CASE REPORT

Peri-implant distal radius fracture due to car collision

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ABSTRACT

Peri-implant fractures have gained increasing importance in orthopedics as the number of surgical procedures involving orthopedic implants rises globally. These fractures pose a significant challenge in terms of diagnosis, treatment, and postoperative management. They manifest as stress fractures distal to the implant site. Developing an effective treatment strategy involves evaluating multiple influencing factors. This article presents a rare case of a peri-implant distal radius fracture in a 63-year-old man, with no comorbidities, resulting from a car accident, classified as C1U in the Michele D'Arienzo system. The surgical intervention included plate fixation for the radius and wire fixation for the ulna. The wire was used for ulna instead of a plate, due to skin injuries, with good results. As life expectancy rises and individuals remain active in their elder years, the incidence of peri-implant fractures is expected to increase. Factors such as the implant type, surgeon's approach, and patient-specific elements may influence peri-implant fracture occurrence. The widespread use of plate fixation for distal radius fractures may also contribute to a parallel increase in such fractures. Providing detailed context and specific case presentation allows better understanding and implications for clinical practice.

KEYWORDS: Peri-implant condition; Distal radius; Fracture; Implant

INTRODUCTION

As we consider the demographic trends of the population, we can observe a significant increase in the incidence of fractures and associated forms of osteosynthesis [1]. Additionally, recurrent falls and the occurrence of new fractures, known as peri-implant fractures, are also expected to rise [2]. The term "peri-implant" signifies that these fractures occur around the implant and include the area where it is fixed in the bone. The incidence of these fractures varies significantly depending on the location and type of the original fracture, the type of implant used, surgical techniques, as well as patient characteristics, including age, comorbidities, and bone density [3]. Among the studies available in the current literature, most are limited to smaller case series and have focused on peri-implant fractures of the hip or femur, while other anatomical locations, such as the tibia, forearm, or humerus, have been much less reported [4,5]. Fractures in the forearm are frequent injuries in adults, and elderly people often suffer distal radial fractures [6,7].

Peri-implant fractures of the forearm have been previously studied only in the pediatric population, with a reported incidence of 7.3% among patients [8]. In this age group, Clement et al. [8] postulated that risk factors for these fractures include radius plates compared to ulna plates and dynamic compression plates compared to one-third tubular plates. We are not aware of any studies evaluating these fractures in adults, so it is unclear if they have similar incidence and risk factors.

Peri-implant fractures of the distal radius are very rare but are likely to increase due to the widespread use of plates in the treatment of radius fractures [9]. Two cases of peri-implant fractures have been reported in the literature [10,11]. Kanjiet et al. [12] described a case of peri-implant fracture at the level of the radius following plate osteosynthesis.

A significant majority of distal radius fractures can be treated nonsurgical [through cast application and reduction], usually leading to satisfactory functional outcomes. Surgical treatment can include options such as closed reduction and percutaneous pinning, external fixation, open reduction, and internal fixation (ORIF). Over the past two decades, the application of ORIF has seen a surge due to its advantages such as rapid recovery, anatomy restoration, and strong stability in cases of comminuted fractures [13,14]. Although ORIF is generally a safe procedure, it has been associated with complication rates ranging from 22% to 27% [15]. Postoperative complications may include infection, nerve/vessel injury, tendon irritation/rupture, stiffness, malunion, nonunion, and hardware prominence. Any procedure that involves retained hardware carries the risk of a peri-implant fracture [15,16]. Mechanical failure, such as plate bending/breaking, screw breaking/loss, or articular fragment collapse leading to intraarticular screw extrusion, is considered a rare

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complication [17]. In this article, we describe a peri-implant distal radius fracture, without implant failure, associated with an ulna fracture, we classified and detailed the chosen treatment.

CASE PRESENTATION

An 18-year history of open reduction and internal fixation for a distal radius fracture was observed in a 63-year-old male patient's left wrist. He was recently involved in a car accident and was admitted to our emergency department. The patient had no comorbidities, no smoking and came from an urban environment.

On physical examination, the wrist showed noticeable deformation and exhibited signs of deep abrasion, with skin and muscle contusion. The patient was incapable of moving his wrist and experienced discomfort even during passive movements. No deficits in vascular or neurological function were observed. X-ray imaging indicated a peri-implant fracture located proximal to the plate in the radius, along with a fracture in the ulnar shaft. The plate remained affixed to the distal radius, and the radiocarpal joint exhibited a dorsal tilt. Furthermore, the patient had radiocarpal and radioulnar arthritis, along with a malunion of the distal radius (Figure 1). The patient underwent surgical treatment using a volar approach. A skin incision was made over the previous surgical scar, and the plate and screws were removed. Subsequently, the reduction was performed. With the radius reduction, the ulna was also reduced, obtaining a stable reduction. After that, internal fixation was performed using a dynamic compression plate (DCP) for the radius fracture and a Kirschner wire for the shaft ulnar fracture. Considering the skin injuries in the ulnar approach, we chose to treat it with a Kirschner wire. Postoperative images confirmed a successful reduction in fractures (Figure 2). After surgery, the forearm was immobilized with a splint for 30 days. After the removal of the splint and Kirschner wire, the patient began rehabilitation to restore the range of motion in his forearm and wrist. Unfortunately, the patient did not follow regular follow-up appointments, which hindered clinical and radiological evaluation.

DISCUSSION

The application of varying plating constructs for the surgical repair of distal radius fractures has gained increasing popularity. It is of utmost importance that the surgical treatment of distal radius fractures restores articular congruity and regular bone alignment [18].

