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Case Report

Scaphoid nonunion with DISI deformity treated in a two-stage operation with the Ilizarov mini fixator: A case report

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ABSTRACT

Scaphoid nonunion causes humpback deformity and dorsal intercalated segment instability (DISI) deformity due to dorsal rotation of the proximal scaphoid fragment. In the treatment of scaphoid nonunion, it is important to not only achieve bone union, but also to improve DISI deformity and carpal bone alignment in order to attenuate pain, increase the range of motion, and prevent the development of osteoarthritis.

We encountered a case of DISI deformity caused by the long-term neglect of scaphoid nonunion that was treated in a two-stage operation with the Ilizarov mini fixator. A 28-year-old male had been injured during a soccer game 10 years ago. Although he had wrist pain, he did not visit a hospital. This led to chronic scaphoid nonunion with DISI deformity. Since 10 years had passed from the initial injury, DISI deformity was considered to be difficult to correct using a single stage procedure. Therefore, a two-stage operation was performed. The Ilizarov mini fixator was used to gradually correct DISI deformity in the first stage, and screw fixation with bone grafting was performed in the second stage.

Difficulties are associated with achieving good clinical results in cases of long-term scaphoid nonunion. In cases of DISI deformity, it is important to correct the alignment of lunate dorsiflexion and the distal carpal row as well as achieve bone union. Although the Ilizarov external fixator has been used for scaphoid nonunion, it has not yet been applied to scaphoid nonunion with DISI deformity. The Ilizarov mini fixator may be useful to correct long-term deformities, and good results were obtained in the present case. It represents an option for the treatment of scaphoid nonunion with DISI deformity.

Introduction

Scaphoid nonunion causes humpback deformity and dorsal intercalated segment instability (DISI) deformity due to dorsal rotation of the proximal scaphoid fragment. This leads to prolonged wrist pain and a limited range of motion. In addition, arthropathic changes progress to scaphoid nonunion advanced collapse, which causes significant dysfunction of the wrist. Therefore, in the treatment of scaphoid nonunion, it is important to not only achieve bone union, but also to improve DISI deformity and carpal bone alignment in order to attenuate pain, increase the range of motion, and prevent the development of osteoarthritis [1]. We herein report a case of DISI deformity caused by the long-term neglect of scaphoid nonunion, which was treated in a two-stage operation with the Ilizarov mini

