of the articular surfaces and the wrist.[7] The 'functional' status of the articulating chondral surfaces and the total number of surfaces were key to the Bain and Begg classification. Functional surfaces seem normal via an arthroscope, meaning they are smooth and shiny. Nonfunctional articular surfaces degenerated or with fibrillation, chondral detachment, or subchondral fracture cannot perform their normal role. [8]

Decision-making in managing Kienbock's disease depends mainly on radiological staging, which may need more accurate. The integrity of the articular surface affects the management decision, and it cannot be seen in an x-ray or CT but can be seen by arthroscopy. Arthroscopy helps in staging the disease by spotting any changes in the articular surface and can help spot a concealed fracture. Wrist stability affects the decision of management; arthroscopy can help us in examining the stability of the carpal bones the integrity of the intercampus ligaments.[9,10]

The goal of this investigation was to evaluate the wrist arthroscopically in cases with Kienbock disease and compare the findings in imaging and wrist arthroscopy in grading Kienbock's disease and making the management decision.

2. Patients and methods

This was a prospective case series study conducted on ten cases of Kienbock's disease at Al-Azhar University Hospitals. Its aim was to correlate radiographic stages with arthroscopic findings and determine whether this changes the surgical decision.

2.1.Inclusion criteria: Age: 17-60 years old, male and female, and patients diagnosed with Kienbock's disease and scheduled for surgical treatment.

2.2.Exclusion criteria: The patient has an open physis and had a previous wrist operation.

2.3.Methods:

Ethical consideration: Every patient in the study gave oral and written informed consent. The ethical issues of patients' names were considered.

All patients were subjected to the following preoperative radiological evaluation: X-ray, CT, and MRI. In each case, we detected the radiological findings (lunate sclerosis, collapse or fracture, ulnar variance, radio scaphoid angle, and radiological classification).

2.4.Surgical Technique: All patients had a radiocarpal and midcarpal wrist arthroscopy.

Setup and Instrumentation: Position: supine, and the arm was suspended with a traction tower; Arthroscopy: 2.7mm 30° arthroscopies used, Video Cameras/ Monitors/ Light Source/ probe /trocar with a trocar sleeve and Motorized Instruments as shaver, other instruments included Knife 15, Mosquito, Cannula and Probe. An arm tourniquet was necessary to obtain good visualization of wrist anatomical structures. The lunate, adjacent articular surfaces, and interosseous ligaments are examined via the 6R portal and the 3–4 portal with a probe.

So, we can detect the arthroscopic findings (Bain classification, lunate fracture or collapse, all the wrist articular surfaces, either functional or not, synovitis, and the integrity of intercampus ligaments).

The collected radiological and arthroscopic data are compared, and then we correlate radiographic stages and arthroscopic findings to determine whether this changes the surgical decision.

2.5.Statistical analysis: Information gathered via a thorough history, physical examination, imaging, and an arthroscopic evaluation. Microsoft Excel was utilized for coding, entering, and analyzing the outcome measures. Information was transferred into SPSS 20.0 (Statistical Package for the Social Sciences) for further examination. A descriptive study was done.

3. Results

Table 1. The studied patients' demographic data and disease grading and management:

CASES	AGE (YEARS)	GENDER	DOMINANT HAND	AFFECTED HAND	ULNAR VARIANCE	MANAGEMENT DICISION
1	42	M	R	L	Neutral	CHANGED
2	35	F	R	R	Negative	NO CHANGE
3	28	M	R	L	Negative	CHANGED
4	35	F	R	L	Negative	NO CHANGE
5	38	F	R	R	Negative	NO CHANGE
6	30	M	R	R	Negative	NO CHANGE
7	44	F	R	R	Neutral	NO CHANGE
8	24	F	R	L	Negative	CHANGED
9	32	F	L	L	Neutral	NO CHANGE
10	45	F	R	R	Neutral	NO CHANGE

Our study included 10 patients, 70% of them were females. Age from 20 to 45 years. 90% of studied patients aged from 30 to 45 years. Right-handed patient occurs in 90% of patients. Right-

side lesion occurs in 50% of patients. So, the dominant hand was affected in 60% of the cases. 60% of our patients had negative ulnar variance. Management decision changed in 30% of the patients after arthroscopic assessment. (Table 1)

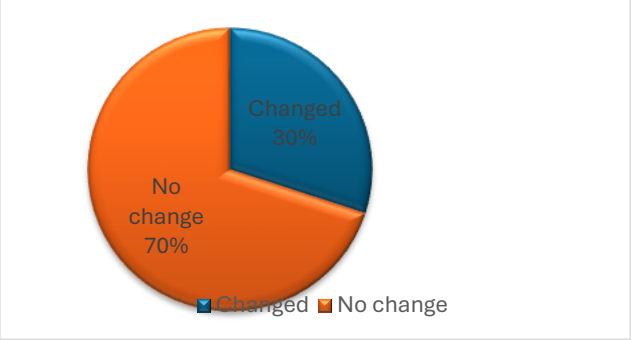

Figure 1. Pie chart showing distribution of patients according to the change in the management decision of kienbock's disease after wrist arthroscopy.

