Case Report

Open segmental fracture of both bone forearm and dislocation of ipsilateral elbow with extruded middle segment radius

Pawan Kumar, Lal Bahadur Manjhi, Ramesh Lal Rajak

Abstract

Extruded middle segment of radius with open segmental fracture both bone forearm and dislocation of ipsilateral elbow is a rare injury. A 12-year-old child presented to us within 4 hours following fall from tree. The child's mother was carrying a 12-cm-long extruded soiled segment of radius. The extruded bone was thoroughly washed. The medullary cavity was properly syringed with antiseptic solution. The bone was autoclaved and put in the muscle plane of the distal forearm after debridement of the wound. After 5 days, a 2.5-mm K-wire was introduced by retrograde method into the proximal radius by passing through the extruded segment. Another 2.5-mm K-wire was passed in ulna. The limb was evaluated clinicoradiologically every 2 weeks. The wound was healed by primary intention. At 4 months, the reposed bone appeared less dense radiologically and K-wire seemed to be out of the bone. In the subsequent months, the roentgenograms show remodeling of the extruded fragment. After 20 weeks, the K-wires were removed (first ulnar and then radial). Complete union was achieved with full range of movement except loss of few degrees of extension of elbow and thumb. This case is reported to show a good outcome following successful incorporation of an extruded segment of radius in an open fracture.

Key words: Children, segmental open fracture, dislocation of elbow, incorporation of extruded segment of radius

Introduction

Extrusion of long middle segment of radius following open segmental fracture both bone forearm and dislocation of ipsilateral elbow is a very rare injury. The surgical options in such cases include secondary autogenous fibular gap grafting or leaving a single bone forearm. Reimplantation of extruded bone is reported as case reports. We hereby report a case of extruded middle segment of radius with successful incorporation following irrigation and proper debridement and reimplantation of extruded segment of radius and internal fixation with IM Nail/K wires in children soon after injury.[1]

Department of Orthopaedic Surgery, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

Address for correspondence: Dr. Pawan Kumar,
Jay Prakash Nagar, Bariyatu Road, Near Booty More, Ranchi - 834 009, Jharkhand, India.
E-mail: pawankr.barnwal@gmail.com

Access this article online	
Quick Response Code:	Website: www.ijoonline.com
	DOI: 10.4103/0019-5413.111512

Case Report

A 12 year old girl presented to the casualty 4 h following fall from tree. She had complaints of pain and swelling with lacerated wound over distal forearm. On examination, swelling, tenderness with deformity of distal forearm was present with dislocation of elbow with 2 × 1 cm long lacerated wound over anterior aspect of distal forearm. There was no neurovascular deficit except a rent in the muscles through which the bone was extruded. The child's mother brought 12 cm extruded and soiled segment of radius. It was diagnosed as open segmental fracture both bone forearm with extruded segment radius and dislocation of ipsilateral elbow [Figure 1]. The X-ray forearm with wrist and elbow – anteroposterior and lateral revealed absence of middle segment of radius with fracture both bone forearm and dislocation of ipsilateral elbow [Figure 1].

The wound was debrided. We planned to reinsert the extruded bone after thorough cleaning and autoclaving. The extruded segment was properly cleaned and scrubbed thoroughly with brush, savlon, hydrogen peroxide, normal saline, and betadine. Mud was removed from the external surface and from within the marrow cavities. Medullary cavity was properly syringed in antiseptic solution. No soft tissue was attached to the extruded segment except a few

irregular tags of periosteum. Wound was irrigated with gentamycin solution and debrided. The extruded middle segment of radius was autoclaved and later immersed in normal saline before reimplantation. Under general anesthesia, elbow was reduced and the extruded segment was put inside the gap through the lacerated wound. Skin was closed loosely. A well padded above elbow slab was applied. After 5 days, the wound was dry. Under general anesthesia, by proximal and distal incisions, one 2.5-mm K-wire was introduced by retrograde method into the proximal radius by passing through the extruded segment and another 2.5-mm K-wire was passed in ulna. The wound was closed. The patient received antibiotics postoperatively for 6 weeks. Gradual physiotherapy was started.

Followup was done at 2 weeks, 6 weeks, 10 weeks, 4 months, 5 months, 6 months, and 10 months with above elbow cast for 3 months [Figure 2]. At 4 months, the graft radiologically appeared less dense but around 5½ months, the bone started reappearing. After 5 months, ulnar wire was removed. Elbow and wrist mobilization exercises were continued. At 10 months followup the whole length of radius was restored.

Patient had no infection, with slight restriction of elbow movement, nearly full range of motion (ROM) at wrist.

