

Original Research Article

Infected gap nonunion of fractures proximal humerus in adolescent: an outcome of 12 cases

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ABSTRACT

Background: There is little data about the risk factors, demographics, and prognosis for nonunions in children. Previous literature has reviewed time periods when contemporary techniques of internal fixation and management of open injuries had not been available. Infected gap nonunion of proximal 1/3 humerus in adolescent is not much reported in literature. The purpose of our study was to evaluate the outcome of infected gap nonunion in 12 cases of adolescent treated by debridement and fibular graft and plating.

Methods: This study was conducted between 2009 to 2015, 12 cases of infected gap nonunion of fractures proximal humerus was included in our study. Each child was followed up minimum for 12 months. Although non unions in the pediatric population are rare, these data underscore the importance of careful evaluation and treatment of these fractures at risk for nonunion.

Results: In our series of 12 cases of infected nonunion of fracture humerus which were treated by bone grafting using fibula strut graft and plating resulted 99% union rate. The rate of union is depending on thorough debridement and fixation along with bone grafting.

Conclusions: Nonunion of pediatric fractures is a rare complication. Most studies on developing pediatric nonunions describe specific fractures that are particularly susceptible to nonunion and malunion, nonunion of humeral lateral condyle and open tibia fractures have received the most attention. Reports of nonunion among pediatric long bone fractures are rare, being either case reports or isolated entities in a larger series of predominantly adult fractures. Fibula is a popular substitute for this method because of its easy accessibility and minimal donor site morbidity.

Keywords: Humerus shaft fracture infection, Gap nonunion, Fracture proximal 1/3 of humerus, Adolescent, Osteomyelitis humerus

INTRODUCTION

Nonunion of pediatric fractures is a rare complication, although first described in 1891 by James Paget.¹ There is little in the recent literature that directly addresses non unions in this patient population. Bone defect has always been a challenge to treat for the orthopaedic surgeon. It became more difficult when happened in adolescent age group. Fibular grafting is a popular method for bridging

the gap in bone defects created by infection, tumour excision or traumatic loss of bone.²⁻⁴ Fibula is a popular substitute for this method because of its easy accessibility and minimal donor site morbidity.⁵ Various other options are also available using the principles of bone transport to bridge the gap. Both ilizarov and monorail system have been used for bone transport.⁶ Both these procedures are technically difficult, cumbersome and have poor patient compliance. Fibular grafting has been used in all age

groups. Our study is aimed at finding the results of non-vascularised fibular strut grafting in the paediatric age group for infected gap nonunion of fracture proximal 1/3 of humerus. Fibular grafting has the advantage of being a much simpler procedure and avoids the use of costly implants making it a more feasible and practical solution for bone defects in developing countries and small hospitals.

METHODS

The study was conducted in Department of Orthopaedics, Indian Naval Hospital Ship Asvini, Colaba, Mumbai, 400005, India and Military hospital Jalandhar, Punjab, India, between February 2009 to December 2015. 12 adolescent patients between age group of 09 to 14 (mean age 12.8) with bone defect (all 12 as a result of chronic osteomyelitis) were included in the prospective study. The nature of infection was bacterial (10 cases of bacterial/pyogenic infected gap nonunion and 02 was post Tuberculosis). Both the infection was completely healed leaving gap nonunion. A written informed consent was obtained from each parent. The age of the patients ranged from 9 year to 14 years. Infection had settled at the time of surgery in patients with chronic osteomyelitis. This was confirmed by preoperative inflammatory markers ESR and CRP which were not elevated in any patient. Bone scan was also done for hot spot. There was no clinical and radiological sign of infection. 08 patients were male and 04 were female. The average gap preoperative was 03 cm and after freshening of both ends of the defect was 05 cm. All 12 cases involved the proximal 1/3rd of humerus. The surgical technique in all these cases included freshening of the bone ends. Intra-operatively tissue was collected and sent for culture. Mid segment of Fibula was harvested from the leg under tourniquet using the posterolateral approach. The fibular graft was inserted in the proximal and distal fracture segment by pushing inside the medullary canal after widening it. This bone was then fixed at the site of the defect with the help of either PHILOS or using plates and screws. Postoperatively the limb was immobilized in plaster slab in form of U slab, above elbow and above knee slab.

All patients were given prophylactic antibiotics. Preoperative antibiotic was given intravenously in all patients. Postoperatively oral antibiotics were given. Patients were followed at three, six, twelve weeks, six month, nine months and twelve months post operatively. Later follow up was done at 6 monthly intervals. Follow up included radiographic evaluation.

RESULTS

12 adolescent with infected gap nonunion of humerus were included in our study. 08 patients were male and 04 were females. All 12 adolescent patients was the result of infective gap nonunion.

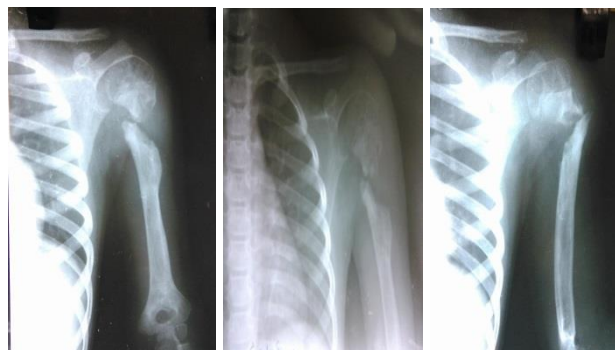


Figure 1: X-Ray arm AP view- preoperatively (showing gap nonunion sequel of infection).