Table 2. the Lichtman (osseous) and Bain (articular) classifications of the studied patients graded as high (H) and low (L) stages. 80% of the studied patients were in the same grading either high or low and 20% of them were in a high osseous stage and a low articular grade.

CASE NUMBER	1	2	3	4	5	6	7	8	9	10
Lichtman (osseous) classification	3A (H)	3A (H)	3C (H)	2 (L)	3C (H)	3C (H)	2 (L)	3C (H)	3A (H)	3C (H)
Bain (articular) classification	2a (L)	1 (L)	2b (H)	1 (L)	2b (H)	4 (H)	2a (L)	4 (H)	3 (H)	3 (H)

Table 3. the Lichtman classification of the studied patients according to the imaging and arthroscopic findings.

	CASES	1	2	3	4	5	6	7	8	9	10
LICHTMAN CLASSIFICATION	X-ray	2	3A	3B	2	3B	3B	2	3C	3A	3B
	CT	3A	3A	3C	2	3C	3C	2	3C	3A	3C
	MRI	3A	3A	3B	2	3C	3B	2	3B	3A	3C
	Arthroscopy	3A	3A	3C	2	3C	3C	2	4	3A	3C

The classification of the disease can be changed according to the findings of imaging and arthroscopy. The classification based on x-ray changed after CT in 50% of the patients and after MRI in 30% of the patients. The classification based on imaging changed after arthroscopic assessment in only one patient. In this patient the lunate fracture detected only by CT scan then confirmed by arthroscopy, and the arthritis was best seen by arthroscopic assessment.

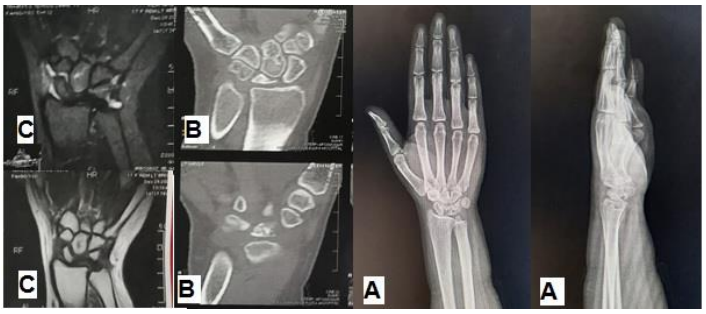

Figure 2. The radiology of the patient in which arthroscopy changed the classification. (A)plain radiograph, (B)CT scan and (C)MRI scan.

Figure 3. the arthroscopy of the patient in which arthroscopy changed the classification. (A)synovitis, (B)non-functional distal lunate and proximal capitate articular surfaces and (C)concealed fracture.

Table 4. Distribution of the studied patients according to the affected articular surfaces.

THE ARTICULAR SURFACE	N=10	%
PROXIMAL LUNATE:		
AFFECTED(NON FUNCTIONAL)	10	100%
NORMAL(FUNCTIONAL)	0	0%
RADIUS LUNATE FOSSA:		
AFFECTED(NON FUNCTIONAL)	7	70%
NORMAL(FUNCTIONAL)	3	30%
DISTAL LUNATE:		
AFFECTED (NON FUNCTIONAL)	6	60%
NORMAL (FUNCTIONAL)	4	40%
PROXIMAL CAPITATE:		
AFFECTED (NON FUNCTIONAL)	2	20%
NORMAL (FUNCTIONAL)	8	80%

This study included 10 patients. The proximal lunate articular surface was affected in all the patients and the radius lunate fossa was affected in 70% of the patients. The distal lunate articular surface was affected in 60% the patients and the proximal capitate was affected in 20% of the patients.

Table 5. Distribution of the studied patients according to the affected synovium and radioscaphoid articulation:

	N=10	%
RADIOSCAPHOID ARTICULATION:		
AFFECTED(NON	2	20%
	8	80%

FUNCTIONAL) NORMAL(FUNCTIONAL)		
SYNOVIUM:		
AFFECTED(SYNOVITIS)	10	100%
NORMAL	0	0%

This study included 10 patients. The radioscaphoid articulation was affected in 20% the patients and all the patients have synovitis.

Table 6. Distribution of the studied patients according to the lunate bone arthroscopic findings:

	N=10	%
CONCEALED FRACTURE:		
POSITIVE	4	40%
NEGATIVE	6	60%
FLOATING LUNATE:		
POSITIVE	6	60%
NEGATIVE	4	40%

During arthroscopic assessment by probing the lunate bone a concealed fracture was found in 40% of the patients and floating lunate in 60% of the patients.

Table 7. Distribution of the studied patients according to the affected lunate ligaments:

	N=10	%
SL LIGAMENT:		
INTACT	4	40%
COMPROMISED	6	60%
LT LIGAMENT:		
INTACT	4	40%
COMPROMISED	6	60%

The Scapho-lunate ligament was compromised in 60% the patients The Luno-triquetral ligament was compromised in 60% the patients.

4. Discussion

While the dominant or primary cause of Kienböck's disease has yet to be determined, the result is necrosis and collapse. The disease is clearly associated with decreased grip strength and wrist motion, and there is a varying degree of lunate collapse.

