



Asymptomatic Nonunion Scaphoid Fracture After Kirschner Wire Fixation of Trans-Scaphoid Lunate Dislocation: A Case Report with 3 Years of Follow-up

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Abstract

Edited by: Igor Spiroski
Citation: Huwae TECJ, Dradjat RS, Refa AA. Asymptomatic Non-union Scaphoid Fracture After Kirschner Wire Fixation of Trans-Scaphoid Lunate Dislocation: A Case Report With 3 Years of Follow-up. Open Access Maced J Med Sci. 2022 Sep 11; 10(C):297-301. <https://doi.org/10.3889/oamjms.2022.10805>
Keywords: Trans-scaphoid lunate dislocation; Non-union; K-wire fixation
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Received: 14-Aug-2022
Revised: 30-Aug-2022
Accepted: 01-Sep-2022
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Funding: This research did not receive any financial support
Competing Interests: The authors have declared that no competing interests exist
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BACKGROUND: Trans-scaphoid lunate dislocation (TSLD) is an orthopedic injury, mostly because of high energy trauma. Due to subtle clinical and radiological findings, it might be easily left undiagnosed, with estimated 25% cases are missed at initial assessment in emergency department. Nonunion scaphoid, which accounts for 5–10% of all scaphoid fractures treated with K-wires fixation, mostly occurs in young and active individual.

CASE PRESENTATION: Thirty-seven-year-old right-handed man complained pain, and restricted range of motion (ROM) on his right wrist after fell from 2 m height. Loss of symmetry and parallelism of joint space in Gilula's line shown in X-ray, possible for a TSLD. We performed dorsal approach and internal fixation using Kirschner wire (1.0). The patient had a short arm cast for 4 weeks. The K-wires were removed 5 weeks postoperatively. We achieved good result clinically in 3, 9, and 36 months of follow-up (Mayo Wrist Score of 70, 80, and 90, respectively). The ROM of wrist is preferable than pre-surgery (RD 20°, UD 20°, and WF-WE 60°) with avascular necrosis of scaphoid in 9th month follow-up (in 2019). Unfortunately, at 3 years of follow-up, X-ray showed nonunion scaphoid, avascular necrosis, and osteophytes between scaphoid and radius. Unless it is asymptomatic, surgery is the recommended treatment for scaphoid non-union to limit further morbidity from pain, weakness, and stiffness of the wrist joint. However, in this case, the patient has been doing any activities with his right hand normally and never felt any pain in the past 2 years, even though the X-ray shows fracture line at distal of scaphoid. Thus, we choose not to do any treatment for it.

CONCLUSION: In the case of TSLD, the use of K-wire fixation shows excellent clinical outcome, but radiological finding shows non-union scaphoid with osteophytes, thus it has possibility to develop degenerative disease in the future.

Introduction

Trans-scaphoid lunate dislocation (TSLD) is an injury in orthopedic cases which severely disrupting the carpal anatomy and mainly is seen in young adults [1], [2], [3]. TSLD is typically caused by high energy trauma in the wrist and a fall with an open hand, mostly in motorcycle accident, falling from height, and sport event [1], [4]. Lunate fracture dislocations, lunate dislocation, and perilunate dislocation account for only 10% of all wrist injuries, with most of them are associated with trans-scaphoid fracture [1], [5], [6]. As many as, 25% of these cases are missed in diagnosis because of other visible and major injuries [7]. Meanwhile, delay in diagnosis may leads to significant risk of arthrosis and poorer outcomes [4].

After confirming the diagnosis, early closed reduction can be performed in the emergency operative room. Both operative and non-operative treatment options have their places and supporters as many

orthopedic surgeons perform early open reduction and internal fixation while others prefer casting after closed reduction [2]. The treatment options for lunate dislocation can be closed reduction with cast, closed reduction with percutaneous Kirschner wire (K-wire) fixation, and open reduction with fixation. After the surgery is done, even though the carpal alignment is restored, there is high risk for wrist stiffness, arthrosis, and non-union.