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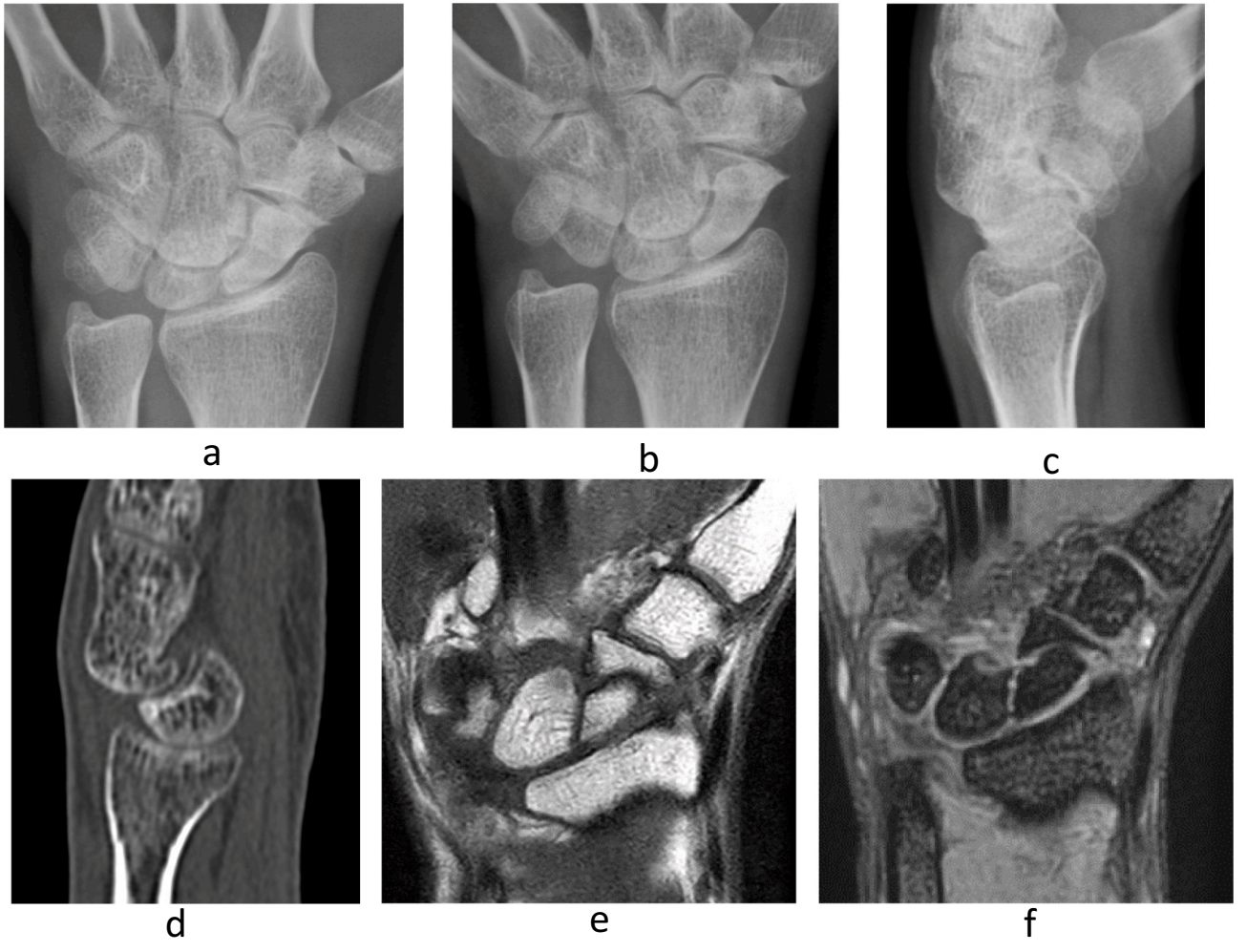

Fig. 1. Initial X-rays in the anteroposterior view (a), ulnar deviation view (b), and lateral view (c) showing a fracture in the middle part of the scaphoid bone (Herbert classification B2). Initial computed tomography (CT) in the sagittal view (d) showing the lunate dorsiflexed 35° relative to the unaffected side. The capitolunate angle was 41°. Coronal T1-weighted magnetic resonance imaging (MRI) (e) and three-dimensional fast field echo MRI (f) revealed no necrosis in the proximal or distal bone fragments.

