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Case Report

Spontaneous Renewal of Pediatric Both-Bone Fracture: Case Report

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Abstract

Severe musculoskeletal injuries, resulting in bone and soft-tissue loss, are often caused by high-energy trauma (i.e. falling from heights and road accidents), and many ultimately lead to extreme limitations in motor functions due to fracture complications or amputations. Traumatic bone injuries are very rare in children and are usually detected following open fractures, and their initial or delayed treatment depends on the conditions of the patient's soft tissue. Here, a rare case of A 13-year-old male patient was referred to the under study hospital due to a roll over car accident with a crush injury, both-bone fracture of the forearm, and radius defects, and the spontaneous repair of the post-traumatic radius defect healing without delayed intervention is presented.

Keywords: Periosteum, Radius, Bone Defect.

Introduction

Severe musculoskeletal injuries, resulting in bone and soft-tissue loss, are often caused by high-energy trauma (i.e. falling from heights and road accidents), and many ultimately lead to extreme limitations in motor functions due to fracture complications or amputations. Traumatic bone injuries are very rare in children and are usually detected following open fractures, and their initial or delayed treatment depends on the conditions of the patient's soft tissue (1,2). Here, a rare case of A 13-year-old male patient was referred to the under study hospital due to a roll over car accident with a crush injury, both-bone fracture of the forearm, and radius defects, and the spontaneous repair of the post-traumatic radius defect healing without delayed intervention is presented.

Case Presentation

A 13-year-old male patient was referred to the hospital under study because of a roll-over car accident with a crush injury, both bone fracture of the forearm, and radius defects. In the initial trauma center, early debridement was performed with a pin through the intramedullary ulna fixation (Figure 1). In the initial examination, a wound <15 cm in size on the volar forearm which involved an area from the elbow to the wrist was evident. The distal pulse of the limb and the sensory examination of organs were within normal ranges. The motor examination was impossible on admission due to the patient's pain and discomfort. In the initial imaging examinations, the ulna shaft fracture with bone defect was observed in 9 cm at the proximal and distal ends of the radius. External fixator pins were inserted in the second metacarpal, and the remaining parts of the shaft and the soft tissue were given time to recover (Figure-2).

After three weeks, due to the patient's late referral for revisit, diagnostic radiography was required, and the findings indicated unanticipated ossification along the radius shaft (Figure-3). Considering the desired movements of the fingers and evidence of osteogenesis, the patient was a candidate for continued treatment.

Eight weeks after insertion of the external fixation, the pins were removed and a plaster cast was applied to the injured bones for one month. Due to the displacement of the distal ulna with respect to the distal radius and diagnosis based on the DRUJ injuries, the plaster cast was placed in full supination (Figure-4).

After opening the plaster cast, the patient was encouraged to perform supination and pronation exercises. There was no pain in the wrists and flex/ext movements were desirable, but despite physical therapy, supination and pronation were limited (Figure-5).