Lichtman classified radiologic findings of Kienbock'skienbock's disease, and the management of Kienbock disease (KD) has traditionally been based on his classification.[11]

In our study, the classification of the disease changed according to imaging and arthroscopy findings. The classification based on x-ray changed after CT in 50% of the patients and after MRI in 30%. The classification based on imaging changed after arthroscopic assessment in only one patient. According to these data, the arthroscopic assessment finding did not add much to the classification as it only helped in grade 4 as the MRI did not confirm the arthritis. CT has a vital role in the classification, but MRI's role is more about confirming the AVN diagnosis than the classification.

Bain used arthroscopy in KD as a vital tool in assessing and managing the disease. Current staging and treatment algorithms would benefit from a greater understanding of the articular cartilage involvement in Kienböck's disease. Arthroscopy of the wrist allows direct visualization and palpation of articular surfaces. This information can be valuable in staging and clinical decision-making in Kienböck's disease. High-resolution MRI provides great information about the integrity of the radiocarpal and midcarpal articulations. However, arthroscopy remains the gold standard against which all noninvasive diagnostic modalities are compared.[12]

In our study, management decisions changed in 30% of the patients. Those three patients had a new management decision after arthroscopic assessment. The first case had a compromised proximal lunate articular surface with a decision of lunate revascularization, but this articulation needed to be bypassed. The second and third cases had a nonfunctional radio scaphoid articulation with a decision of transferring the central load to this articulation, but it was not the best decision to make; so the fusion of this articulation was a better choice, but we found the stability of the proximal carpal row was compromised in these cases, so the best decision was salvage procedure such as PRC or total Wrist fusion.

As in MacLean and Bain's study, all our patients have synovitis. Arthroscopic debridement was done for all cases to visualize the field better and as a part of the management. So, arthroscopy is helpful in all cases as a diagnostic tool and treatment.[5]

The change in the management decision is mainly based on the amount of articular compromise and carpal collapse. These data can be best provided by arthroscopic assessment of the wrist. In 2017, a collaboration of multiple classification schemes to better inform diagnosis and treatment was developed. Considering the patient's age, lunate revascularization potential, and individual carpal pathoanatomic characteristics, the combined classification simplified the many useful schemes. Lichtman and Bain separated the algorithm into three sections: (A) age, (B) stage of the lunate and (C) state of the wrist. Section (A) divides patient age into three subgroups with the potential for success of nonoperative treatment: less than 15 years of age, 16 to 20 years of age, and more than 70 years of age. Patients aged 21 and 70 were then analyzed separately in sections (B) and (C) with operative considerations. Section (B) is subdivided into three parts evaluating lunate integrity with associated treatment suggestions. Section (C) is split into four subgroups based on

the amount of articular compromise and carpal collapse.[9,13]

By comparing the classifications of Kienbock's in our patients, we found that the disease affects different parts of the lunate and wrist. So, there are osseous, vascular, and articular-based classifications. However, they could be more perfectly synchronized as the patient can have a high osseous stage and a low articular grade. MacLean and Bain, in collaboration with Lichtman, recently published their hypotheses concerning the etiology and pathogenesis of KD and introduced a novel algorithm considering the disease's osseous, vascular, and chondral components. The management should consider the higher grade of them all.[5,12]

Arthroscopic assessment is an effective method for staging wrist articular surface in Kienbock disease and in confirming the radiological classification of the disease. It also has a vital role in deciding the best way of management. Bain and Durrant stated that arthroscopy represents the "gold standard" in assessing chondral surfaces.[12]

In our study, we found that radio scaphoid articulation assessment has a vital role in many modalities of kienbock management in which the load of the carpus is transferred from the lunate fossa to the scaphoid fossa, such as STT fusion and SC fusion and partial capitate shortening. Bain and Begg's arthroscopic staging system does not consider the integrity of the wrist ligaments. Also, it does not consider capsule synovitis, but Bain reconsidered those in his new algorithm of Kienbock's treatment. [6]

Based on the classifications and algorithm proposed by Lichtman, Schmitt, and Bain, the objectives of surgical intervention are as follows: alleviate pain, safeguard against lunate collapse, and prevent wrist degeneration and collapse. Lunate reconstruction in focal compromise to the lunate should be considered, motion-preserving procedures should be considered when the lunate is unreconstructible, and salvage procedures should be considered when the wrist is unreconstructible. Thus, when determining the optimal procedure, it is necessary to consider various factors.[1]

This is the first study to correlate radiological densification with arthroscowithing.

Our study's limitations included a small study group, no follow-up to confirm the new management prognosis and vascular classification, and gadolinium MRI was not included.

4. Conclusion

Arthroscopic assessment is an effective method for staging the wrist articular surface in Kienbock disease and confirming the radiological classification of the disease. It also has a vital role in deciding the best management approach. It is the gold standard for assessing the articular surfaces of the lunate and wrist and evaluating the peri-lunate ligament tears. Also, probing helps evaluate the integrity of the lunate bone.

Disclosure

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Authorship

All authors have a substantial contribution to the article

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There are no conflicts of interest.

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