

Evaluation of Performance of Single Bone Forearm as A Salvage Procedure in Different Clinical Scenarios – A Short Case Series

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Abstract

Patients frequently present with deformity of forearm with bone loss in either of the forearm bones due to various reasons. In this study two children suffering from chronic osteomyelitis and one having neglected Monteggia fracture were selected. In all three cases, single bone forearm reconstruction by radioulnar fusion was attempted successfully. Cosmetic and functional outcomes were evaluated and were satisfactory. Single bone forearm is a safe and effective salvage procedure in deformity of forearm with significant bone loss in different clinical scenarios not amenable to usual reconstructive techniques. This procedure also results in satisfactory range of motion with performance of normal daily activities, hand function and cosmetic value.

Keywords: Monteggia fracture, Osteomyelitis, Radioulnar fusion, Single bone forearm

INTRODUCTION

The forearm serves as a connecting link between elbow and wrist providing pronation and supination. These movements are associated with brain growth and differentiation of prehensile thumb based on evolution and human embryology.¹

The normal anatomy should be restored as close as possible as the movements are vital for our activities of daily living (ADL). Radius and ulna are complexly joined proximally through radiohumeral and radioulnar joints and distally through distal radioulnar and radiocarpal joints providing ideal biomechanics for elbow and wrist movements and also for forearm pronation and supination. Both the proximal and distal radioulnar joints are trochoid and reinforced distally with triangular fibrocartilage complex (TFCC).^{2,3}

The joints are further stabilised by intervening capsule, ligaments, muscles and tendons. The interosseus space

between the relatively straight ulna and curved radius is bridged by the interosseus membrane which is of vital importance to forearm rotations and often referred to as a modified joint. The interosseus membrane has both intervening oblique and transverse fibres and is thin distally and thick proximally.

The radius and ulna are rare sites for haematogenous osteomyelitis in children (<3%). The infection usually involves the metaphyses and can destroy the whole bone. In infants, the forearm involvement may be a manifestation of a multifocal infection. The acute infection presents with fever, pain, swelling, pseudoparalysis and occasionally, a compartment syndrome.⁴ Although cure rates have improved due to early detection and improved antibiotics, the diagnosis is not always obvious and may be delayed. Chronicity may occur resulting in a pathological fracture, sequestrum formation, discharging sinuses and pseudoarthrosis. The aim of this study is to evaluate the results of single bone forearm reconstruction in different situations.

CLINICAL MATERIAL

Three patients have had radio ulnar fusion at Dept. of Orthopaedics, IPGME & R, S.S.K.M Hospital, Kolkata in the last 2 years. Table 1 gives the indications for the operation, the age at that time, and the length of follow up.

CASE ONE

A 15 year old boy presented with history of gradually increasing deformity of left forearm with increasing difficulty in day to day activities for last 10 years following trauma. On examination there is varus and recurvatum deformity, wasting of biceps, triceps & forearm muscles, ROM of elbow 15-80 degree of flexion, 0-90 degree supination, no pronation, shoulder and wrist was normal and elbow was unstable (Figures 1 and 2).

An 8 cm posterior longitudinal incision was made half above and half below the elbow. Selection of the level of excision of radius was done by gentle firm downward forearm traction and marking over the radial shaft at the level of the proximal ulna. Trimming of the sclerosed end of proximal ulna was done till punctuate bleeding appeared. Radial shaft was cut at the pre-marked area and proximal radius excised. Distal shaft of radius is delivered from radial to ulnar compartment so that ulnar part comes in to close contact to radial cut ends in straight position of forearm. TENS nail was used to fix the ends. Cortico-cancellous bone graft was given at the reduced site (Figure 3). Wound was closed in layers. Stitches were removed after 12 days. Initially limb was immobilised in 30 degree flexion and full supination. Thereafter from 3rd week onwards patient's elbow was kept in adjustable elbow splint initially for twelve hourly in flexion and extension alternately for three weeks then six hourly alternately (Figure 4).

Deformity was corrected in 20 degree of supination. ROM of elbow - 0-130 degrees of flexion. Length was gained by 4 cm from previous length. Sound radiological union of radius and ulna was achieved in 6.5 mths (Figures 5 and 6). Hand function is regained with functionally stable elbow with better cosmetic appearance (Figure 7).

