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Single Bone Forearm for Post Traumatic Bone Defect: A Case Report

Case Report

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Abstract

22 years old male patient was victim of severe trauma of the left upper Limb causing multiple fractures of the clavicle, humerus, radius with large bone defect of the ulna. Soft tissues damage was also significant with section of median and ulnar nerve, radial artery, flexor tendons of the hand and fingers. Treatment consisted initially to realize excision of devitalised and contaminated tissues from the wound, obtain skeletal stabilization with restoration of the upper limb length, and exceed the cap of infection. Secondarily, the one bone forearm procedure was performed to recover maximum of function. One year and half after injury, the patient had full elbow flexion-extension with very satisfactory fingers mobility.

Keywords: Trauma; Upper Limb; Open Fracture; Bone Defect; One Bone Forearm.

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Introduction

Groves [1] described in 1921 the first case of a patient treated for a large bone radial defect by transplanting the ulna into the distal fragment of the radius to produce a one-bone forearm. A few years later, Greenwood [2] and Watson-Jones [3] reported two separate similar cases. Since then, there have been few reported cases of one-bone forearm for diaphyseal defects following tumor resection, severe trauma and osteomyelitis. In this article, we report a complex case of combined skeletal and soft-tissue traumatic injuries of the forearm. After overcoming infection risk, the first stage of treatment consisted to realize one-bone forearm. Secondarily, wrist arthrodesis in a neutral position was performed to recover optimum function.

Case Report

22 years old male patient was victim of a highway accident (pedestrian struck by a car) with violent and direct impact at the left upper limb. The accident caused open forearm fracture type IIIB (Figure 1) with a large ulna bone defect, associated to humerus and clavicle fractures of the same side (Figure 2). The patient was transferred to the operating room in 2 hours after the trauma. Surgical exploration revealed a section of the radial artery, the median and ulnar nerves and all of flexor tendons. The patient was treated under general anesthesia. We realized internal fixation of clavicle and humerus fractures with appropriate screwed plates. At the forearm, intramedullary fixation with K-wires for both bones was performed. Ulnar bone defect was filled with two doses of Simplex® antibiotic cement including 2g of Tobramycin (Figure 3). At the end of the act, the soft tissue was repaired by rapprochement and simple sutures. In postoperative, intravenous antibiotic treatment based on Cefazolin and Tobramycin for 3 days was introduced. Clinical outcome was favorable. One year after, the proximal ulna was fixed at the distal radius bone with screwed plate in neutral position to restore forearm stability (Figure 4). The upper limb was protected in a splint for eight weeks until bone consolidation. At the last follow-up, there was no elbow instability with a range of movement between -7° to 120°. The wrist was painful and blocked at 70° of palmar flexion. Six months later, a wrist arthrodesis in functioning position was realized (Figure 5). At the last follow-up, grip and pinch strengths on the affected side were 30 kg and 7 kg respectively, which were 46% and 40% of that on the unaffected side. On the Peterson and colleagues [4] scoring system (Table 1), which assigns points to function, pain, and attainment of union, the patient scored a 6 of 10 points. To evaluate outcome after nerve repair, we used Rosen Scale instrument [5] that references to sensory and motor recovery as well as pain and discomfort, our patient total score was 1.7 relative to a maximum of 3.

Discussion

The management of diaphyseal forearm defects remains very complex. In the literature, several techniques have been described. The choice should take account in addition to the importance of bone defect, the soft tissue injuries associated [6, 7]. For this reason, a careful clinical assessment of the vascular and neurological status of the limb is required. Poor prognostic signs for limb

Figure 1. open forearm fracture type IIIB.

Figure 2. ulna fracture with a large bone defect.

Figure 3. intramedullary fixation with K-wires.

