The Management of Kienböck Disease: A Survey of the ASSH Membership

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Abstract

Background The purpose of this study was to determine the current trends and common practices for the treatment of Kienböck disease at different stages.

Question/Purpose To determine the current trends and common practices by hand surgeons for the treatment of Kienböck disease.

Methods A survey with hypothetical Kienböck disease cases stratified by the Lichtman staging system was distributed to the American Society for Surgery of the Hand (ASSH) members. Questions and responses reflected common treatment strategies.

Results Of a total of 375 worldwide respondents, preferred treatments of Kienböck disease were as follows: for Stage I disease, an initial trial of splinting was favored (74%), followed by radial shortening osteotomy for continued symptoms. For Stage II disease, 63% of surgeons preferred surgical intervention, particularly radial shortening osteotomy. For Stage IIIa with negative ulnar variance, 69% chose radial shortening osteotomy. Responses were heterogeneous for Stage IIIa Kienböck with positive variance, and capitate shortening osteotomy and vascularized bone grafting were preferred. Salvage procedures predominated for Stage IIIb disease, including proximal row carpectomy (PRC; 42%), intracarpal arthrodesis (21%), and total wrist fusion (10.7%). Similarly, Stage IV disease was treated by 87% of respondents by either PRC or wrist fusion. Without regard to stage of disease, 90% of participants reported using the same Lichtman staging to guide treatment and would also alter treatment strategy based upon ulnar variance.

Conclusions Most respondents used Lichtman staging and ulnar variance to guide treatment decisions. Results indicate that the most common surgical treatments were radial shortening osteotomy for early disease and PRC in later stages.

Level of Evidence Level IV, Economic/Decision Analysis

Keywords
- Kienböck disease
- wrist
- carpal
- arthritis
- lunate
- survey
- treatment
- trends

In 1910 Robert Kienböck, an Austrian radiologist, described a cohort of patients with osteomalacia of the lunate.[1] Although he was not the first physician to describe this phenomenon, he believed that these changes were due to an avascular necrosis of the lunate as a result of a traumatic insult.[2] The etiology of Kienböck disease remains a topic of debate and controversy.[3,4] A classification of Kienböck disease was published by Stahl in 1947,[5] and in an effort to describe the disease better Lichtman et al introduced a modified classification system, which remains the most commonly used today, with four broad stages of disease.[6] This classification was originally based on radiographs, although in later papers the use of advanced imaging modalities such as magnetic resonance imaging (MRI) was included.[6–10] This classification system has good interobserver reliability.[7,8,10–15]

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There are several treatment options available for managing Kienböck disease, and they are primarily based on the stage of the disease on presentation. The goals for treatment include pain relief, motion preservation, and maintenance of strength and function,[16] although there is insufficient evidence supporting the superiority of any single treatment procedure that can consistently and reliably achieve these goals.[17] Additionally, there is a lack of level 1 evidence from large, prospective, randomized trials comparing different treatment options for Kienböck disease, as this is a rare disease making it difficult to obtain enough power to obtain statistically significant results[18–31]; thus, the aim of this study was to determine the current trends and common practices by hand surgeons for the treatment of Kienböck disease at different Lichtman stages.

Materials and Methods

After institutional review board approval, a questionnaire was developed and members of the American Society for Surgery of the Hand (ASSH) were surveyed. The survey was conducted electronically with an Internet-based questionnaire distributed via email to ASSH national and international members using SurveyGizmo (Surveygizmo.com, Boulder, CO, USA). Surgeons were presented with several cases of Kienböck disease at different Lichtman classification stages and asked to choose their optimal intervention from a list of operative and nonoperative modalities. In addition, they were asked to answer several general and demographic questions.