There is approximately 10% non-union rate in scaphoid cases [8]. Risk factors for non-union scaphoid have been known as location of scaphoid fracture (proximal pole), fracture displacement, poor vascularity, carpal instability, time to treatment, heavy worker, smoking, and associated radial styloidectomy [9]. The goals of treatment for nonunion scaphoid include bony union, correction of deformity, relief of symptoms, and limitation of arthrosis [8]. Surgery is the recommended treatment for symptomatic scaphoid nonunion to limit further morbidity [10]. Vascularized bone graft with fixation is reported to have highest percentage of bony union [11].

Nevertheless, it is critical to recognize these uncommon injuries at the time of admission to prevent loss of wrist function. In this study, we present a TSLD patient treated with open reduction and K-wire fixation as a treatment choice.

Case Presentation

A 37-years-old right-handed male complained pain and swelling on his right wrist after falling from two meters of height while working. We found swollen right wrist without wound at the site of trauma. Tenderness and limited range of motion (ROM) were noted with normal neurovascular examination. Wrist X-ray AP/Lateral showed a loss of symmetry and parallelism of the joint space in Gilula's line (Figure 1). These findings showed us the possible trans-scaphoid and lunate dislocation with other proximal carpal bones shift toward to dorsal side of the wrist. We decided to do a dorsal approach and performed open reduction and internal fixation using Kirschner wire 1.0 (K-wires). Postoperative X-ray indicated a complete reduction of lesser and greater arcs, and Gilula's line was also normalized (Figure 2). The patient then had a short arm cast for 4 weeks, and the K-wires were removed after 5 weeks.

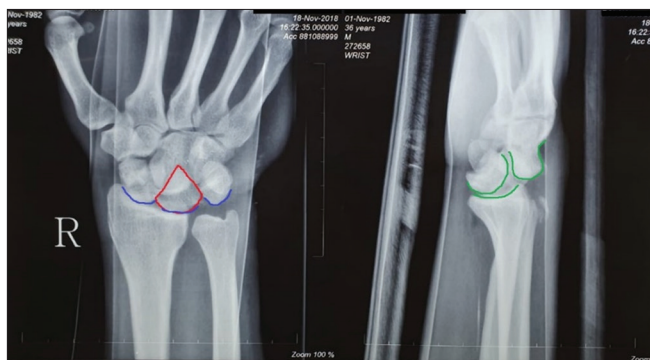


Figure 1: Pre-operative X-ray of the wrist. We can see the disruption in Gilula's line (blue line), lunate "piece of pie" sign (red line), and misalignment of radius, lunate, and capitate (green line)

In the 9 months of follow-up (Figures 3-5), we found good result in Mayo wrist score (Score 80) and preferable ROM of the wrist (radial deviation 20°, ulnar deviation 20°, wrist flexion, and extension 60°). Unfortunately, at 3 years of follow-up, even though there was better clinical outcome (Mayo Wrist Score 90) and better ROM (radial deviation 20°, ulnar deviation 30°, wrist flexion, and extension 75°), the X-ray showed nonunion scaphoid, and osteophyte in the space between scaphoid and radius (Figures 6-7).

Discussion

In 1980, Mayfield describes that mechanism of perilunate wrist instability consist of four stages with perilunate or lunate dislocation as a result. When a person fall with an outstretched hand, the impact force on the wrist produces supination injury that starts radially then either fractures the scaphoid body or causes ligamentous disruption in the scapho-lunate interval [5]. The four stages consist with Stage 1: A progressive rupture of the scapho-lunate ligament from volar to dorsal, followed by Stage 2: Dorsal capitate dislocation with dissociation at the luno-capitate joint, Stage 3: Luno-triquetral ligament disruption, with the rest of the carpus displaced, usually dorsally, and Stage 4: Complete ligament disruption with the lunate forced to volar side by the capitate resulting to lunate dislocation [5].

From inspection, deformity from lunate dislocation not directly apparent because the hand mainly has edema, hematoma, and usually without any open wound. The patient still feeling pain around the wrist with limited ROM. These sign not particularly specific for lunate dislocation and often overlooked by the clinician during initial assessment; moreover, if there is any other worse visible injury. Neurological symptoms are not uncommon in lunate dislocation, lunate dislocated to volar area through the space of



Figure 2: Post-operative radiograph and clinical photo of the wrist



Figure 3: X-ray of the wrist in the 3 months of follow-up. There is nonunion finding in the scaphoid

Poirier, a weak area in the floor of the carpal tunnel, and compressing the median nerve produces paresthesia to the distal area [5], [12] but these neurological symptoms are not always seen in lunate dislocation.



