Case Report

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Journal of Clinical & Experimental Orthopaedics
ISSN 2471-8416

2018
Vol.4 No.1:53

DOI: 10.4172/2471-8416.100053

Diaphyseal Fracture of both Bone Forearm with Distal Radio-Ulnar Joint Dislocation: An Unusual Entity

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Received date: February 22, 2018; **Accepted date:** March 06, 2018; **Published date:** March 10, 2018

Citation: Jain SK, Kohli GBS (2018) Diaphyseal Fracture of both Bone Forearm with Distal Radio-Ulnar Joint Dislocation- An Unusual Entity. J Clin Exp Orthop Vol 4.No1:53.

Abstract

Introduction: Diaphyseal fractures of both radius and ulna are a common entity. The indirect forces which can lead to diaphyseal fracture of radius and ulna are also responsible for injuring distal radio-ulnar joint (DRUJ). However, simultaneous occurrence of fractures of both forearm bones, along with DRUJ disruption, is an uncommon entity.

Case report: We came across a patient, who sustained fractures of both forearm bones with DRUJ dislocation. He was treated with open reduction and internal fixation of both the forearm fractures. His DRUJ reduced spontaneously after anatomical reduction of both fractures and was found to be stable on intra-operative assessment. He was immobilized in long arm splint for healing of DRUJ for 4 weeks. The fracture healed and the patient attained full range of motion at 12 weeks follow up.

Conclusion: Distal and proximal joints should be thoroughly examined in all the forearm fractures. Anatomical reduction of forearm bones is essential to obtain congruent DRUJ. Any instability of DRUJ should be assessed intra-operatively and dealt with accordingly for favorable functional outcome.

Introduction

Diaphyseal fractures of both radius and ulna, also known as "both bone" forearm fractures, are common orthopedic injuries. The vast majority of forearm shaft fractures occur in young males with good bone stock, therefore, most frequently occur due to high-energy trauma such as motor vehicle accidents or sports injuries [1-5]. The forces resulting in diaphyseal fracture of radius and ulna could be either direct or indirect. The fracture resulting from direct or bending forces are usually at same level in both the bones with substantial soft tissue injury. Torsional forces with axial loading, such as those occurring during a fall with a hyperpronated forearm and wrist extension, can lead to both-bone forearm fractures at different levels or to fracture of distal third radius with distal radio-ulnar joint (DRUJ) disruption (Galeazzi fracture) [6-9]. Although the mechanism of injury of both these fracture patterns is the same, the association of both bone forearm fracture and distal radio-ulnar joint (DRUJ) disruption is an uncommon injury. We came across a patient who sustained fractures of both radius and ulna with dislocation of DRUJ. He was treated with open reduction and dynamic compression plating and long arm splint.

Case Report

A 30 years old male patient presented to our emergency department with injury to the left forearm following a road traffic accident. He was driving a bike which was hit from the side. Patient tried to resist the fall with an extended elbow and wrist with the palm touching the ground resulting in axial force and leading to fracture of both the forearm bones. After initial assessment and stabilization, examination of the left forearm was carried out. His left forearm was bent volarwards without any breach of skin. There was no distal neurovascular deficit. He was given an above elbow slab and radiographic examination was done. The radiographs showed a mid-shaft fracture of both radius and ulna with slight communition of radius, and with dislocation of the distal radio-ulnar joint with dorsal displacement of distal ulna (**Figures 1 and 2**).

The elbow joint was normal. After obtaining the consent, definitive treatment was done in the form of open reduction and internal fixation. The radius was approached through volar (Henry) approach and the ulna was approached through the plane between flexor carpi ulnaris (FCU) and extensor carpi ulnaris (ECU). Both the fractures were reduced and fixed with 3.5mm dynamic compression plates (**Figures 3 and 4**). Anatomical fixation of both the radius and ulna led to reduction of the DRUJ. Intra-operative assessment of DRUJ showed a reduced and stable joint. The forearm was immobilized in a long arm splint for 4 weeks for healing of DRUJ. After four weeks, gentle range of motion exercises were started. The fracture healed completely at 12 weeks and the patient attained full range of motion of the forearm (supination and pronation) and wrist. There was no subsequent subluxation or dislocation of the DRUJ. The grip strengths of both hands were comparable.

Figure 1: Pre-operative Oblique view showing fracture of radius and ulna.

Figure 2: Pre-operative lateral view showing fracture of radius and ulna with dislocation of distal radio-ulnar joint (DRUJ).