The questionnaire comprised four clinical scenarios of Kienböck disease based on the Lichtman classification. Each case described the same "typical" patient, a right-hand-dominant healthy adult male laborer with a 6-month history of atraumatic wrist pain limiting his ability to work. These case presentations varied primarily on radiographic findings. Although radiographic images were not provided, descriptions of the standard posteroanterior (PA), oblique, and lateral radiographs of the affected wrist were given and a radiographic diagnosis was provided as a closing statement, e.g., "A diagnosis of Stage I Kienböck's disease is made." This was done to ensure that all respondents understood the stage of disease they were treating and to avoid differences in radiographic interpretation of the diagnosis. After each case presentation, a question about preferred treatment was asked. Answer choices provided a wide range of treatment options including nonoperative management with immobilization, operative, and salvage procedures. Most of the answer choices consisted of tiered response, which further specified their previous answer. For example, if the surgeon chose "trial of splinting/cast immobilization," then a second set of answer choices would present themselves to answer the question of "for how long?" Similarly, if the treatment chosen was "radial shortening" or "core decompression," the subsequent answer choices were about how much shortening—"0 mm (width of saw only), 2 mm, 3 mm, or 4 mm"—or "radius core decompression, ulna core decompression, or both radius and ulna core decompression." Furthermore, respondents had the opportunity to provide free text answers if desired. Treatment options included trial of splinting/immobilization, core decompression, vascularized bone graft, external fixation with additional procedures, pinning of scaphotrapeziotrapezoidal (STT) or scapholunate joint without external fixation, radial shortening osteotomy, radial wedge osteotomy, capitate shortening osteotomy, intercarpal arthrodesis, lunate excision, proximal row carpectomy (PRC), or total wrist fusion. The cases presented were Stage I, IIIa with negative variance, IIIa with positive variance, and IIIb. Stage II and IV treatments were asked as addenda to cases one (Stage I) and four (Stage IIIb). For example, after the preferred treatment choice was given for the first case presentation, the subsequent question would read "would your preferred treatment change if the x-rays revealed lunate sclerosis without collapse (i.e., Stage II Kienböck's disease)?"; thus, minimizing the questionnaire burden on surgeons by having the same case being presented consecutively. Additionally, questions were asked regarding whether the respondent valued the Lichtman classification scheme and whether the respondent used ulnar variance to guide treatment, and demographic data were collected with questions focused on type of residency and fellowship training and experience.

Questionnaire responses were collected anonymously and electronically tabulated. Results were expressed as means for continuous variables and as percentage for frequency distribution of categorical data. Since the survey software allowed respondents to skip questions without submitting a response, the number of responses per question varied throughout the questionnaire. Respondents were excluded if they completed less than 75% of the questionnaire. To diminish selection bias, if a response to a specific question was missing, the respondent was excluded from the analyses of that specific question only.

Results

The results from 390 participants were received and 15 respondents were excluded for incomplete data, leaving 375 survey responses for inclusion in the analysis. Respondents had an average length of practice of 20 years (range, 1–50 years) and comprised 16 countries including 91% from North America (41 of 50 states), 4% from Europe, 3% from Asia, 2% from South America, and 1% from Australia. Most respondents (86%) completed an orthopaedic surgery residency, followed by plastic surgery (10%) and general surgery (3%) residencies. Additionally, 96% completed a specialized hand surgery fellowship. Other demographic variables are summarized in ►**Table 1**. Additionally, a significant portion of respondents (90%) utilized the Lichtman classification stage and the type of ulnar variance in deciding treatment strategy for Kienböck disease.

The distribution of treatment options ranged from a trial of nonoperative management (i.e., splinting or case immobilization) to operative reconstructive and salvage procedures, summarized in ►**Table 2**. When presented with a patient with Stage I Kienböck disease, 218 surgeons (74%) would initially trial splinting or cast immobilization for an average of

Table 1 Demographics of respondents

Residency training	n = 299	
General surgery	10	3%
Orthopaedic surgery	258	86%
Plastic surgery	31	10%
Hand fellowship trained?	**297**	
Yes	286	96%
No	11	4%
Region of practice	**273**	
North America	248	91%
Europe	11	4%
South America	4	1.5%
Asia	8	3%
Australia	2	0.7%
U.S. practice	**241**	**88%**
New England	68	28%
Northwest	12	5%
Southwest	28	12%
Midwest	39	16%
Central/Mountain	27	11%
South	67	28%
Years in practice	**287**	
1–5	6	2%
6–10	34	12%
11–20	117	41%
21–30	93	32%
31–40	30	10%
> 41	7	2%
Arthroscopies/year	**303**	
0	43	14%
< 5	32	10%
5–20	139	46%
> 20	89	30%

7 weeks. The remaining 77 surgeons (26%) elected for operative treatment, of whom 39 (51%) preferred a radial shortening osteotomy with a median shortening of 2 mm, 13 (17%) a vascularized bone graft, and 13 (17%) a core decompression. Other procedures were chosen by 5% or fewer of surgeons.

