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Surgical Treatment of Patient with Advanced Kienböck's Disease: A Case Report

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Abstract

Background. For more than a century, many methods of treating Kienböck's disease have been developed, although none of them could achieve consistently good results. The transposition of the pisiform into the lunate location after removal of the latter, as well as the combination of this operation with a shortening osteotomy of the radius, is considered as one of the promising methods of this disease treatment. ***The purpose of this publication*** was to demonstrate the options of the modern reconstructive surgery for the treatment the stage IIIb Kienböck's disease. ***Case presentation***. A clinical case of a successful non-free transplant of a blood-supplied pisiform in aseptic necrosis of the lunate is described. A patient was a 21 year old military serviceman with stage IIIb Kienböck's disease complicated by persistent pain syndrome and severe dysfunction of the left wrist. He underwent removing the fragmented lunate with replacing it with a pisiform on the tendon feeding pedicle and performing simultaneous shortening osteotomy of the radius. The displaced bone was fixed with an anchor to the dorsal surface of the distal radial metaepiphysis. In 12 months after the surgery, an improvement of the wrist function was achieved in the form of an increase in the range of motion compared with the preoperative period and a significant decrease in the level of pain syndrome. The radiological examination at the same time showed the preservation of the shape, size and intra-articular localization of the bone autograft. ***Conclusion***. The use of transposition of the blood-supplied pisiform on a permanent tendon feeding pedicle into the region of the removed lunate demonstrated, in our opinion, the favorable possibilities of successful surgical treatment of the late stages of Kienböck's disease. A favorable outcome of such treatment is possible only in a specialized hospital, where there are trained specialists in the field of hand surgery, and there are also opportunities for employment a modern rehabilitation complex aimed at restoring movements in the hand joints, taking into account the strength and coordination parameters of its anatomical structures.

Keywords: Kienböck's disease, aseptic necrosis of the lunate, blood-supplied pisiform, shortening osteotomy of the radius.

Aseptic necrosis of the lunate was first described by J.L. Peste in 1843, regarded it as a consequence of a fracture [1]. In 1910, the Austrian radiologist R. Kienböck gave a systematic X-ray description of the disease, calling it "lunate malation". Since publication of practical guide to fractures and dislocations by K. Speed in 1916 this pathology was named Kienböck's disease [2]. The etiology of the disease is still not clear, but a number of predisposing factors have been identified, which are considered to be anatomical shape of the lunate and the lunate fossa of the radius; morphologic type of the ulna development; features of the lunate blood supply, injury to the wrist preceding the disease; the patient's profession. Metabolic, viral and genetic theories also remain relevant [3, 4].

The incidence of Kienböck's disease is difficult to assess due to nonspecific clinical symp-

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toms, as well as the absence of X-ray signs at the initial stages of the disease. However, this condition occurs more likely among young and middle-aged men (mainly 20 to 40 years old), especially manual labours. In women, it is detected less often and manifests itself at an older age than in men. There were described cases of the disease in children, including a 6-year-old child. However, in these cases, a more favorable progress of the disease comparing to adults was noted even without any treatment [3, 5]. A positive correlation was observed between the development of lunate aseptic necrosis and the diseases like systemic lupus erythematosus, scleroderma, dermatomyositis, rheumatoid arthritis, and Crohn's disease. The particular interest of some studies is the role of the antiphospholipid antibodies, which were detected in series of Kienböck's disease cases [3].

Many methods of treatment of this disease have been developed, none of which can achieve consistently good results [6]. For this purpose, various options of bone grafting were performed with vascularized and non-vascularized grafts transplanted both in free and pedicled versions, including the use of mesenchymal stem cells, osteotomies of the radial and capitate bones, partial or total arthrodesis of the wrist joint, its arthroplasty or lunar reconstruction with bone cement [6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18]. The surgical treatment tactics mostly based on the X-ray signs of changes in the lunate itself and the nearby wrist bones. In 1977, D.M. Lichtmann et al. modified the classification of F. Stahl and described 4 stages of Kienböck's disease progression [19, 20]. The shortening osteotomy of the radius remains the most widespread variant of the surgical treatment in stages II and IIIa [10, 14, 21]. Currently, there is no generally accepted surgical option. One of the promising methods of treatment is the transposition of the pisiform into the lunate site after its removal, as well as the combination of this operation with the shortening osteotomy of the radius [22, 23, 24]. Exactly this option we present in our current clinical observation. It provided a good result of complex surgical treatment of a military serviceman with stage IIIb aseptic necrosis of the lunate of the left hand.