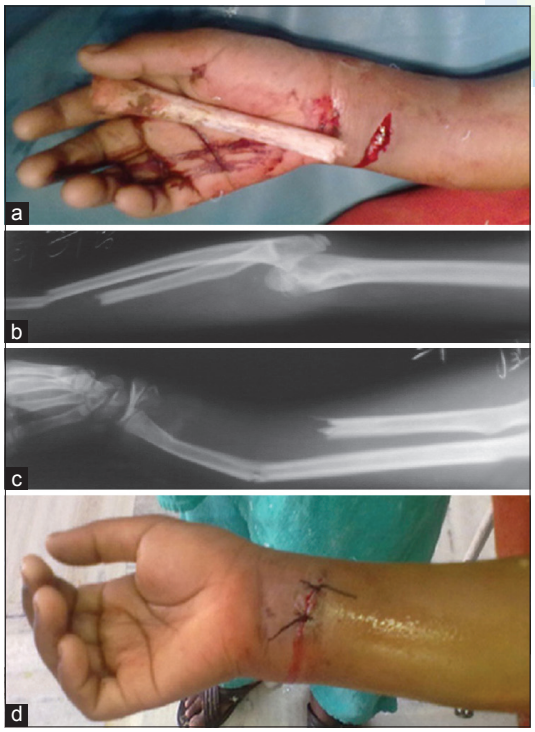

Figure 1: Clinical photograph showing (a) extruded segment with deformity forearm and elbow, X-ray showing (b) dislocation of elbow and absence of segment (c) fracture ulna with segmental fracture radius with absence of middle segment (d) immediate postoperative photograph of forearm

X-ray showed complete remodeling of the bones. The child was fit to use her hand for writing, eating, and other activities of daily living (ADL) at 10 months [Figure 3].

Discussion

Segmental extrusion of major bone is a difficult clinical problem for reconstruction of the bone gap. Kirkup[2] and Abell[3] reported successful replacements of extruded segments of femoral shafts in adults. The lengths of the extruded segments in their cases were about 9 inches and 7½ inches, respectively. Tuli *et al.*[4] reported traumatic extrusion of diaphysis of both radius and ulna being successfully replaced and maintained by a plaster of Paris (POP) cast in a 8 years and 2¼ months old child. Axhausen[5] was the first to systemically examine repair of dead bone and described the process of simultaneous absorption of dead bone and incomplete irregular replacement by new bone. Nonvascularized cortical grafts have been used with success, especially after tumor resection.[6]

By creeping substitution process, the old dead bone is gradually absorbed and replaced by new bone.[7] The amount of new bone formed depends largely on the extent of living bone with which dead bone is in contact. Stable vascular recipient bed is necessary for this to occur. Rate of remineralization and subsequent revascularization correlates strongly with clinical success of the graft. Autologous cancellous grafts, 5 mm thick, completely revascularizes in 20-25 days. Autologous bone grafts replaced by creeping substitution are weaker structurally from 6 weeks to 6

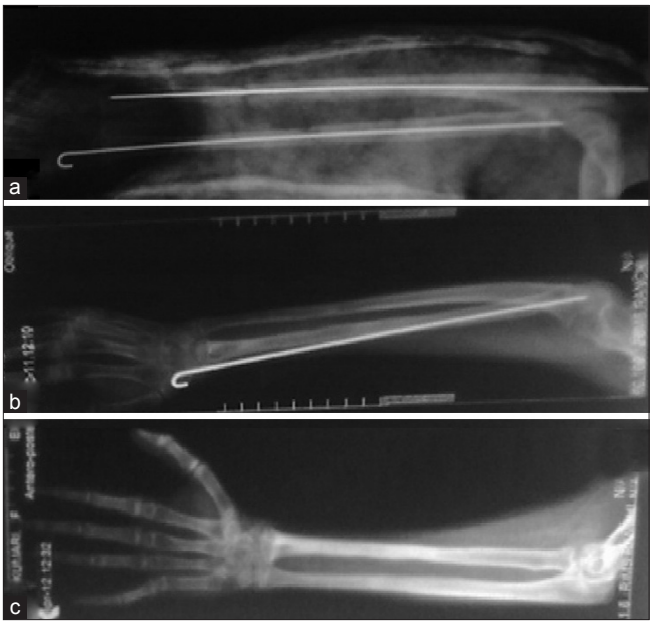

Figure 2: (a) X-ray after 2 weeks (b) after 4 months showing less denser bone indicating decalcifi cation and K-wire out of the bone (c) after 10 months showing complete remodeling of both bones forearm