Sixty percent of respondents indicated that they would alter their treatment strategy if the patient's diagnosis was Stage II Kienböck disease. Thirty-seven percent would still perform a splinting trial; however, the majority of respondents instead opted for operative treatment and most favored a radial shortening osteotomy.

When presented with a patient with Stage IIIa Kienböck disease with 3 mm of negative ulnar variance, the most common treatment chosen (69%) was a radial shortening osteotomy with a median shortening of 3mm. Only 15 surgeons (5%) chose to trial splinting and the remaining responses did not show a preferential treatment, with vascularized bone grafting (10%), intercarpal arthrodesis (4%), and PRC (4%) being the alternative treatments.

The responses for Stage IIIa Kienböck disease with 2 mm of positive ulnar variance were more heterogeneous and failed to demonstrate a preference for a single modality. The most common procedures were capitate shortening osteotomy (28%), vascularized bone graft (18%), and radial wedge osteotomy (12%).

The majority of surgeons selected a salvage procedure for Stage IIIb Kienböck disease. This included PRC (42%), intercarpal arthrodesis (21%), and total wrist fusion (11%). The respondents who opted for a nonsalvage intervention would perform a radial shortening osteotomy (12%), a vascularized bone grafting (6%), or a trial of splinting (4%).

If Stage IV Kienböck disease was diagnosed, as opposed to Stage IIIb disease, 56% would not change their treatment of these patients. Seventy-one percent would perform a PRC, 16% a total wrist fusion, with 8% choosing an intercarpal arthrodesis or a radial shortening osteotomy.

Discussion

The purpose of this study was to establish the trends of practice by hand surgeons, when encountering a case of Kienböck disease. Despite more than a dozen described interventions for Kienböck disease, there was general agreement of treatment. Based on our results, the most common treatment approaches preferred at each stage of Kienböck disease are summarized in ►**Table 3**.

Results of a European survey of orthopaedic surgeons in the United Kingdom, Germany and France on treatment options for Kienböck disease were published in 2012.[32] For Stage I Kienböck disease, radial shortening osteotomy was the overwhelmingly preferred initial therapy in the UK (68%), France (49%), and Germany (69%). On the other hand, our study demonstrated that most surgeons (74%) would initially try nonoperative management. For Stage IIIb Kienböck disease, both the UK (56%) and France (53%) preferred a radial shortening osteotomy, while German respondents preferred STT arthrodesis (41%) or wrist denervation (33%). ►**Fig. 1** illustrates the overall trends of Kienböck disease management at different stages.

An interesting finding in our study that highlights the rarity and lack of familiarity of this disease was the fact that 6% of surgeons would still shorten the radius even in the setting of ulnar positive variance.[33] Furthermore, a frequent comment among respondents was that they had never seen or heard of a case of Kienböck disease with positive ulnar variance and requested to ascertain the degree of ulnar variance. Even though ulnar variance is clearly a determining factor for basing treatment decisions, this has not been included in the Lichtman classification for Kienböck disease.[6]

Bain et al have described a system of classifying Kienböck disease using arthroscopy; it proposes to describe the extent of disease more accurately than can be accomplished using

Table 2 Summary of results by stage, number of respondents (percentage of total per stage)