Figure 4: X-ray of the wrist in the 9 months of follow-up

X-ray anteroposterior and lateral (AP/Lat) of wrist joint is pivotal to diagnose lunate dislocation. Sign that often seen in carpal dislocation on AP projection such as, disruption on the gilulas's line, piece of pie sign on lunate, "crowded" looks at the carpal bones, and in

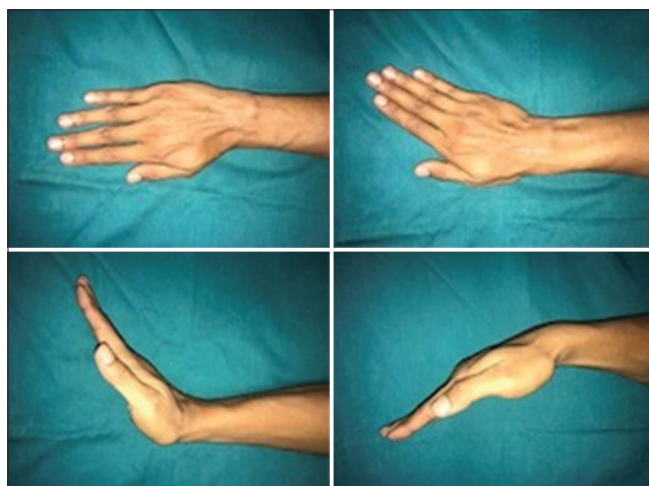


Figure 5: Clinical appearance 9 months follow-up. Radial deviation 20°, ulnar deviation 20°, wrist flexion, and extension 60°

some cases, there is Terry-Thomas sign. Gilula's line consists of three arcs, the first arc is a smooth curve

outlining the proximal convexities of the scaphoid, lunate, and triquetrum, the second arc is a curve tracing the distal concave surfaces of the same bones, and the third arc is curve that follows the main proximal curvatures of the capitate and hamate. If disruption or "step-off" on the gilula's line seen on the AP projection, then carpal dislocation is highly suspected [13]. When there is a disassociation between scaphoid and lunate, lunate, which in rectangular shape in AP projection is seen triangular like a "piece of pie" and there could be a gap between scaphoid and lunate called Terry-Thomas sign [12], [14].



Figure 6: X-ray of the wrist in the 36 months of follow-up. There is non-union scaphoid and osteophytes shown in scaphoid-radius joint

The lateral view is crucial, because if the radius, lunate, or capitate are not aligned, a carpal disruption must be assumed. The "spilled teacup" sign can be seen when the lunate rotates anteriorly around the radio-lunate ligament [5], [14]. Perilunate dislocation is when the lunate still articulates with radius fossa, and when lunate dislocate anteriorly beyond radius fossa the injury is called lunate dislocation [12], [14].

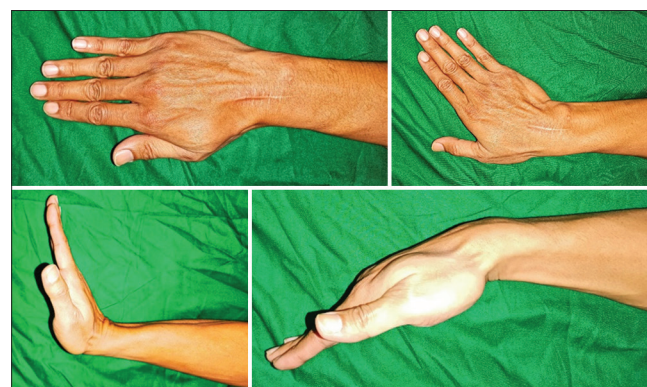


Figure 7: Clinical appearance 36 months of follow-up. Radial deviation 20°, ulnar deviation 30°, wrist flexion, and extension 75°

The treatment for lunate dislocation consists of closed reduction with cast, closed reduction with percutaneous Kirschner wire (K-wire) fixation, and open reduction with fixation. Urgent reduction is important, close reduction best performed in operating theater unless there is vascular or nerve compression then the closed reduction should be performed in emergency room. Even after closed reduction, further stabilization

is important to maintain the reduction. Acute treatment produced better results, but there was not always a connection between radiological and clinical outcomes [1], [4].