The purpose – to to demonstrate the possibilities of modern reconstructive surgery in the treatment of the patients with stage IIIb Kienböck's disease.

Case report

A 21-year-old military serviceman was admitted to the clinic with complaints of pain in the left wrist worsen by physical activity and restriction of movement in the left wrist. The patient was examined clinically (questioning on the DASH, PRWE, Mayo, VAS scales, measuring the range of motion of the wrist and hand grip strength) and radiographically (X-ray in AP and lateral planes, CT) on admission and in 12 months after the surgery.

The pronounced pain syndrome was found in the projection of the lunate on a moving wrist and in left forearm during axial load on a fist. The range of motion in the left wrist was: flexion 35°, extension 40°, radial abduction 10°, ulnar adduction 5°, external and internal rotation of the left forearm was unrestricted. The grip strength of the left hand was significantly reduced compared with the right. Accordingly, the dynamometry of the affected hand was 10 kg, while the healthy hand – 45 kg. The assessment results before surgery by the rating scales: DASH 35.8; PRWE 35, Mayo 55, VAS 9.

These symptoms sharply impeded the patient's daily life and made it impossible to continue his military service. The left wrist X-ray and CT showed signs of stage IIIb left lunate aseptic necrosis and anatomical shortening of the ulna relative to the radius at the level of the wrist joint (negative ulnar variance). The X-ray index of the wrist was 0.4, the scaphoid-crescent angle – 45 ° (Fig. 1).

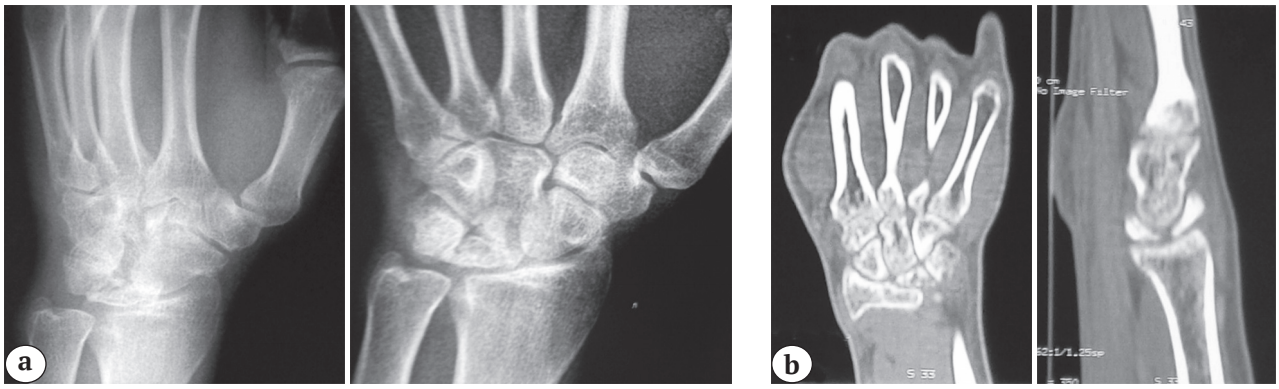

Figure 1. X-rays and CT of the left wrist of the patient, 21 years old, on admission: a – X-ray of the left hand (AP and lateral planes): signs of aseptic necrosis, fragmentation of the lunate, "negative ulnar variance"; b – CT of the left wrist: signs of aseptic necrosis of the lunate, stage IIIb.

In order to restore the left wrist function and eliminate the pain, the patient underwent shortening osteotomy of the radius, osteosynthesis of the radius with a plate, removal of the left lunate with its replacement by the pedicled pisiform flap with anchoring fixation. This surgery was performed under combined anesthesia using a binocular x3,3 loupe. The patient was in supine position with the left upper limb on arm board. A hemostatic pneumatic tourniquet was placed on the upper third of the left forearm (250 mm Hg). Next, a figured approach was performed on the anterior surface of the lower third of the left forearm with 10 cm transition to the palmar surface of the hand with layered exposure of the radius and proximal row of wrist bones. The shortening osteotomy of the distal radius by 3 mm by an oscillating saw was performed followed by osteosynthesis of its fragments with a volar locking plate. The lunate was resected. Further, the pisiform on the tendon feeding pedicle was isolated. The thickness of the pedicle was a half of the flexor carpi ulnaris width. The graft was moved under the flexor tendons of the fingers to the lunate area. The defect was replaced by the pisiform, anchored to the dorsal surface of the distal radius. Due to the mismatch between the size and shape of the pisiform graft and the removed lunate, as well as the danger of the damage to the graft blood supply, the reconstruction of the proximal row of wrist bones ligaments did not seem appropriate. It should also be noted that the palmar slope of the scaphoid did not change as a result of the surgery and amounted to 45 ° (Fig. 2).