Figure 4. radiograph of the one bone forearm procedure.

salvage are a major soft-tissue injury, an ischaemic time in excess of six hours, the presence of significant neurological deficit and other major organ injuries. There are a number of scores devised to assist the surgeon in making the decision as to whether to opt for salvage or amputation in patients with this type of injury. In general, Low scores were found to be useful in predicting the potential for limb salvage, but high scores were not good predictors of amputation. The final decision to opt for salvage must be based also on consideration of the general status of the patient [8-11]. In our context, we used the mangled extremity severity score (MESS) (Table 2) based on skeletal/soft-tissue injury, limb ischemia, shock, and patient age. Our patient scored 5 which is considered favorable for salvage the forearm.

Once a decision is made to proceed with salvage, debridement and stabilisation will be required. External fixation is primarily indicated for open grade IIIB and IIIC fractures with severe soft-tissue injury. In these cases, the external fixator confers quick and efficient stabilization and minimizes infection risk [12]. In our patient, we were forced in emergency conditions to opt for an intramedullary fixation with K-wires due to the unavailability of the external fixator on the day of patient admission. Thanks to

Figure 5. Clinical aspect after the wrist arthrodesis.

Table 1. Peterson and colleagues scoring system.

Category	Level	Points
Functional capability	Near normal	6
	Complex activities	4
	Activities of daily living	2
	Minimal	0
Pain level	None	3
	Mild	2
	Moderate	1
	Severe	0
Union	Yes	1
	No	0
Grading system: 8-10 cumulative points= excellent; 6-7 points= good; 4-5 points= fair; 0-3 points= poor		

Table 2. the mangled severity scale (MESS).

Component	Point
Skeletal and soft tissue injury	
Low energy	1
Medium energy	2
High energy	3
Very high energy	4
Limb ischemia (score is doubled for ischemia > 6h)	
Pulse reduced or absent but perfusion normal	1
Pulselessness: paresthesias, diminished capillary refill	2
Cool, paralyzed, insensate, numb	3
Shock	
Systolic blood pressure always > 90 mm Hg	0
Hypotensive transiently	1
Persistent hypotension	2
Age (years)	
< 30	0
30-50	1
> 50	2

the cement spacer, we had a satisfactory stability and obtained a correct length of the forearm. The upper limb was protected in a splint for eight weeks until radius consolidation.

At the stage of restoration of the upper limb function, the one-bone forearm, that was performed the first time by Hey Groves [1] in 1921, represents a good therapeutic option to consider. It was described initially for the treatment of post traumatic bone defect when the proximal ulna and distal metaphysis of the radius are present. Physiological basis of this technique is the fact that the ulna as a distal extension of the arm is important for elbow function, and the radius as a proximal extension of the hand is important for the radio-carpal joint function. For this reason, this procedure finds its interest when radio-carpal and humero-ulnar joints are intact [13]. To get a good bone contact, radio ulnar union must be carried at least 4 centimeters from the distal metaphysis of the radius and fixed by screwed plate [14]. Clinically, the loss of forearm rotations is compensated by shoulder movements with better grip strength and retention of shoulder and wrist movements. In our case, at distance from trauma, X-rays showed good humero ulnar congruence with radial head dislocation. Elbow mobility in flexion extension was possible with cor-

rect amplitudes. The pronosupination was blocked at 0° and the hand was drooping with a wrist joint relatively free. Radio ulnar translation was performed at approximately 10 centimeters from the elbow joint because of the significant ulna large bone defect.

In terms of results, diaphyseal bone defects reconstruction in the forearm has been reported to have encouraging evolution. At the recipient site, the most common complication which remains infrequent is represented by nonunion. In the series of Jacoby SM and al. [15] which included 10 posttraumatic forearm bone defects treated by radioulnar transposition, the union was held successfully in 7 cases. In our context, and after radioulnar translation, bony union was carried within a period of 3 months.

Conclusion

The management of diaphyseal skeletal posttraumatic defects of the forearm is a real challenge. The one-bone forearm is a salvage option that restores the upper limb function. It finds its interest when radio-carpal and humero-ulnar joints are intact. This procedure offers very encouraging results especially in combination with other complementary acts.

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