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Staging and treatment in Kienböck's disease

Muhittin Sener[1], Mesut Tahta[2]

ABSTRACT

Kienböck's disease, also known as lunatomalacia, was first described by Viennese radiologist Robert Kienböck in 1910 as a 'disorder in the nutrition of the lunatum as a result of trauma'. Although the disease was identified more than 100 years ago, its etiology and treatment are still controversial.

In this article, after the general information about Kienböck's disease, the widely used classifications related to the disease and the treatment options applied on the basis of these classifications will be reviewed.

Key words: *Lunatum, wrist, Kienböck's disease*

Etiology

The exact etiology of lunatum avascular necrosis is still unknown. It is a common accepted opinion that the vascularity of the lunatum is somehow interrupted.

There are various theories about the causes that impair the vascular nutrition of the bone.

Trauma: Although it is a view supported by some authors, no real lunatomalacia has been shown after the traumatic lunatum dislocation. In addition, no ligament tears indicating the definite effect of trauma were shown in these patients. [1,2].

Recurrent minor trauma: In studies, prevalence in workers using vibrating instruments was not higher than that of sedentary workers [3]. On the other hand, Gelberman stated that the vascular structure of the lunatum supports the Kienböck's theory, which is caused not by a single fracture, subluxation or dislocation, but by recurrent minor traumas [4]. Lluch and Garcia-Elias stated that recurrent micro-traumas are not the primary cause of Kienböck's disease, but are a factor in the increase of symptoms in the existing disease [5].

Ulnar variance: The relationship between Ulnar variance changes and Kienböck's disease is controversial. In some studies, it was stated that there was a relationship between negative ulnar variance and Kienböck's disease [6-8]. However, contrary to this view, there are numerous studies that report that the disease is also seen in ulnar zero or ulnar positive patients. D'Hoore and Nakamuro reported that negative ulnar variance was not a risk factor for Kienböck's disease

Author affiliations : *[1] Department of Orthopedics, Traumatology and Hand Surgery, Private Practice, Izmir, Turkey [2] Department of Orthopedics and Traumatology, Egepol Surgery Hospital, Izmir, Turkey*
Correspondence : *Mesut Tahta, MD, Department of Orthopedics and Traumatology, Egepol Surgery Hospital, Izmir, Turkey. e-mail: mesuttahta@hotmail.com*
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[9,10]. On the other hand, Lluch and Garcia-Elias stated that bilateral cases should be seen at a much higher incidence if ulnar variance had an effect on the formation of Kienböck's disease [5].

Vascularity: The vascular anatomy of lunatum was studied extensively in Kienböck's disease. Circulation is provided by complex extraosseous and intraosseous anastomosis from radial, ulnar and anterior interosseous arteries. According to their incidence, 3 major intraosseous vascular patterns defined by symbols Y, I, X were defined [4].

Some authors have suggested that lunatums with a single volar or dorsal vein, are more prone to avascular necrosis [4,11]. The study was not carried out on diseased lunatums and a vascular pattern specific to Kienböck's disease could not be demonstrated [1]. Watson et al. stated that vascular anatomy had no role in the formation of Kienböck disease [12].

Intraosseous pressure: Schiltenwolf and his colleagues suggested that intraosseous pressure increase was associated with Kienböck's disease, and that venous congestion blocking arterial flow posed a risk factor for osteonecrosis [13]. However, no data has been produced to support this hypothesis [14].

In the literature, we also see that Kienböck's disease is associated with a wide range of pathologies such as the geometry of the lunatum, coagulation disorders, genetic factors, cerebral palsy, steroid use, septic embolism and scleroderma.

Clinical Findings

Although Kienböck's disease can also be seen in pediatric (teenbock) and older age groups, it is usually seen 2 times more often in men and between the ages of 20 and 40.

The typical symptom of the disease is dorsal wrist pain. Pain increases especially with extension with wrist movements. It's reduced by rest. There may or may not be trauma to the history. There is swelling and tenderness in the wrist dorsal in the perilunat area. The findings are indicative of radiocarpal effusion due to synovitis around the lunatum. Over time, wrist movements and grip strength decrease. In advanced stages, signs of carpal instability and degenerative arthritis are seen. Since these findings are not specific, Kienböck should be considered in patients with wrist pain in the younger age group. During the examination, the normal wrist must be evaluated.