Table 1: Details of three radio ulnar fusions

	Indication	Age	Length of Follow Up
1.	Neglected Monteggia fracture	15 yrs	18 months
2.	Chronic Osteomyelitis	5 yrs	17 months
3.	Chronic Osteomyelitis	12 yrs	18 months

CASE TWO

A 12 yr old girl presented with chief complaints of pain and gradual bowing of left forearm for last two years following an incident of acute osteomyelitis of left forearm bones. On examination there was antero medial bowing of



Figure 1: (a and b) Pre operative clinical photographs

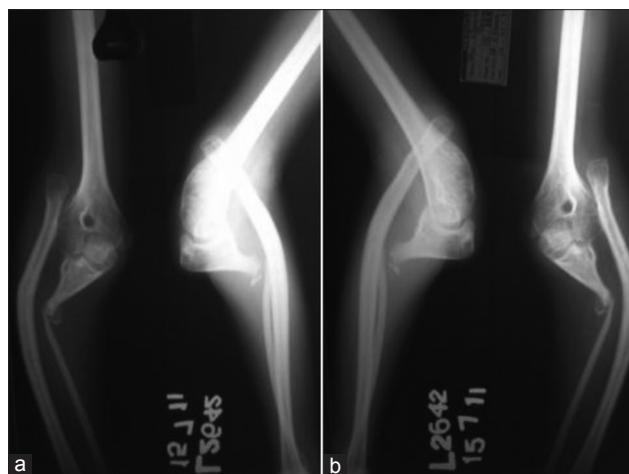


Figure 2: (a and b) Pre op X-ray



Figure 3: (a and b) Post op X-ray

forearm, wasting of muscles, ROM:15-90 degree of flexion, 0-20 degree of supination, pronation nil, wrist was normal. X-Ray showed diffuse sclerosis of radius with diaphyseal bone gap of 7 cm with bowing of ulna (Figure 8).

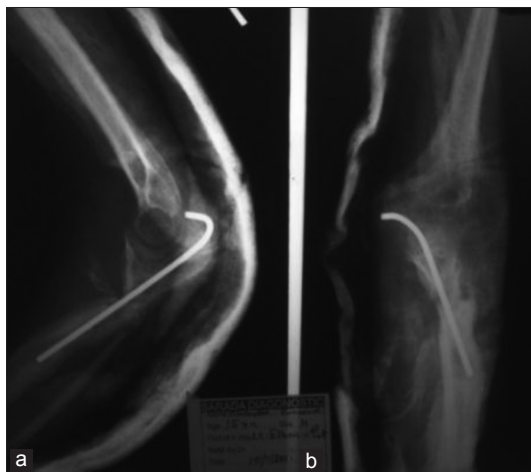


Figure 4: (a and b) 3 month follow up

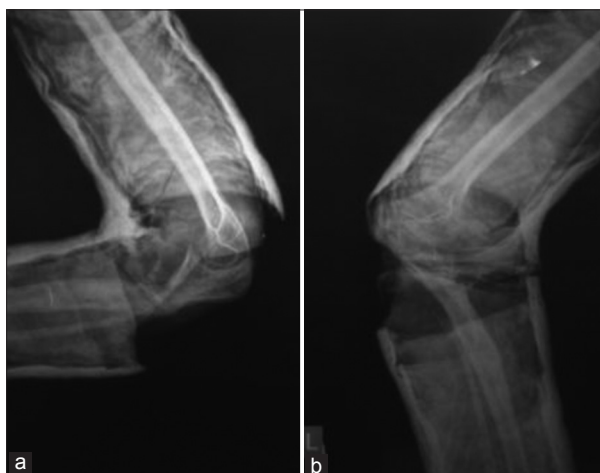


Figure 5: (a and b) 6 month follow up

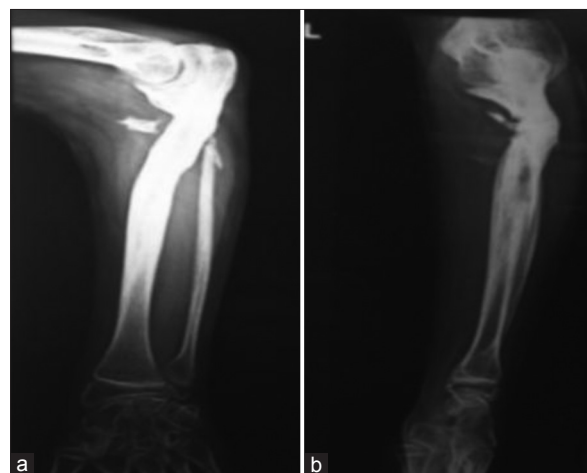


Figure 6: (a and b) 18 month follow up

Operation was done to reconstruct a single bone forearm. Proximal ulna was fused with distal radius & fixed with one intramedullary K-wire. After stitch removal limb was immobilized in long arm plaster cast with elbow in 90 degree flexion, forearm in neutral rotation for eight wks. When radioulnar union was obvious clinicoradiologically, patient was allowed to do vigorous elbow exercises and regular follow up has been done. K-wire was removed after eight months (Figures 9 and 10).