	I	II^	IIIa (–)	IIIa (+)	IIIb	IV^
Trial of splinting	**218 (74%)**	**84 (37%)**	**15 (5.1%)**	**10 (3.5%)**	**10 (3.5%)**	**6 (2.3%)**
4 weeks	45		3	2	0	
6 weeks	92		4	4	6	
8 weeks	39		3	2	2	
12 weeks	33		3	2	1	
16 weeks	2		0		0	
> 16 weeks	2		0	0	0	
Core decompression	**13 (4.4%)**	**12 (5.2%)**	**7 (2.4%)**	**20 (7.1%)**	**3 (1%)**	**0 (0%)**
Radius	10		7	17	2	
Both radius and ulna	2		0	3	1	
Vascularized bone graft	**13 (4.4%)**	**19 (8.4%)**	**28 (9.6%)**	**51 (18%)**	**16 (5.7%)**	**4 (1.6%)**
Pedicled transplant from the distal radius	11		22	44	13	
Direct implantation of metacarpal artery	1		5	6	2	
Free vascularized graft	1		1	1	1	
External fixation	**1 (0.3%)**	**1 (0.4%)**	**3 (1%)**	**4 (1.4%)**	**0 (0%)**	**0 (0%)**
6 weeks	0		1	1	0	
8 weeks	0		2	1	0	
Pinning	**3 (0.3%)**	**1 (0.4%)**	**0 (0%)**	**6 (2.1%)**	**4 (1.4%)**	**0 (0%)**
Radial shortening osteotomy	**39 (13%)**	**69 (30%)**	**201 (69%)**	**17 (6%)**	**34 (12.1%)**	**9 (3.5%)**
0 mm (width of saw)	4		3	4	6	
1 mm	3		3	0	4	
2 mm	21		55	7	15	
3 mm	7		129	5	6	
4 mm	0		11	1	0	
Radial wedge osteotomy	**4 (1.3%)**	**4 (1.7%)**	**4 (1.4%)**	**32 (11%)**	**1 (0.3%)**	**2 (0.8%)**
Decrease radial inclination angle	4		2	27	1	
Increase radial inclination angle	0		1	5	0	
Capitate shortening osteotomy	**3 (1%)**	**1 (0.4%)**	**5 (1.7%)**	**79 (28%)**	**3 (1.1%)**	**1 (0.4%)**
Intercarpal arthrodesis	**0 (0%)**	**3 (1.3%)**	**12 (4.1%)**	**26 (9.3%)**	**59 (21%)**	**10 (3.9%)**
Capitohamate	0		0	1	1	
Lunetotriquetral	0		0	2	1	
Scaphocapitate	0		6	17	43	
STT	0		5	6	11	
Lunate excision	**0 (0%)**	**0 (0%)**	**0 (0%)**	**0 (0%)**	**2 (0.7%)**	**1 (0.4%)**
Without replacement	0		0	0	2	
Proximal row carpectomy	**0 (0%)**	**0 (0%)**	**10 (3.4%)**	**28 (10%)**	**119 (42%)**	**181 (71%)**
Total wrist fusion	**1 (0.3%)**	**0 (0%)**	**5 (1.7%)**	**6 (2.1%)**	**30 (10.7%)**	**42 (16%)**
Surgical, unspecified		**33 (15%)**				
Total number per stage	**295**	**227**	**290**	**279**	**281**	**256**

^ = Stages II and IV were presented via additional questions posed after stages I and IIIb questions were asked, respectively. Respondents were asked via free-text to describe how their surgical plan would change; therefore, subcategory responses are unavailable for these two stages.

only plain radiographs.[34,35] Respondents in our study cited this system multiple times. The status of the lunate articular cartilage determined by arthroscopic evaluation may be an important consideration for surgical treatment.

Similar to other studies of this nature, there are several limitations of our research. There is a possible selection bias, as only ASSH members were surveyed. However, we feel this is still a representative population, as these cases will likely be