Staging

In Kienböck's disease, radiological, pathological, arthroscopic multiscopic staging systems were defined and these classifications were later updated and tried to be associated with treatment algorithms. The fact that there are many staging systems indicates that this issue is still unresolved. The most commonly used staging system today is the radiological classification made by Lichtman in 1977 [15]. In his paper, Lichtman evaluated Kienböck patients who were actually treated with silicone arthroplasty by dividing the patients into 4 stages radiologically. Lichtman updated this classification in 1993 and expanded it in 2010 by adding the definitions Phase 0 and Phase 3C [16,17] (Table 1).

According to the extended classification, Lichtman defined as Stage 0 conditions in which standard radiology and MRI imaging were normal in patients with intermittent pain. In phase 3C, the lunatum has fragmentation or coronal fracture. According to Lichtman, the prognosis of stage 3C cases is poor [17].

Table 1. Lichtman classification.

Stage	Xray	MRI
1	Normal	T1: reduced signal T2: variable
2	Sclerosis	T1: reduced signal T2: variable
3A	Collapsed Lunatum	T1: reduced signal T2: variable
3B	Collapsed Lunatum and carpus Lunatum Scaphoid rotation (RS angle>60)	T1: reduced signal T2: generally reduced
4	Pancarpal arthritis (midcarpal and/or radiocarpal)	T1: reduced signal T2: reduced signal

Numerous studies have been conducted on the reliability of lichtman classification and some studies have found that not reliable [18-20]. Aydemir et al. in their study, which investigated the reliability of lichtman classification, they suggested that this classification alone was inadequate and should be evaluated in conformity with other imaging methods [21].

Perfusion MRI and arthroscopic classification systems defined in recent years have made important contributions to the prognosis of the disease and more accurate treatment plan. Accordingly, Schmitt et al. showed contrast in lunatum, in T1 sections with gadolinium perfusion technique [22]. This examination ensured that low-signal edema was separated from the neovascular repair tissue that holds contrast. In this technique, 3 different forms of zones are defined in the disease; proximal necrotic bone that does not hold contrast, hypervascular moderate repair zone and distal normal bone section. Accordingly, areas holding contrast have a good recovery prognosis, while low signal areas show poor prognosis.

The classification of carpal osteonecrosis after MRI developed by Schmitt et al. is given in Table 2 [23].

Bain and Begg, on the other hand, arthroscopically defined a classification based on the number and localization of the "impaired joint face" [24]. Accordingly, the distorted joint surface; fibrillation, fissure, cartilage loss, floating cartilage surface, fracture or arthritis (Figure 1). Bain then defined a treatment algorithm based on excision, fusion and load distribution alteration, which takes into account the impaired joint surface in arthroscopy [25].

Table 2. Schmitt classification.

Type	MRI finding	Prognosis
N	Normal signal	-
A	Homogeneous contrast Involvement (edema) (normal lunatum perfusion)	Good
B	Heterogeneous contrast (partial osteonecrosis)	Medium
C	No contrast (complicated osteonecrosis)	Bad

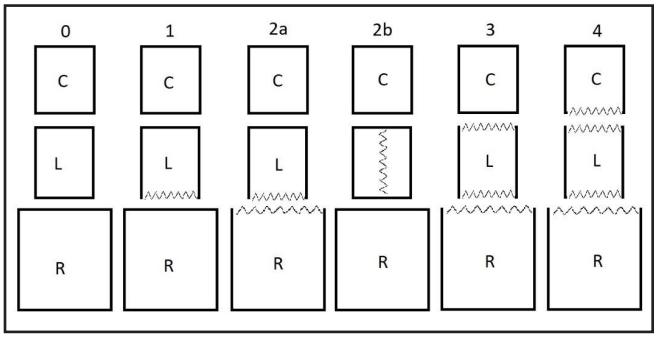

Figure 1. Arthroscopic classification based on impaired joint surfaces and localization (Bain and Begg classification).

Treatment

In Kienböck's disease, there is a confusion, such as the combination of different treatment options, sometimes alone and sometimes multiple techniques. Another complexity; the same treatment can be applied at different stages. Therefore, changes or updates in staging also lead to changes and complexity in treatment schemes. Nevertheless, since a staging-free treatment cannot be considered. It is going to be explained the treatment based on the Lichtman classification, which is most commonly used, in tabisi review.