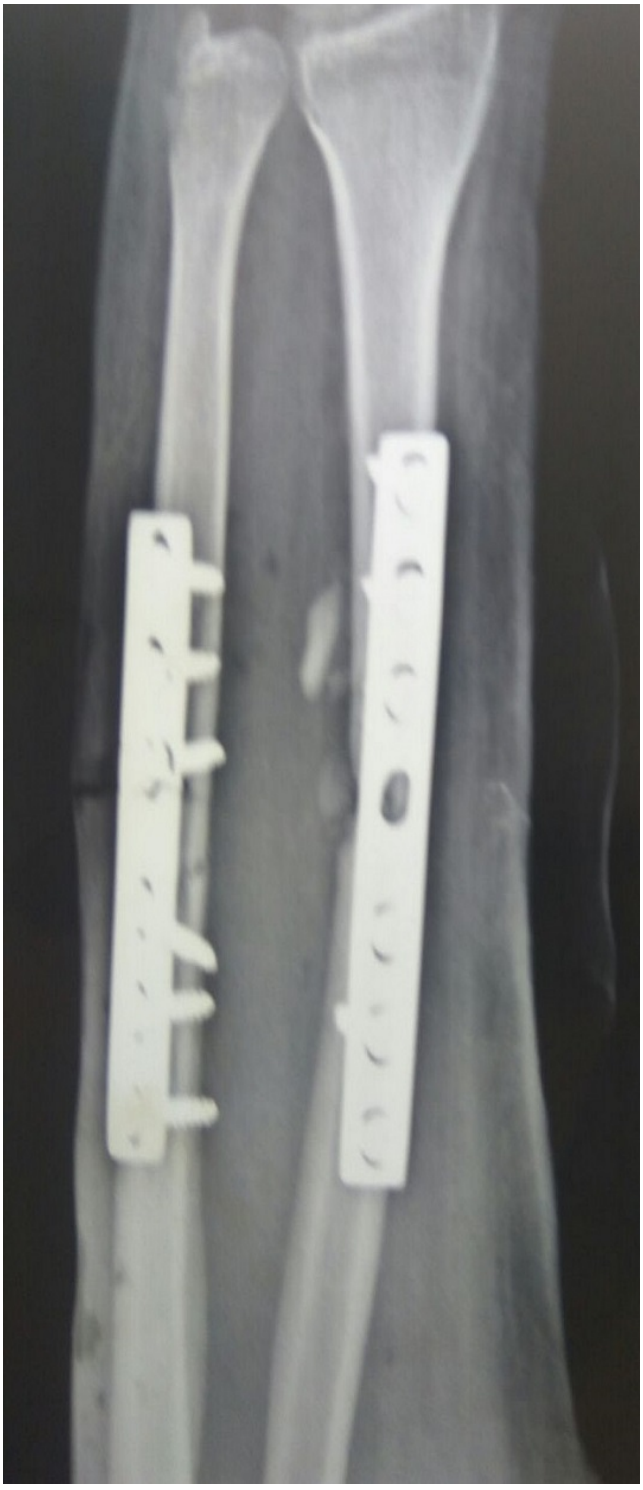

Figure 3: Post-operative Antero-posterior showing fixation of radius and ulna fracture with anatomical reduction of DRUJ.

Figure 4: Post-operative lateral views showing anatomical redction of radius and ulna fracture with reduction of DRUJ.

Discussion

The Radius and Ulna are constrained firmly by the interosseous membrane and ligamentous structures at the proximal and distal radio-ulnar joints. Hence, any disruption (e.g. fracture) in the length of the radius can affect either of these

joints [6]. Torsional forces with axial loading, occurring during a fall with a hyperpronated forearm and an extended wrist, can lead to fracture through the radial shaft and progress distally rupturing the interosseous membrane and finally injuring either the triangular fibrocartilage complex (TFCC) [6-9] or ulna. Although the mechanism of injury of Galeazzi fracture dislocation and diaphyseal fracture of radius and ulna is the same, simultaneous occurrence of both these entities is uncommon.

The distal radio-ulnar joint (DRUJ), an articulation between the head of the ulna and ulnar notch of the radius, is primarily stabilized by the triangular fibrocartilage complex (TFCC)[9], hence dislocation of the DRUJ requires severe disruption of the TFCC. It has been clearly explained in the literature that the fracture of the distal third of radius results in marked shortening of the radius relative to ulna, resulting in disruption of TFCC [10].