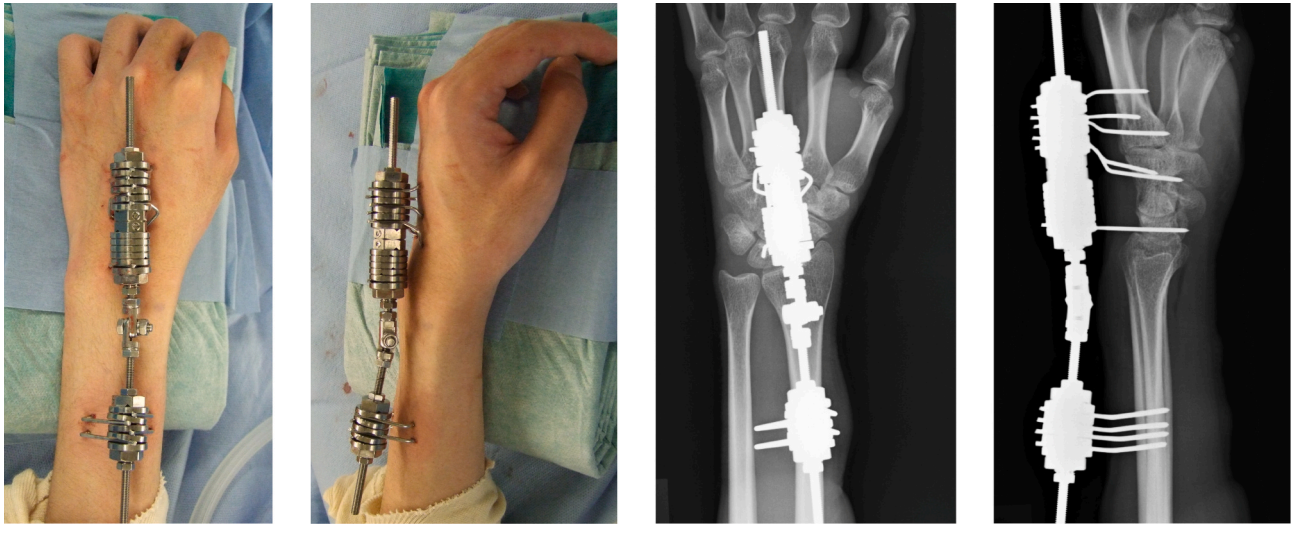

Fig. 2. After the first operation (a, b), X-rays in the anteroposterior view (c) and lateral view (d) showed that three 1.6-mm Ilizarov wires were inserted into the third metacarpal bone, two into the capitate, one into the lunate, and four into the radius. The wires of the third metacarpal, capitate and lunate, and radius were fixed as separate fixation units.

fixator.

Case description

The patient was a 28-year-old male with an unremarkable medical history. He injured his right wrist joint 10 years ago while playing soccer. Although he had wrist pain, he did not visit a hospital. Ten years later, pain in the right wrist worsened with increasing frequency due to the nature of his work, and, thus, he visited to our hospital.

The findings of the first visit revealed tenderness in the radial region of the right wrist that increased with wrist motion. The wrist ranges of motion (affected side/unaffected side) were 40/68° for dorsiflexion and 30/67° for palmar flexion. Grip strengths for the affected and unaffected sides were 20 and 32 kg, respectively. The Mayo wrist score was 40 points (pain intensity: severe to intolerable; functional status: restricted employment; range of motion: 50–74 % of the normal side; grip strength: 50–75 % of the normal side).

Wrist X-ray and computed tomography showed a fracture in the middle part of the scaphoid bone (Herbert classification B2), and the lunate dorsiflexed 35° relative to the unaffected side. The capitolunate angle was 41°. MRI showed no necrosis in the proximal or distal bone fragments (Fig. 1). Based on these clinical findings, the present case was diagnosed as chronic scaphoid nonunion with DISI deformity.

Since 10 years had passed from the initial injury, difficulties were anticipated with correcting DISI deformity in a single stage procedure. An evaluation with fluoroscopy showed that the positional relationship between the lunate and capitate bones did not change. Therefore, we decided to correct DISI deformity gradually using the Ilizarov mini fixator in the first stage, followed by screw fixation with bone grafting for scaphoid nonunion in the second stage. In the first stage, three 1.6-mm Ilizarov wires were inserted into the third metacarpal bone, two into the capitate, one into the lunate, and four into the radius (Fig. 2). The wires of the third metacarpal, capitate and lunate, and radius were fixed as separate fixation units. In addition to traction of the wrist joint, dorsiflexion of the lunate bone was gradually corrected. The external fixator was attached for approximately 2 months, and the second stage was performed after the deformity has been corrected. The second operation was performed by the volar approach, the nonunion site was freshened, and osteosynthesis was performed using headless screws (Acutrack II mini, 22 mm) with iliac bone grafting (Fig. 3).

After the second operation, bone union was achieved in approximately 3 months. One year after the operation, the patient had no pain, the range of motion increased to 57° for dorsiflexion, 63° for palmar flexion, 16° for radial flexion, and 28° for ulnar flexion, and grip strength was 22.3 kg on the affected side. The patient had no functional disorders in the activities of daily living. The Mayo wrist score increased to 75 points (pain intensity: no pain; functional status: return to regular employment; range of motion (% of the normal side): 75–99 %; grip strength (% of the normal side): 50–75 %). The capitolunate angle increased to 10° (Fig. 4).

Discussion

The general guidelines for the treatment of scaphoid nonunion currently include the maintenance of a blood supply, the correction of carpal bone alignment by bone grafting, stable internal fixation, and the correction of carpal instability. Fernandez et al. achieved good clinical results using the palmar wedged bone grafting technique, even in patients with abnormal carpal bone alignment [2].