Union was achieved at both ends in 10 case out of 12 (83%) of the patients after the first surgery. In one patient with gap non-union of humerus did not unite (Table 1). Second surgery in the form of bone grafting was done 8 months after the first surgery. Union occurred in this case after 15 weeks of the second surgery. In another patient the fibular graft resorbed and developed infection, which was managed by removal of implant and re debridement and pop cast application. Later on after 9 months re-bone grafting was done along with Rush nail. The union occurred in 26 weeks at both ends after the second surgery (Table 2). Average time to union was 24 weeks with a range of 12-32 weeks. Average shortening in the limb was 3.5 cm with a range of 2-6 cm. Range of motion of the proximal and distal joint was almost full. Superficial infection was seen in two patients who were treated by antibiotics. No complication was seen at the donor site.

We used SPSS statistical software version 17 for all statistical calculations when required in our study.



Figure 2: X-ray arm AP view- 3 months postoperatively.

Table 1: Patients demographical details (mean age 12.8 years).

Patients no	Age	Sex	Cause of nonunion of humerus	Period of non union	Results after initial treatment
1	13	M	Acute osteomyelitis	2 year	Union achieved
2	14	M	Acute osteomyelitis	4 year	Union achieved
3	13	M	Acute osteomyelitis	4 year	Failed
4	14	M	Acute osteomyelitis	3 year	Union achieved
5	13	M	Acute osteomyelitis	2 year	Union achieved
6	14	M	Acute osteomyelitis	5 year	Union achieved
7	12	M	Acute osteomyelitis	4 year	failed
8	14	M	Acute osteomyelitis	4 year	Union achieved
9	09	F	Acute osteomyelitis	2 year	Union achieved
10	13	F	Acute osteomyelitis	7 year	Union achieved
11	14	F	TB osteomyelitis	4 year	Union achieved
12	11	F	TB osteomyelitis	3 year	Union achieved
Total 12					

Table 2: Patients demographical details after initial failed results were second surgery was done for patient no 3 and 7 above supra.

Patients no (Refer table no 1 above)	Age	Sex	Cause of nonunion of after first surgery	Type of second surgery done
3	13	M	Not known	Re grafting was done after 8 months union achieved at end of 15 weeks
7	12	M	Resorption of fibular graft infection	Removal of implant and re debridement and pop cast application. After 9 months re-bone grafting was done along with Rush nail. union achieved at end of 26 weeks after the second surgery



Figure 3: X-ray arm AP view- 9 months postoperatively.

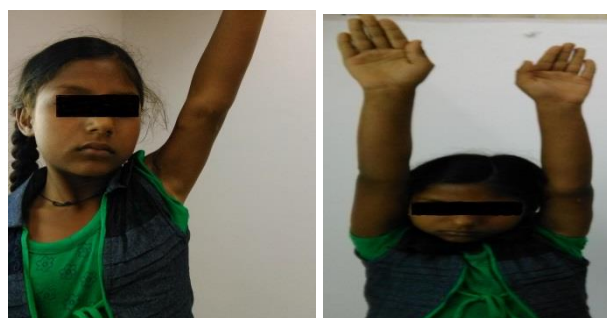


Figure 5: Shoulder abduction after 8 months postoperatively.



Figure 4: X-ray arm AP view- 12 months postoperative (shows fully united fracture).

DISCUSSION

Nonunion is difficult to define due to multiple factors affecting bone healing. In general, absence of any clinical or radiographic evidence of fracture healing progression for 2-3 months after the expected time constitutes a nonunion. But this definition of nonunion cannot be used for both adult and pediatric fractures due to rapid healing and excellent remodeling potential in children. Adamczyk et al considered radiographic appearance and persistent pain at fracture site to define nonunion and

delayed union in children.¹⁰ Lack of callus bridging the fracture with persistent pain at the fracture site beyond 2 months was defined as delayed union for these fractures. In addition, if no further bridging was seen and the patient continued to have pain at the fracture with continued non operative management beyond 04 months, the fracture was considered to have become a nonunion. Posttraumatic nonunion in an otherwise healthy child has been reported following open injuries, open reduction, infection or repeated manipulations.⁷ Abnormality in bone such as osteogenesis imperfect and neurofibromatosis also predisposes to nonunion.⁸ Pseudoarthrosis in infants and children are almost always associated with neurofibromatosis.⁸ Literature search showed four case reports describing nonunion following conservative treatment of closed paediatric fractures.⁹

Two involved distal ulna, one distal radius and one distal fibula. In a series of thirty cases of diaphyseal nonunion in children reported by Lewallen et al, only two cases were closed fractures treated by closed means, both involving tibia.² Adamczyk et al reported six cases of forearm fracture, which developed nonunion of ulna following treatment with cast.¹⁰ There is a few studies showing excellent outcomes in patients treated surgically with severely displaced fracture humerus particularly those above the age of 13 years.¹¹ In our series of 12 cases of infected nonunion of fracture humerus which were treated by bone grafting using fibula strut graft and plating resulted 99% union rate. The rate of union is depending on thorough debridement and fixation along with bone grafting.

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Ethical approval: The study was approved by the institutional ethics committee

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