The interosseous membrane is a complex ligamentous structure that connects the interosseous borders of the radius and ulna and transfers load from the radius to the ulna. It consists of a central band, a proximal band, membranous portions, and accessory bands. The central band, the strongest portion of the interosseous membrane, originates from the proximal one third of the radius and inserts at the distal quarter of the ulna [11]. Because the interosseous membrane has no attachment to the distal one third of the radius, hence fractures involving this area are usually associated with a higher risk of shortening and hence disruption of DRUJ, resulting in Galeazzi fracture.

The Galeazzi-equivalent lesion is a variant of the classic Galeazzi fracture and is usually seen in skeletally immature children and adolescents. It is characterized by fracture of the radius with fracture through the distal growth plate of the ulna but without disruption of the DRUJ [12]. The distal epiphysis separates, but the ligamentous restraints of the DRUJ do not rupture, probably because, in children, the epiphyseal plate is biomechanically weaker than the ligamentous complex that stabilizes the DRUJ [13].

These two mechanism of injury explain that forces pass from radius to the DRUJ and then to the ulna. These forces exit either at the DRUJ or Ulna, injuring one of these structures but never both. But in the present case, there was injury to both DRUJ and ulna, which is difficult to explain from these mechanisms. Mikić coined the term “Galeazzi-type fracture” to describe this type of injury pattern which involves fracture of the both bones of forearm with disruption of DRUJ [14] but he did not described the mechanism resulting in this type of injury pattern. The possible mechanism of Galeazzi- type fracture could be that the axial loading of the forearm in pronation, which causes fracture of the radius and disruption of the DRUJ with dorsal dislocation of the distal ulna, could have continued further resulting in a fracture of ulna. This injury seems to represent a biomechanically unique failure of forearm stability, and further biomechanical studies are needed to elucidate the pattern.

The DRUJ disruption is evident clinically in the form of joint tenderness and prominence of the ulnar head dorsally or palmarly. The radiographic examination includes antero-posterior and lateral wrist X-rays. Findings suggestive of DRUJ injury may include fracture of the ulnar styloid base, widening of the DRUJ on the AP view, dislocation or subluxation of the radius relative to the ulna on the true lateral view, shortening of the radius >5 mm relative to the distal ulna, and asymmetry compared with the uninjured contralateral DRUJ [9,15-16]. Axial CT has been recommended for diagnosis of DRUJ disruption when assessment of the integrity of the DRUJ is difficult on plain radiographs [17].

The treatment of this type of unstable fracture patterns is essentially surgical with the aim to restore bony length and provide stable fixation and reduction of DRUJ. Inability to restore the length of the forearm bones can result in persistent dislocation of DRUJ. Dynamic compression plate fixation is the preferred method of osteosynthesis for radius and ulna [1,18-21]. Restoration of the radial bow at the time of open reduction is important in reconstituting the normal architecture of the forearm and the DRUJ [22]. Care must be taken to contour the plate accurately to restore the normal sagittal bow and eliminate any chances of subluxation of the DRUJ [23]. ORIF of both-bone and Galeazzi fractures does not guarantee DRUJ stability; hence, it is critical to assess the DRUJ intra-operatively following reduction and fixation of the radius and ulna [21].

The stability of the DRUJ can be tested clinically with the forearm in supination and throughout forearm rotation. The DRUJ is considered as unstable in the setting of gross antero-posterior translation of the radio-ulnar joint with displacement of the ulnar head out of the sigmoid notch. This assessment can confirm whether the DRUJ is reducible and stable, reducible and unstable, or irreducible [7]. Reducible and stable DRUJ does not require any further surgical treatment [24], however, unstable DRUJ needs to be made stable either by repair of TFCC or trans-fixation with Kirschner wires [1,14]. The fracture of ulna styloid is also a contributory factor, resulting in instability of DRUJ, often require fixation with lag screw, pins or tension band wiring. In the present case, there was no ulnar styloid fracture and DRUJ was found to be stable after fixation of Radius and Ulna, hence the limb was immobilized in long arm slab for 4 weeks.

Conclusion

Distal and proximal joints should be thoroughly examined in all the forearm fractures. Anatomical reduction of forearm bones is essential to obtain congruent DRUJ. Intra-operative assessment of DRUJ is of paramount importance to achieve favorable functional outcome. Any instability of DRUJ should be dealt with accordingly either by repair of TFCC or trans-fixation with Kirschner wires.

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