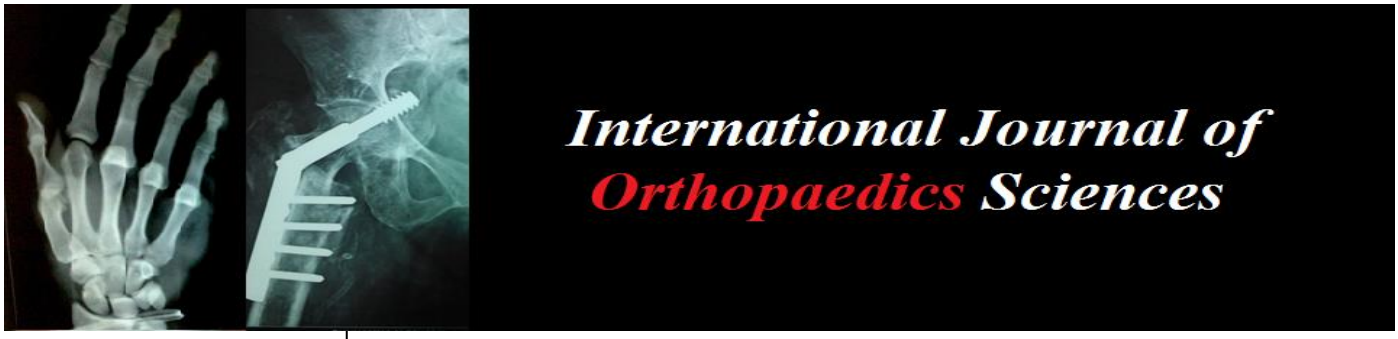

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Assessment of radiological outcomes in gap non-union of long bones using non-vascularised fibular strut graft augmented with corticocancellous graft

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Abstract
Background: A prospective study was conducted in the department of Orthopaedics & Traumatology in Dr. D.Y Patil Hospital, Navi Mumbai from January 2015 to June 2017 to assess radiological outcomes in traumatic gap non-union of long bones after primary plate fixation failure using non-vascularised fibular strut graft augmented with corticocancellous graft.
Methods: A total of 20 patients were included in study presenting with non-union of humerus. In 13 males and 7 females, age between 18-65 years (average 41 years), were operated using non-vascularized fibular strut graft taken from ipsilateral site augmented with auto corticocancellous graft. All the patients were operated by same surgeon with removal of previous plate and fixing with re-plating and intramedullary fibular grafting. The mean follow-up was 9 months (range 6-12 months). The patients were assessed for functional range of motion along with x-ray. Union was achieved after confirming on x-ray.
Observations & Results: In study 20 patients there were 13 males and 7 females with average age being 41.35 yrs, average length of fibular graft was 6.3 cm and mean duration of union 21.15 weeks.1 patient was lost in follow up and none of patients showed non union or secondary intervention thus ensuring Bony union in all 20 patients treated with graft and plating
Conclusion: This procedure successfully showed that union at nonunion site with adequate vascularity and good soft tissue coverage can be achieved with proper patient selection and using fibular graft in addition to traditional plating and CC graft technique. Even though procedure is lengthy but it's simplicity, reproducibility and non expensive and patient compliant outcomes makes it a valid option to achieve union in nonunion.

Keywords: Non union, plating, non-vascularized fibular graft, cortico cancellous graft

Introduction
Non Union humerus after primary plating in traumatic cases has been matter of concern as they are associated with angulations, shortening, painful movement and deformity and loss of function Management of this fracture has undergone tremendous evolution over the preceding few years. Non vascularised Fibular strut grafting is a popular method for bridging the gap in bone defects created by traumatic bone loss, tumor excision, or bone loss as sequelae to chronic infection and in established non union among post operative cases [1-4]. Fibula graft has been studied and used extensively for bridging bone gaps as it is easy accessible and allows uncomplicated retrieval with minimal donor site morbidity [5]. Alternate methods which utilize the principles of bone transport or distraction osteogenesis to bridge the gap has been in trend since 90's like ilizarov's and Limb reconstruction rail system have been used for bone transport [6, 7, 8]. Both these procedures are technically, demanding have indigent patient compliance. Fibular grafting has been used in all age groups. 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 centers. Primary goal of treatment aims anatomical restoration with rigid and stable fixation using fibula as a scaffolding bridge kept in situ with plate and augmentation with CC graft and immediate mobilization of limb so as to minimize the risk post operative stiffness around elbow and shoulder joint.