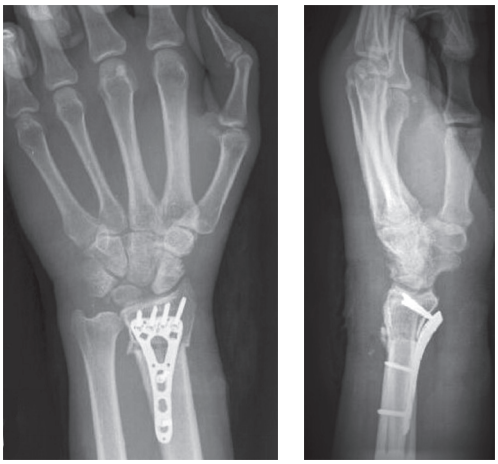

Figure 2. X-rays of the left wrist (AP and lateral planes) of a 21-year-old patient, immediately after the surgery.

In the postoperative period, the patient received vasoactive therapy, and a course of hyperbaric oxygenation. Postoperative wounds healed by primary intention. Immobilization of the left wrist was carried out with a circular plaster cast for 12 weeks. Then a course of complex rehabilitation was carried out: physiotherapy, massage, a complex of physical exercises to improve hand joints movements.

As a result, the patient's range of motion in the left wrist increased: flexion 45°, extension 45°, abduction 20°, adduction 10°. The left forearm external and internal rotation were normal. The pain syndrome regressed. The dynamometry of the right hand 42 kg, left – 28 kg (Fig. 3).

The results of the assessment on the scales one year after the surgery: DASH 5.8; PRWE 7, Mayo 70, VAS 2.

The patient's left wrist CT performed in 3 months after the surgery indicated the fusion of the radius along the line of the shortening osteotomy and the absence of secondary displacement of the bone autograft (Fig. 4 a). The comparative study in 12 months revealed the presence of some cysts and local sclerosis of the transposed pisiform. However, there were no changes in its intra-articular localization. Also, the initial signs of osteoarthritis in the region of the lunar fossa of the radius were revealed (Fig. 4 b).

The wrist index was 0.40 before surgery and 0.39 one year after. The total treatment period was 12 months. Based on the results of the examination, the soldier was recognized as fit for military service with minor restrictions.

Figure 3. The functional outcome of the left hand in the 21-year-old patient in 12 months after the surgery: a – flexion; b – extension; c – finger grip.

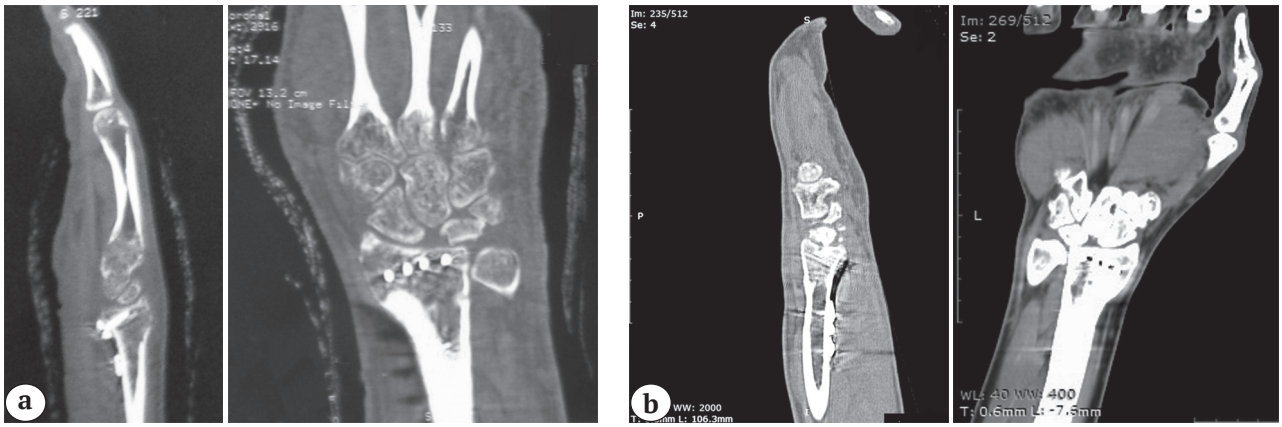

Figure 4. CT of the left wrist (AP and lateral planes) of the 21-year-old patient, after the surgery: a – in 3 months, fusion of the radius along the osteotomy line is noted; b – in 12 months, marked sclerosis and cystic lesion of the pisiform and lunate fossa of the radius.