Multiple studies stated that open reduction and internal fixation have better results than closed reduction with or without fixation [1], [2], [4], [5], [6]. Bagheri *et al.*, in his study, treated 20 patients with early open reduction and internal fixation which have higher Mayo wrist score compared with closed reduction with long arm cast [2]. Open reduction procedure gives the surgeon better view to the anatomical figure in the injury site, access to ligament repair, and accurate reduction; therefore result to better anatomical restoration [1], [5]. Moreover, if there is a scaphoid fracture, then open reduction and internal fixation is highly recommended because despite a good initial reduction of the fracture, non-union of the trans-scaphoid injury is common without internal fixation of the scaphoid fracture because of reduction loss and instability [1], [5]. A proximal row carpectomy can be beneficial for a lunate dislocation if reduction is not possible and the patient is symptomatic [5].

There are multiple surgical approaches for TSLD such as: Dorsal approach, volar approach, and combination from both of them. Every approach has its own benefit, the dorsal approach provide adequate view to the proximal carpal row and mid-carpal joint allowing more precision in reducing the scapho-lunate interval and ligament repair and the volar approach allows for the repair of the essential volar ligaments and decompression of the carpal tunnel in volar lunate dislocation [4], [5]. Capo *et al.* suggest that combined dorsal and volar approach allow the best exposure for repairing all structures and reducing the carpus as anatomically as possible [4].

Carpal fixation using several pins is done to stabilize and allow healing to the scapholunate ligament [4]. With complete stabilization, the angle between the scaphoid and the lunate returns to normal ($>60^\circ$) and the scapholunate gap is reduced to $<3 \text{ mm}^3$. Several type tools for fixation is available for carpal dislocation; there is Herbert's screw, headless screw, and K-wire. Melsom and Leslie, in their study, stated that union rates using K-wire are lower than Herbert's screw because of less compression in the fracture site and the need for prolonged immobilization [5], [6]. We choose K-wire because K-wire is simpler, cheaper, easier to obtain, and easier to be used. Inoue, in his study, describes that Herbert's screw is more difficult to insert accurately compared to K-wire in some cases [6].

Postoperatively, the patient's wrist is immobilized with a cast for 4 weeks. Casting allows healing of ligament and bone not disrupted, for the purpose to avoid non-union and instability of the wrist on the follow-up. There is increasing evidence that early mobilization is beneficial and does not appear to hinder ligament repair [5]. Duration of casting recommended by Inoue is 4 weeks. Four weeks casting duration reported

gave better results on the wrist function. Other studies have recommended different casting duration. But some of them recommended if the duration of 4 weeks was more suitable by Inoue compared with more than 5 weeks [5]. There is a connection between delayed treatment of TSLD and a poor outcome. Accuracy of reduction and maintenance of reduction were also linked to poorer outcomes [5].

In this patient, due to our limited facilities, we performed dorsal approach and internal fixation using Kirschner wire (1.0). The patient had a short arm cast for 4 weeks. The K-wires were removed 5 weeks postoperatively. We achieved good result clinically in 3, 9, and 36 months of follow up (Mayo Wrist Score of 70, 80, and 90, respectively). At 3rd months of follow-up, we suggested the patient to underwent another surgery but the patient rejected. The ROM of wrist is preferable than pre-surgery (RD 20° , UD 20° , and WF-WE 60°) with avascular necrosis of scaphoid in 9th month (2019). Unfortunately, at 3 years of follow-up, X-ray showed non-union scaphoid, avascular necrosis, and osteophytes between scaphoid and radius without any clinical symptoms.

In scaphoid non-union case, the treatment goals for scaphoid non-union include union, correction of deformity, relief of symptoms, and limitation of arthrosis. For now, there are no differences between treatment for symptomatic and asymptomatic non-union scaphoid. Surgery is recommended for scaphoid non-union with internal fixation without bone grafting, and both vascularized and non-vascularized bone grafting as the surgery options [8]. Now he feels no pain in his right wrist for more than 2 years although he uses his hand every day.

Conclusion

For the conclusion, based on the patient's condition, in the case of TSLD, the use of K-wire fixation shows excellent clinical outcome, but radiological finding shows non-union scaphoid with osteophytes, thus, it has possibility to develop degenerative disease in the future.

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