Figure-1. First forearm radiography

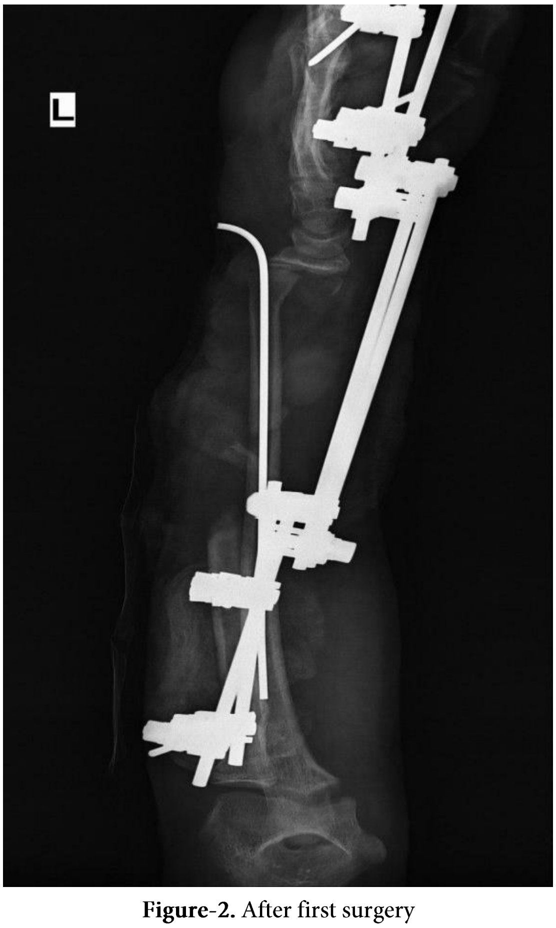

Figure-2. After first surgery

Figure-3. Three weeks later

Figure-4. After cast placement

Figure-5. Final status

Discussion

Traumatic bone defect (BD) is very rare in the general population, especially in children. This type of BD is more common in open fractures (3). Open limb fractures are at high risk for infection, since the integrity of the skin and its underlying tissue is disrupted and the bone is exposed to the external environment. Hence, open fractures cause infection and morbidity more than closed fractures and are considered orthopedic emergencies. Open limb fractures constitute 0.7%-2% of all pediatric fractures, and open fractures of the forearm and wrist account for approximately 1%-2% of them (3). It seems that such fractures are well treated by internal fixation with k-wire or flexible nail, and there is a lower risk of malunion or nonunion with them. Pediatric epidemiological studies dealing with BDs are very limited; in the study by Keating (2005), only 0.4% of fractures in 10-year-old patients had a BD, most of which were tibial, diaphyseal, and observed in male patients (4).

Many surgeons attempt to treat a bone defect after the soft tissue heals and the risk of infection and amputation is resolved. Among the available treatment options for bone defect, osteochondral allograft, vascular bone autograft, acute shortening and acute/later lengthening, use of bone substitute, and induced membrane technique (Masquelet procedure) are noteworthy. In all of the abovementioned procedures, the application of some kind of internal fixation, i.e. plating, intramedullary nailing, or external fixation (from etching and plaster casting to exterior fixators), is recommended. There are some reports of spontaneous repair of bone defect in children by the periosteum as case studies. Because each of the aforementioned techniques has its own advantages and disadvantages, the treatment of choice for bone loss firmly depends on the case, taste, and experience of the surgeon and the patient's condition.

The important limitations of the use of allograft, for which there are reports of its therapeutic success (5), are infection and nonunion of bone (6). Vascular bone graft is also popular (7); even in an article on upper limb defecation, the allograft was used to form one-bone forearm, and the results were satisfactory (8). Its main limitations were donor site morbidity, difficulty of the surgical technique, and failure of the graft (3).

The shortening method has been employed in defects larger than 6 cm and acceptable results have been reported, but patient admission and the stiffness and lengthening of the limb in the future (in terms of bone and soft tissue quality) restrict its application (9).

Bone substitute is also used as an auxiliary method to fill small defects (10).

Fans of the Masquelet technique emphasize its efficacy, simplicity, and limited complications such as the need for proper soft tissue, good blood supply, and close proximity to the joint surface. Infection, pin tract infection, and bone absorption are of its reported complications (11-13).

Spontaneous repair of the bone following trauma in children is attributed to the function of periosteum. In children, the periosteum is thick and blood-rich, easily detached from the bone, and has more ossification proteins than those of adults (14). In addition to its role in osteogenesis, the periosteum is of great importance in closed fractures as an internal splint. The complex coordination between inflammatory cells, stem cells, ossifying cells, endothelial cells, and growth factors is effective in the healing process. The initial stage of the healing process is inflammation, the formation of hematoma, and the chemotaxis of inflammatory cells into the fracture site.

A review of animal model studies showed that periosteum plays a vital role in ossification, but most of these articles report on defects smaller than 5 cm, which cannot be generalized to all clinical cases (15).

In a rat model study by Yasui, the results indicated that contrary to previous beliefs which considered two ossification types (early and delayed) as endochondral bone formation and intramembranous, there is also a third type of ossification from surrounding fibrous cells called transchondral (15).

Human studies are mostly case reports of lower limbs (16-

20). Fewer cases have reported on the upper limbs, especially the radius bone (21), and have used external fixation, traction, or plaster casting (22); use of the sentence "thanks to periosteum" guided all ossification paths to the periosteum.

In the current case, apart from the importance of the periosteum in bone defect healing, the DRUJ state should be considered from the beginning. Of course, such issues are now resolved retrospectively; possibly saving the organ was more important during the treatment. Therefore, DRJU therapy would be a suitable treatment of choice for the reported patient undergoing ulna distal epiphysiodesis.

Conclusions

Most studies on spontaneous repair of bone defects in children are case reports. Although most of these cases indicate the critical role of the intact periosteum as an important factor in healing and spontaneous regeneration of defects, due to the complexity of the healing process and the multiplicity of the factors involved, it seems that the spontaneous bone defect healing plan using periosteum cannot be used as a first-line treatment. No criterion has been defined to employ this method; therefore, further interventional studies and clinical trials are required to investigate the factors influencing spontaneous repair by periosteum and possible criteria for employing this therapeutic technique.

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Authors' Contribution

All authors pass the four criteria for authorship contribution based on the International Committee of Medical Journal Editors (ICMJE) recommendations.

Conflict of Interests

The authors declared no potential conflict of interests with respect to the research, authorship, and/or publication of this article.

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