Initial treatment in lichtman stages 0 and 1 is almost always to eliminate etiological causes, immobilization with plaster, splint or splint and anti-inflammatory drug therapy. These stages are the only agreed stages in the treatment of Kienböck's disease in the literature. Conservative methods should be applied for at least 3 months in patients at this stage. It is also important for patients to avoid excessive activities and heavy lifting. If symptoms persist despite conservative treatment or if the disease has progressed in radiological examinations, surgical intervention should be considered [26].

Lunatum decompression (forage +/- grafting) can be applied in stage 1 and stage 2 cases that progress despite conservative treatment. Decompression can be done openly or arthroscopically. The goal here is to reduce intra-bone pressure. Bone grafting and synovec-

tomy can also be performed together [27,28]. Surgical debridement of existing synovitis is important in relieving pain.

If there is a negative ulnar variance in stages 1,2 and 3A, radial shortening or ulnar lenghtening can be performed to reduce the load on the lunatum. Radial shortening is generally preferred as grafts are not required. Osteotomy is performed from the metaphyseal region. This allows early rehabilitation. Ulnar lenghtening has a high complication rate and morbidity [29].

If phases 1, 2 and 3A have positive or neutral ulnar variance STT pinning, capital shortening, radial wedge osteotomy or external fixation can be applied. These procedures are initiatives that free the lunatum from burden.

The authors's preference is to apply partial capital shortening osteotomy in patients in Stages 2 and 3a [30,31]. It is hypothesised that the capitalization attempt will not make a major change to the architecture of the capitatum and did not lose the option of a secondary rescue attempt if the disease progressed. In addition, MRI examinations after partial capital shortening osteotomy showed that revascularization of the lunatum was achieved [32].

Vascularized bone graft techniques can also be used for revascularization in patients in stages 1,2 and 3A where there is no deterioration of the joint surfaces. For this purpose, psiforme, palmar or dorsal distal radius, 2nd metacarpal head, or vascularized grafts with pedicules can be transposed to the necrotic region in the lunatum [33-37].

Free vascularized medial femoral osteochondral reconstruction may be applied in stage 3A and 3B cases [38,39]. This technique is also an alternative for fusion or excision in advanced cases of cartilage damage. Radioscapholunat fusion (RSL), Scaphocapitate fusion (SK) or Scaphotrapetrapezoid (STT) fusion can be performed in stage 3B cases where radiolunate joint is affected. In stage 3 cases where the radial column can remain intact, limited fusions in the form of SC fusion or STT are performed, disabling the central column load distribution and transferring the load to the radial is ensured. Thus, both the load on the lunatum is reduced and the carpal collapse is prevented [40,41].

Some surgeons have stated that radial shortening osteotomy is not contraindicated and can be applied in advanced stages such as 3B without radiocarpal osteoartritis [42,43].

In stage 3C cases with coronal fracture, all lunatum has collapsed. Pathology in the lunatum is irreversible. At this stage, excision of the necrozed lunatum is recommended. The excised lunatum area can be replaced with tendon, titanium or pyrocarbon prosthesis or scaphocapitate or capitohamate fusion can be applied following lunatum excision. [44-48]. Although various replacement methods have been defined with biological or nonbiological materials, these interventions have not become popular due to their complications.

Another rescue attempt applied in Stage 3C cases where radius's lunat surface and capitatum's joint surface are normal is Proximal Row Carpectomy (PSK). PSK is an attempt to maintain the wrist movement but cause a decrease in grip strength. Preferably low expectations should be recommended in patients over 45 years of age [49,50]. It has also been reported that neurectomy is useful with PSK [51]. However, it has not been shown an advantage of neurectomy in the literature [52].

In stage 4 cases with pan arthritis, total wrist fusion or total wrist arthroplasty is performed.

As a result, CT is especially useful in detecting arthritis, coronal fracture or fragmentation and planning treatment in Stage 3 cases, allows for a more detailed evaluation of bone structure. On the other hand, in Kienböck's disease, it is necessary to evaluate each case in its own way. It would be appropriate to plan the possible interventions from the beginning, as the disease may progress despite the treatment.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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