Figure 3: Clinical photograph showing final outcome – ventral aspect of hand forearm and elbow

months, but may be normal by 1 year. Central portion of the autograft is the last to undergo the process of revascularization and reconstruction[8]. A fracture of the graft seems to take place when the process of reconstruction lags behind the process of resorption. Complete incorporation of the autograft is shown by remodeling of the bone and its trabecular pattern according to the physiological needs of the grafts in the extremity.[9] Cancellous grafts are useful for short defects (<6 cm) in a well vascularized, noninfected bed, while larger segmental defects may be treated with cortical grafting.[10]

In the present case, 12 cm long extruded middle segment of radius was put in the normal physiological environment of the body by keeping it in its bed after autoclaving. After 5 days, 2.5-mm K-wire was introduced into the proximal radius through the extruded segment. Extruded bone was being invaded by host blood vessels. Thus, bone was formed as the bone graft induced the surrounding connective tissue into bone. As a result, at around 4 months, decalcification started in the bone and radiologically appeared less dense and K-wire seemed to be out of the bone. In the subsequent months, the roentgenograms showed the evidence of revascularization, remineralization, and finally remodeling of the bones. These processes appeared to start at the ends of grafts at their junctions with the metaphyseal end and proceed toward the diaphysis. Ultimately, the extruded middle segment radius got completely revascularized and finally absorbed with the parent bone. Both radius and ulna regained their final shape, size, and strength. Successful incorporation of the bone was related to retention of the periosteum in the beds of the extruded bones, creeping substitution, control of infection, good nutritional status, physiotherapy, and younger age of the patient. This outcome is reported to occur in children well.[11]

In our series, the length of the extruded segment of radius was about 5 inches compared to other series, Kirkup and Abell in which the length of the extruded segment of femoral shafts were about 9 inches and 7½ inches respectively. Clinical and experimental data demonstrate periosteum plays a pivotal role in bone autograft healing and remodeling. Periosteum contains multi-potent mesenchymal stem cells that are capable of differentiating into bone and cartilage.[12] Periosteal sleeve was not exactly identified and the extruded bone piece could not be put inside the periosteal sleeve. So whatever had happened, occurred inside the extruded autograft.

References

1. Calder PR, Achan P, Barry M. Diaphyseal forearm fractures in children treated with intramedullary fixation: Outcome of K-wire versus elastic stable intramedullary Nail. Injury 2003;34:278-82.
2. Kirkup JR. Traumatic femoral bone loss. J Bone Joint Surg Br 1965;47:106-10.
3. Abell CF. Extrusion of femoral shaft fragment by trauma and successful replacement. A case report. J Bone Joint Surg Am 1966;48:537-41.
4. Tuli SM. Traumatic extrusion of the diaphyses of the radius and ulna successfully treated by replacement. Case report with five-year followup. J Bone Joint Surg Am 1967;49:745-9.
5. Axhausen G. Aseptic necrosis. Langenbecks Arch Klin Chir Ver Dtsch Z Chir 1922;120:325-46.
6. Tuli SM. Bridging of bone defects by massive bone grafts in tumorous conditions and in osteomyelitis. Clin Orthop Relat Res 1972;87:60-73.
7. Phemister DB. Repair of bone in the presence of aseptic necrosis resulting from fractures, transplantation and vascular obstruction. J Bone Joint Surg Am 1930;12:769-87
8. Greenwald AS, Boden SD, Goldberg VM, Khan Y, Laurencin CT, Rosier RN. American Academy of Orthopaedic Surgeons. The Committee on Biological Implants. Bone-graft substitutes: Facts, fictions and applications. Bone Joint Surg Am 2001;83-ASuppl 2 Pt 2:98-103.
9. Friedlander GE. Current concepts review: Bone grafts: The basic science rationale for clinical applications. J Bone Joint Surg Am 1987;69:786-90
10. Enneking WF, Eady JL, Burchardt H. Autogenous cortical bone grafts in the reconstruction of segmental skeletal defects. J Bone Joint Surg Am 1980;62:1039-58.
11. Glancy GL, Brugioni DJ, Eilert RE, Chang FM. Autograft versus allograft for benign lesions in children. Clin Orthop Relat Res 1991 Jan; 262:28-33
12. Zhang X, Awad HA, O'Keefe RJ, Guldberg RE, Schwarz EM. A perspective: Engineering periosteum for structural bone graft healing. Clin Orthop Related Res 2008;466:1777-87.

How to cite this article: Kumar P, Manjhi LB, Rajak RL. Open segmental fracture of both bone forearm and dislocation of ipsilateral elbow with extruded middle segment radius. Indian J Orthop 2013;47:307-9.

Source of Support: Nil, **Conflict of Interest:** None.