Our study aims at use of simple technique in treatment of traumatic gap non-union of humerus after primary plate fixation failure using non-vascularised fibular strut graft augmented with corticocancellous graft and study its radiological outcomes.

Material and method

This prospective study was conducted in department of Orthopaedics and Traumatology Dr. D.Y Patil Hospital, Navi Mumbai from Oct 2013 to march 2017. All patients attending OPD or emergency with chronic established non union due to post operative procedures or chronic osteomyelitis with bone gap defect was included in study and total of 20 patients were selected. Patients were treated with Plating after removal of previous plate and removal of callus and fibular graft fixation and cortico-cancellous graft. Inclusion criteria

1. Patient between 25 to 60 yrs of age
2. Motivated patients who agreed to undergo procedure which chances of failure and reoperation.
3. Patients with established non union with at least 9 months elapsed since last procedure

Exclusion criteria

1) Patient is unfit for surgery

Subjects were evaluated using plain radiographs of humerus in antero-posterior, lateral views. Diagnosed cases were after routine investigations and anesthetic fitness were operated.

Surgical technique f**or removal of fibular graft**

All patients were operated under general anesthesia after regular fitness. Of total patients 13 males and 7 females were operated using the poster lateral approach and non-vascularized fibular strut graft taken from ipsilateral site and was augmented with auto corticocancellous graft after fish scaling and petalling and fixing with locking plates.

Surgical technique

All the 20 cases of humerus non union were operated by same surgeon. Incision was given along previous site and fractures site was exposed with plate in situ intact or broken. Plate was removed and edges were freshened. Fibular graft harvested from ipsilateral side of varied length as per requirement and width was sculpted as per diameter of bone. This bone was then fixed at the site of the defect with the help of plates and screws. Cancellous bone grafting from iliac crest was also done at both proximal and distal end of the fibular graft to facilitate union. Postoperatively the limb was immobilized in plaster slab in form of U slab. All patients were given prophylactic antibiotics. Pre-operative 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 and documentation of any complication.

Results

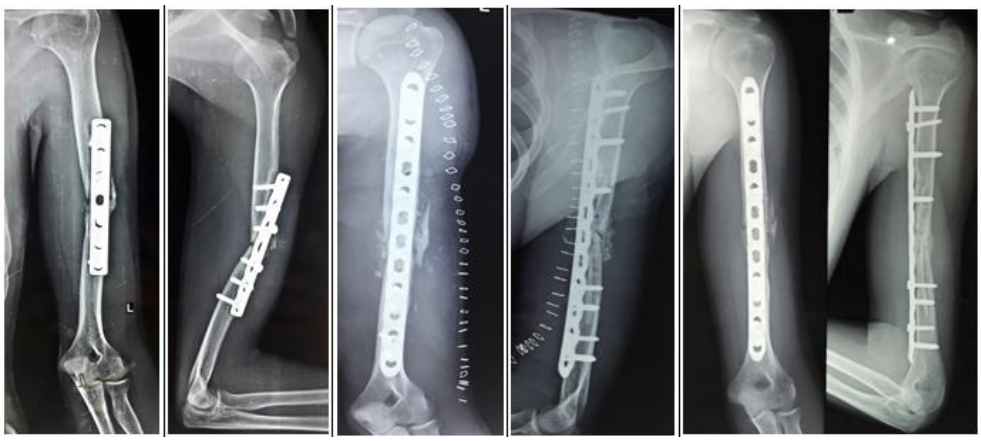
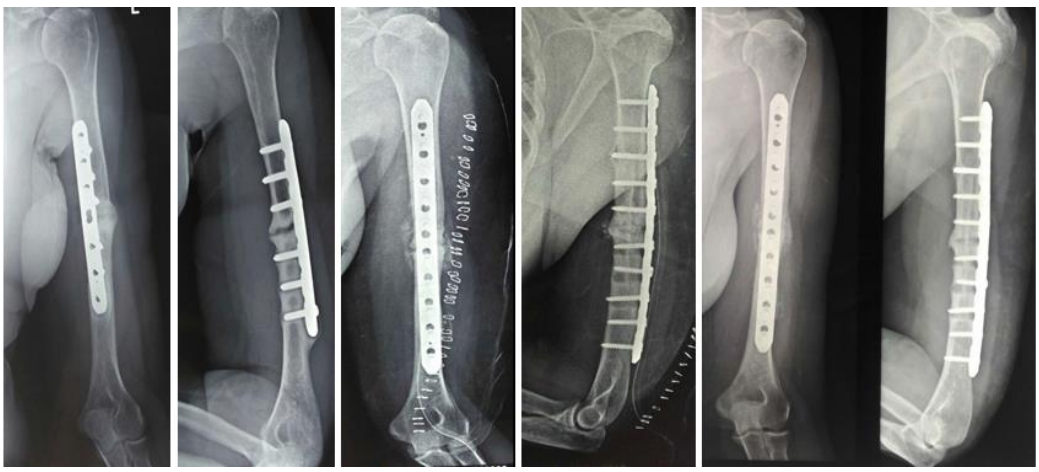