Schuind et al. reported decreases in the success rate from 88 to 62 % after 5 years of the initial injury, and identified the time from the initial injury to surgery as the main predictor of a poor prognosis [3].

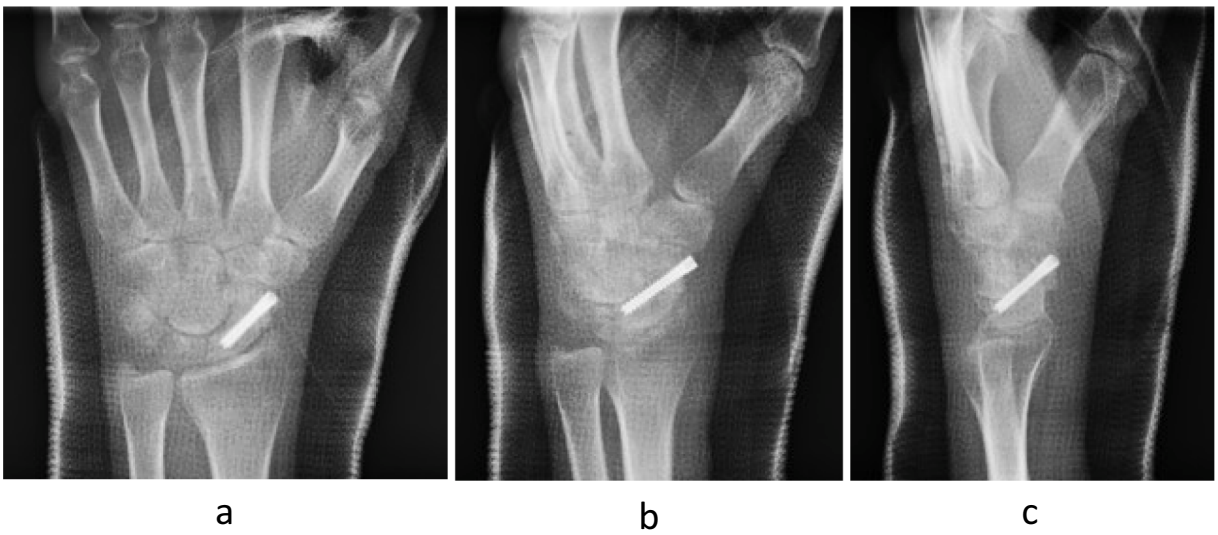

Fig. 3. X-rays after the second operation in the anteroposterior view (a), oblique view (b), and lateral view (c) showing osteosynthesis performed using headless screws (Acutrack II mini, 22 mm).