Finally we achieved painless, stable forearm without any unsightly deformity with ROM of 0-135 degree of elbow flexion with forearm fixed in mid prone position (Figure 11).

CASE THREE

A 5 yr old girl presented with pain, inability to take food with her right hand, inability to lift an object with her right hand and progressive deformity for last two years following an incident of trauma and acute osteomyelitis of right forearm bones. On examination, there was anterolateral bowing of forearm, wasting of muscles, ROM-20-80 degree of flexion of elbow, 0-20 degree supination, no pronation with normal shoulder and wrist movements and unstable elbow. X-ray showed chronic osteomyelitis of ulnar shaft with bone gap, proximal radioulnar joint dislocation with proximal migration of radial head (Figure 12).

Operative steps were almost similar to the previous case with proximal radius excised, proximal ulna fixed with remaining part of radius with one intramedullary TENS nail with incorporation of corticancellous bone graft (Figure 13). At 4 month follow up, radioulnar nonunion was suspected (Figures 14 and 15). So, TENS nail was removed, freshening of fracture ends was done and radius fixed with ulna with semi tubular plate and screws (Figure 16). After stitch removal limb was immobilized in a plaster cast for 3 months with elbow in 90 degree flexion, forearm in neutral rotation. With regular follow up, radioulnar union was still not evident clinicoradiologically and definite gap was visible in X-ray (Figure 17). This time autogenous bone marrow was given at non union site and finally union was achieved (Figure 18).

Finally, the girl has painless stable elbow and forearm with no unsightly deformity. ROM of elbow remains at 20-140 degree flexion, fixed in 40 degree supination. Most importantly the girl can take her food with her own hand, and can do her day to day activities without any significant restriction (Figure 19).



Figure 7: (a-d) Postop clinical photographs of case-1 at 18 months showing satisfactory elbow motions and forearm fixed in 20 degree supination



Figure 8: (a and b) Preoperative X-ray of case-2 showing gap non-union of radius



Figure 10: (a and b) 15 months follow up

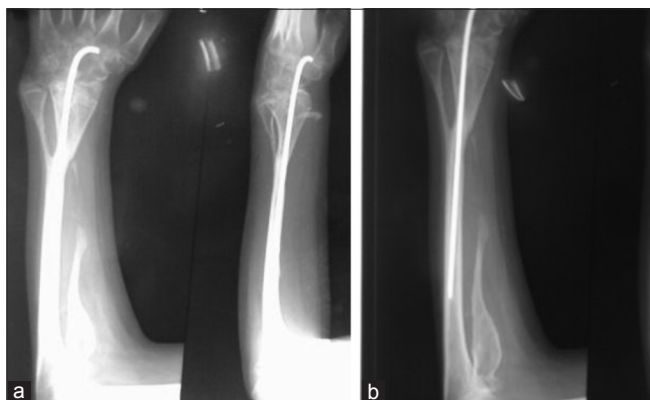


Figure 9: (a and b) Post operative X-ray of case-2 at 3



Figure 11: (a and b) Post op clinical photographs of case 2 at 15 months follow up showing satisfactory elbow motion and forearm is fixed in midprone position

DISCUSSION & SUMMARY

Deficiency of a segment of radius or ulna causes deformity especially in children due to relative growth discrepancy between the two bones. Partial absence of ulna causes dislocation of radiocapitellar joint with subsequent manus varus deformity whereas the same in radius produces

dislocation of distal radioulnar joint and manus valgus deformity.⁵ The extent of such deformities depends on various factors namely age of onset, cause, preliminary treatment among others.