Fig 2: 39 yr/F with Humerus plating 1and half yrs back with gap non union of 3mm a. Locking plate was removed and locking plate with non-vascularised fibular strut graft augmented with corticocancellous grafting was done. Post-operative X-ray AP/Latera Limmediate and after 3 months.



Results

Details and results in 20 patients.

S. no	A/s	Bone involved	Implant	Union (in weeks)	Length of fibular graft	Fibula + CC graft
1	35/f	Humerus	Plating	20	8cm	Both
2	44/m	Humerus	Plating	22	8 cm	Both
3	30/m	Humerus	Plating	24	7 cm	Both
4	55/f	Humerus	Plating	22	8 cm	Both
5	37/m	Humerus	Plating	20	7 cm	Both
6	51/m	Humerus	Plating	22	5 cm	Both
7	29/f	Humerus	Plating	18	5 cm	Both
8	42/m	Humerus	Plating	22	8 cm	Both
9	39/m	Humerus	Plating	20	7 cm	Both
10	54/f	Humerus	Plating	19	5 cm	Both
11	53/m	Humerus	Plating	22	5 cm	Both
12	32/m	Humerus	Plating	20	5 cm	Both
13	45/f	Humerus	Plating	22	8 cm	Both
14	28/m	Humerus	Plating	20	5 cm	Both
15	47/m	Humerus	Plating	18	5 cm	Both
16	39/m	Humerus	Plating	24	8 cm	Both
17	50/f	Humerus	Plating	22	5 cm	Both
18	48/m	Humerus	Plating	20	5 cm	Both
19	31/f	Humerus	Plating	22	7 cm	Both
20	38/m	Humerus	Plating	24	5 cm	Both

All the patients were followed up at an average period of 6-12 months (average 9 months) after the non-vascularized fibular strut graft was used. Over a period of 3 months of the grafting union was achieved which was seen on radiographs. Union was achieved at both, distal grafting bone fixation and proximal graft bone fixation confirming on x-ray. Even the donor site healed primarily without any problems, pain or functional disability. One patient was lost to follow up.

Discussion

Treatment of nonunion present as a challenging problem to the orthopaedics [2, 3]. In 1877 Albert first proposed the use of fibula as a substitute. He obtained fusion between the fibula and femur in a patient with congenital absence of proximal tibia. Since then the fibula has been used as a substitute for bone defect [1]. No any functional disadvantage after harvesting fibular strut graft. In many studies proven that non-vascularized grafts were as strong as vascularized grafts [2].

Stress fracture of both non-vascularized and vascularized have been reported [3, 4]. Fracture of grafts has not occurred in our study. Comparison between vascularized and non-vascularized fibular strut the union was major problem at defect site with non-vascularized graft [5]. We achieved bony union in result of our study in which we have treated ten patients we use simple and non complicated procedure for treatment of non-union by non-vascularized fibular strut graft augmented with corticocancellous bone graft and by additional appropriate fixation and immobilization in form of external fixation, contoured implants and plaster or functional brace or splint until radiographic union at graft site. This procedure successfully showed that union at nonunion site with adequate vascularity and good soft tissue coverage which is simple, in expensive, does not require high quality training or complex technique with personal staff is still a valid option to achieve union in non-union. Non-vascularised fibular grafting has been used to treat bone defect for a long time. Removal of fibula did not cause any complication in the donor leg. Non-vascularised fibular grafting is a simple procedure. The procedure is relatively easy and has much better patient compliance when compared to other methods of treating bone defect like bone lengthening procedures using ilizarov.

Conclusion

Non-vasularised fibular graft augmented with corticocancellous graft supplemented with internal or external fixation device is a simple procedure to bridge bone defects and achieve union. Though union period takes longer duration but if used in selected patients can yield excellent results. It should be avoided when the recipient bed is not ideal like atrophic fracture non-union and post-traumatic infective non-unions. Overall procedure used in conjunction with plating, ilizarov's or external fixator can achieve excellent radiological and functional outcomes.

Conflicts of interest: None

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