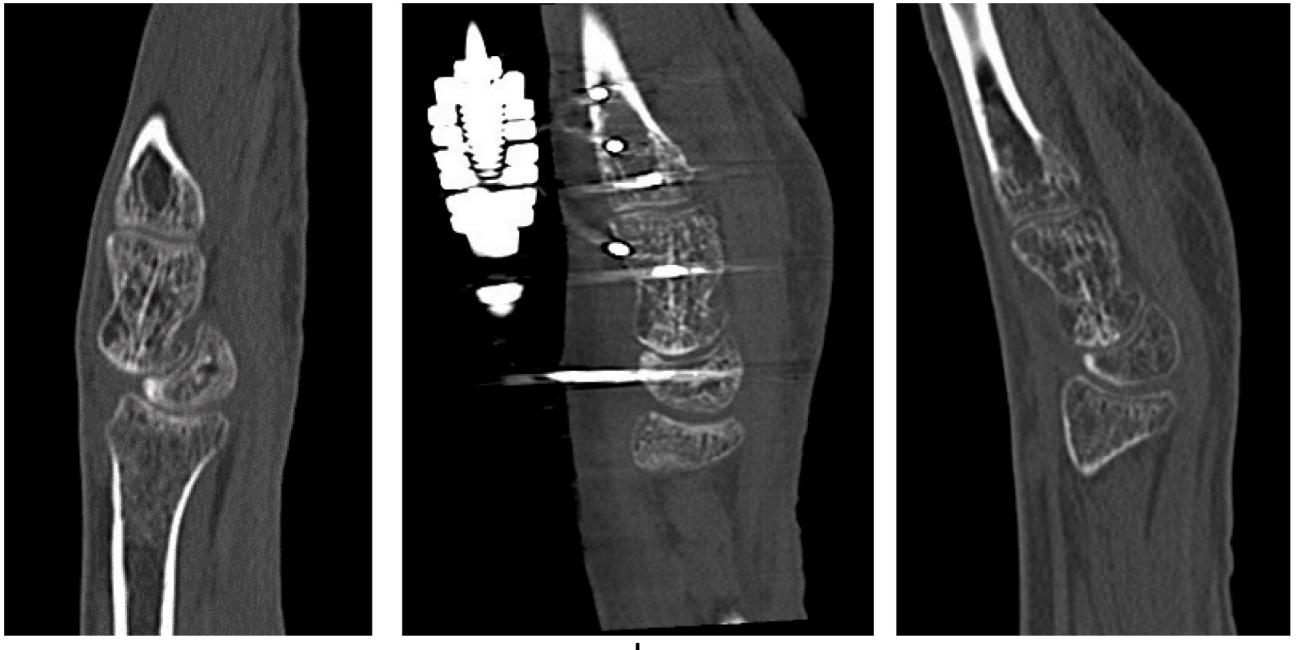

Fig. 4. The capitolunate angle was 41° on CT before the first operation (a), 5° before the second operation, which involved corrections with the Ilizarov mini fixator (b), and 10° 3 months after the second operation, which achieved bone union.

Shah et al. reviewed 50 patients with scaphoid nonunion treated by wedged bone grafting and Herbert screw fixation. Fourteen of these patients had chronic nonunion with a duration of 5 to 25 years, while 36 patients underwent surgery within 5 years of the initial injury. The union rate was 57 % in patients with chronic nonunion and 88 % in those treated within 5 years [4]. Nakamura et al. reported that only 1 out of 12 patients with scaphoid nonunion for more than 5 years had excellent or good outcomes in a wrist evaluation using Cooney's wrist score [5–7]. These findings suggest that patients with the long-term neglect of scaphoid nonunion of more than 5 years were unlikely to obtain good surgical results.

In cases of scaphoid nonunion with DISI deformity, it is important to correct the alignment of lunate dorsiflexion and the distal carpal row and achieve bony union [1]. Amadio et al. investigated the relationship between the degree of scaphoid flexion deformity and clinical symptoms. Residual scaphoid flexion deformity with an intrascaphoid angle (ISA) of more than 45° significantly increased clinical symptoms, such as pain and a limited range of motion, as well as the frequency of osteoarthritis [8]. Nakamura et al. reported that the degree of DISI deformity was associated with a reduced grip strength and limited range of motion, suggesting that increases in ISA and the improvement of DISI deformity are important [9]. Regarding long-term deformities, difficulties are anticipated with achieving bone union and correcting the alignment by one-stage bone grafting.

Therefore, we considered the application of the Ilizarov mini fixator for the gradual correction of DISI deformity. After the correction of the carpal bone alignment in the first stage, iliac bone grafting and screw fixation were performed to achieve bone union in the second stage. The Ilizarov external fixator is often used for deformity corrections, and its effectiveness has been demonstrated. Marko et al. reported the treatment of scaphoid nonunion with the ring-type Ilizarov external fixator; however, it was not used to correct DISI deformity [10,11]. This is the first case report of scaphoid nonunion with DISI deformity being corrected using the Ilizarov mini fixator.

The Ilizarov mini fixator allows the wire to be inserted freely according to the shape of the bone and attaches to a hollow bolt, thereby avoiding tendon damage [12]. Although there are some disadvantages, such as the limited use of the hand while the fixator is in place and the possibility of pin site infection, it was possible to correct a long-term deformity and good results were obtained. It represents an option for the treatment of scaphoid nonunion with DISI deformity.

Conclusions

In cases of chronic scaphoid nonunion with long-term DISI deformity after injury, the gradual correction of DISI deformity using the Ilizarov Mini Fixator represents one option for treatment.

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None.

Declaration of competing interest

The authors declare that there are no relevant conflicts of interest.

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Not applicable.

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