Usually, plate and screw constructs act as load bearers and are more rigid than native bone. This biomechanical concept creates a potential increase in stress at the bone-plate interface or at the most proximal screw hole (considered the weakest point), possibly resulting in peri-implant fractures [19].

Peri-implant wrist fractures are incredibly rare, but we foresee an increase in these fractures given the growing application of plates for wrist fracture treatments [9]. A limited number of cases involving fractures located proximally to the volar radius plate have been reported in the existing literature [10–12,20].

Peri-implant fractures are uncommon, with contributory factors including patient characteristics [such as osteoporosis, smoking habits, comorbidities] and mechanical influences [21]. This case presents a middle-aged man who experienced a distal radius refracture after initial fixation.

Fig. 1. Lateral and Anterior-Posterior [AP] left wrist radiograph showing the peri-implant fracture.

Fig. 2. X-rays in AP and L view: postoperative reduction of fractures using a DCP plate for the radial fracture and a Kirschner wire for the shaft ulnar fracture, imaging undertaken in a plaster cast.

The characteristics of our patient, which can influence the fracture rates, is similar from those in other studies [10–12,20].

Such fractures commonly present as stress fractures that occur in close proximity to the distal end of the implant. Based on the fracture level and the specific type of plate failure, we applied the classification proposed by D'Arienzo for peri-implant wrist fractures, categorizing it as type C1U (radius fractures occur proximally, within 3.5cm from the plate and in association with a fracture of the ulna) [22].

Fixing fractures around implants presents distinct difficulties. The initial placement of the implant may increase the vulnerability to subsequent fractures, as the long-term presence of the device can alter bone structure and make it more prone to fractures. Additionally, the implant itself can impede the healing process and interfere with the positioning of other fixation devices [23].

The surgical methods employed for wrist implants can determine post-operative outcomes. In our study the treatment did not completely follow the therapeutic algorithm recommended by Stramazzo in his article according to the new classification [22]. We replace the plate with a DCP plate, not with a longer anatomical plate because it was not available at the time of surgery. For the ulna fracture, we use internal fixation with a Kirschner wire and not a plate because the patient had a deep abrasion of the skin in the ulnar approach region. Kistler et al. [20] outline alternative methods for treating peri-implant fractures of the radius, which mainly involve the removal of existing hardware and the application of revision ORIF. While one individual with an intramedullary device faced partial hardware removal because of screw complications, several others were treated with different types of volar distal radius plates. One notable case featured a patient with extensive comminution who received a dorsal wrist spanning plate. Additionally, an adolescent with pre-existing deformities was treated using Kirschner wires rather than a standard revision plate.

In a study conducted by Barrera-Ochoa et al. in 2018, a case was presented involving a patient who experienced peri-implant radial and ulnar shaft fractures following volar locking plate fixation of the distal radius. The patient had been involved in a high-energy traffic accident but was ultimately treated successfully [11]. Given the rising incidence of distal radius fracture open reduction and internal fixation, it is likely that peri-implant distal radius fractures will receive greater recognition in the future.

Post-surgical care and rehabilitation protocols for wrist procedures can differ and impact the rates of peri-implant fractures. However, in our study, we could not thoroughly examine this aspect.

We monitored patients for a duration of 2 months, with some not returning for follow-up appointments. Other studies had different follow-up durations, which might have affected the complications they reported [20]. While common complications often include tendon irritation or rupture, nerve discomfort, and malunion or a loss of reduction, we are unable to delve into these in our study due to the limited follow-up.

Several factors can increase the risk of peri-implant fractures, including older age, osteoporosis or osteopenia, poor bone quality, compromised healing capacity, implant-related factors (such as design, position, or size), and factors that increase mechanical stress on the implant, such as obesity or high-impact activities [2,24–26]. In literature were

investigated and included also: initial fixation with unlocked screw instead of locking screw, hypertension [27] has been postulated as a risk factor for fracture in women (the association is independent of bone mineral density), osteoporosis in postmenopausal women. New studies also included neurological disorders (dementia-related, infection-related, movement-related, neural development, neuromuscular, psychological, trauma-related, vascular, and other neuronal diseases) because they can cause deficits in the bone, including osteopenia/osteoporosis and increased fracture risk [28].

CONCLUSIONS

Peri-implant fracture is an uncommon complication following surgical fixation of the distal radius and is infrequently reported. This study presents a case of peri-implant fracture at the level of the distal radius in a young patient following a high-energy trauma. An individualized surgical approach was employed due to the associated skin injuries. Drawing from the conducted study and pertinent literature, it can be deduced that managing peri-implant fractures in the wrist necessitates an individualized approach, guided by several overarching principles. The primary objective should revolve around reinstating the biomechanical stability of the bone. Also, the characteristics of the traumatic event, the condition of the plate, and the specific location of the fracture can vary significantly, highlighting the need for a comprehensive assessment of the position of the fracture relative to the plate to formulate an appropriate surgical treatment plan.

Due to the limited number of cases, it is challenging to draw comprehensive conclusions or establish specific risk factors for radius peri-implant fractures. Further research and studies with larger sample sizes are necessary to gain a better understanding of the incidence, management, and complications associated with radius peri-implant fractures.

Declaration of interest

The authors confirm that there are no conflicts of interest to disclose.

Informed consent

The patient has given his written informed consent for the publication of this case along with the accompanying photographs.

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