Table 3 Most common treatments based on survey results

Stage	Classification criteria	Treatment
I	Normal except for the possibility of either a linear or a compression fracture	Trial of splinting or cast immobilization. Radial shortening osteotomy for persistent symptoms.
II	Definite density changes apparent in the lunate	Same as stage I, with radial shortening osteotomy more aggressively pursued
IIIa (–)	Collapse of entire lunate without fixed scaphoid rotation, negative ulnar variance	Radial shortening osteotomy
IIIa (+)	Collapse of entire lunate without fixed scaphoid rotation, positive ulnar variance	Attempt vascularized bone grafting of lunate or capitate shortening osteotomy. Otherwise, PRC.
IIIb	Collapse of entire lunate with fixed scaphoid rotation	Salvage procedures (PRC, intercarpal arthrodesis)
IV	Stage III with generalized degenerative changes in the carpus	PRC if possible, total wrist fusion otherwise

seen or referred to a hand specialist. Additionally, our study included 33 international surgeons belonging to the society. Similarly, we did not discriminate between lengths of practice, which can result in individuals failing to respond if they have not had sufficient exposure to this rare disease. Even with all these limitations, we obtained a large number of respondents ($n = 375$) with diverse demographics including age and length of practice, and we believe that the data obtained offer insight into the individual treatment preference for managing this rare disease. An additional limitation of this study, which may have added to the heterogeneity of responses, is that there were no radiographic images provided with each case. We believed this would simplify the objectiveness of our study by removing radiographic interpretation from the question, but certain treatment options can only be selected given the presence or absence of specific carpal pathology. For example, PRC can be a successful salvage option, but the capitate head must be mostly free of degenerative changes, while in cases of mild arthritic changes, partial resection of the capitate or interposition arthroplasty of dorsal wrist capsule can be performed as adjuvants.[36,37]

In conclusion, the majority of surgeons use the Lichtman staging system for guiding the treatment of Kienböck's disease, while also basing their treatment approach on ulnar variance. Most surgeons perform a radial shortening osteotomy for Stage I disease after failed conservative treatment, and this is the favorite treatment for Stage II and Stage IIIa with ulnar negative variance. Stage IIIa with positive ulnar variance was treated heterogeneously, with capitate shortening osteotomy being most common, followed by vascularized bone grafting, although there was no clear consensus. Salvage procedures predominated in Stage IIIb and IV and included PRC, intercarpal arthrodesis, and total wrist fusion. This study shows the challenges faced by hand surgeons

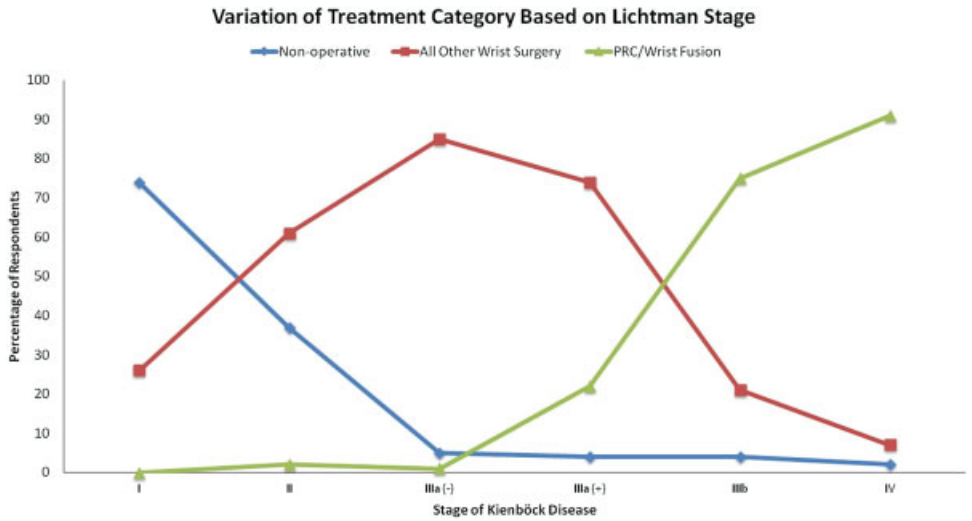

Fig. 1 Variation of treatment category based on Lichtman stage. Overall percentages of preferred approaches as grouped into nonoperative, nonsalvage (all other wrist surgery), and salvage (PRC/intercarpal arthrodesis/wrist fusion) demonstrate the trend toward of incremental increase in aggressiveness as the stage of Kienböck disease at presentation progresses.

treating Kienböck disease and highlights the need for high-level research to be performed on this rare disease.

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Conflict of Interest
None

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