Discussion

The presented clinical case demonstrates the possibility of successful replacement of the lunate in the patient with stage IIIb Kienböck's disease with pedicled pisiform flap on the tendon pedicle.

The signs of the advanced stages of Kienböck's disease (IIIb – IV) are: the "collapse" of the corrupted lunate, rotation of the scaphoid, a decrease in the height of the wrist due to the proximal migration of the capitate, and the signs of the wrist osteoarthritis. At these stages, revascularization of the lunate is impossible, and reconstructive surgery has no significant clinical effect [22]. Therefore, in such cases, the partial arthrodesis of the wrist bones (STT or SC) is often performed with or without removal of the lunate, lunate arthroplasty, removal of the wrist bones proximal row, or total arthrodesis of the wrist. Despite good treatment outcomes after the removal of the wrist bone proximal row, this type of surgery significantly violates the biomechanics of the wrist and usually considered as the last attempt to preserve the function of the wrist before its total arthrodesis [6, 11, 15, 22].

L. Innes and R.J. Strauch conducted a Kienböck Disease Outcome Study based on PubMed, Medline and Cochrane publications from 1998 to 2008. They showed that there was no ideal operation that would restore the range of motion and grip strength of the hand, reduced the severity of pain syndrome and stop the progression of the Kienböck's disease radiological picture [25].

In 1982 P. Saffar first performed and described the technique of transposition of the pisiform into the lunar site. The advantages of this operation are: preservation of biomechanics of the wrist close to normal, improvement of its function, reduction of pain syndrome and restoration of the grip strength in a relatively short time. Anatomical studies showed that the blood supply to the lunate in most cases was carried out through the dorsal carpal branch of the dorsal ulnar branch of the ulnar artery, that departs from the ulnar artery 2 to 5 cm proximal to the pisiform. This artery, except for supplying the pisiform, takes part in the blood supply to the flexor carpi ulnaris and ulna itself. Less often, this vessel departs directly from the ulnar artery. The diameter of the dorsal ulnar branch of the ulnar artery is 0.8 to 1.3 mm and the length is 3 to 7 cm, which makes it possible to use the pisiform as a vascularized bone autograft in the treatment of Kienböck's disease [26].

Thus, the relocation of the pisiform on the tendinous feeding pedicle allows us to hope for partial preservation of the blood supply to the graft due to the peritendinous vessels. X-ray examination of our patient in 12 months after the surgery showed the preservation of the shape and size of the pisiform. Despite the presence of its local sclerosis and few cysts, this indirectly indicates the preservation of the nutrition of the bone autograft over the observation period.

The clinical result of this surgery was an improvement of the wrist function. This manifested by an increase in the range of motion compared with the preoperative period and the significant decrease of the pain syndrome.

Nevertheless, the operation of transposition of the pisiform to the site of the removed lunate also has its drawbacks, associated mainly with the relative instability of the pisiform due to the absence of the necessary ligaments, as well as with its obviously smaller size compared with the lunate.

However, an analysis of scientific publications has shown that these drawbacks do not lead to increased pain or reduction of the wrist function, probably due to the inevitable partial denervation of the joint [22, 23]. This was confirmed in the present clinical observation.

The presented clinical case of transposition of a vascularized pisiform on a permanent tendon feeding pedicle into the area of the removed lunate demonstrates, in our opinion, the favorable possibilities of successful surgical treatment of the advanced

stages of Kienböck's disease. The features of the treatment, of course, are the technical complexity of the performed surgery, the availability of special instruments and a trained surgical team. Therefore, in our opinion, a favorable outcome of this surgery is possible only in a specialized hospital which possesses trained hand surgery specialists, and a complex of modern rehabilitation aimed at restoring hand joints movements, particularly the strength and coordination.

Consent

The patient gave an informed consent for the publication of this clinical case.

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Authors' contributions

V.V. Khominets – text preparation, making fundamental changes.

M.V. Tkachenko – planning of the surgery with its subsequent implementation, text preparation.

V.S. Ivanov – literature review.

D.Yu. Muhkurya – text preparation.

All authors made a significant contribution to the research and preparation of the article and read and approved the final version before its publication. They agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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