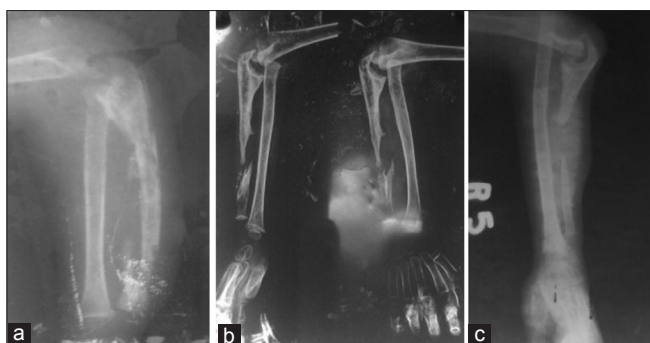


Figure 12: (a-c) Preoperative radiographs of case 3



Figure 13: (a and b) immediate postoperative radiograph of Case 3

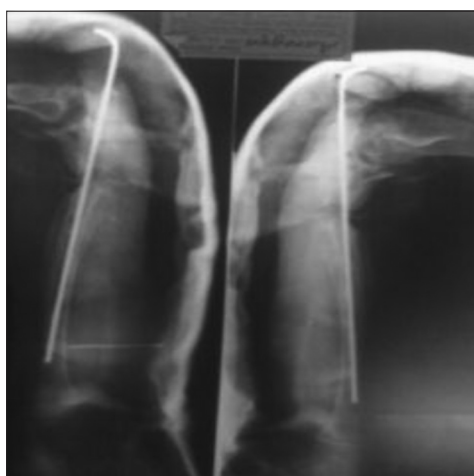


Figure 14: 3 month followup

Among the pathological conditions causing unequal growth of the radius and ulna are congenital absence of part of the radius and ulna, osteomyelitis with sequestration of the diaphysis of one or both bone, benign bone tumours and injury. Congenital defects in the radius and ulna are variable in amount and are often associated with deformities in the hand or other parts of the body. Each case must be considered individually and careful selection is necessary before operation is advised.



Figure 15: 4 month follow

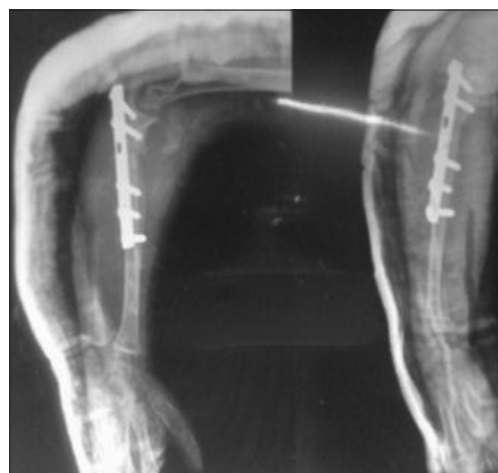


Figure 16: Plate fixation



Figure 17: 7 month followup (nonunion)

The choice of treatment of a gap defect in a forearm bone lies between a replacement graft and radio-ulnar fusion to provide a single bone forearm.^{6,7}



Figure 18: Union after bonemarrow inj

Segmental diaphyseal defect with viable ends can be still managed by autogenous bone grafting or bone graft substitutes with fixation but wide deficiencies with atrophic ends and concurrent infection is a clinical dilemma.

Single bone forearm reconstruction may be a satisfactory clinical option in such cases. Loss of forearm rotations is compensated by shoulder movements with better grip strength and retention of shoulder and wrist movements. The requirement for radio-ulnar transposition are intact radio-carpal and humero-ulnar joints.^{8,9}

The growth discrepancy is not of much concern once continuity is established and further axial growth produces satisfactory cosmetic and functional outcome.

The operation of radioulnar transposition was devised by Hey Grooves(1921) of Bristol. Greenwood (1932),⁶ Watson Jones (1934),⁵ Vitale(1952)⁷ reported a few cases with good cosmetic and functional results. M N Rasool et al reported twelve cases of pyogenic osteomyelitis of forearm bones, treated with single bone forearm & had good outcomes.⁴

CONCLUSION

In this study, three patients were studied. Among them two patients were suffering from chronic osteomyelitis and one was having neglected Monteggia fracture. Single bone forearm reconstruction was done in all three cases. Intramedullary fixation was done in all three cases.¹⁰ Non union occurred in one case which was managed by plate fixation and bone marrow injection at fracture site. We achieved stable forearm with satisfactory range of movement, good hand function and without any unsightly deformity in all three cases.



Figure 19: (a-f) Post op clinical photographs of case 3 at 17 months follow up showing forearm fixed at 40 degree supination; can put hand to mouth for feeding

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