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Fibular Strut Graft Along With Iliac Crest Graft As An Adjunct To Plating In Treatment Of Atrophic Non Union Fracture Shaft Of Humerus

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Abstract: Study Design: *Prospective study.*
Purpose: *To evaluate functional and radiological outcome in patients with atrophic non union fracture shat of humerus.*
Methods: *7patients with atrophic non union involving shaft of humerus (proximal, middle and distal third) were included in the study, were managed by open reduction freshening of edges, intramedullary strut graft insertion followed by fixation with locking plates with iliac crest graft at the fracture site and were followed periodically between October 2016 to September 2018 .Clinical and radiological evaluations were performed regularly at 2 weeks, 1 month, 3 months, 6 months, 1 year, and then at 6-month intervalsStandard anteroposterior and lateral radiographs were obtained.DASH score was used to evaluate the functional results preoperatively and one year after the operation.*
Results*:*
All the fractures united clinically and radiologically at a period between three months to six months. No patient developed any wound complication. Average shortening of the limbs was 23.28 mm. None of the patients had any neurovascular complication nor had any pain at the fracture sites. There was a significant improvement in the functionality of all the patient at the end of one year.
Conclusions:
Though there are several methods of fixation, management of atrophic non union of fracture shaft of humerus is technically demanding due to gross osteoporosis, reduced viability of bone ends and associated stiffness of proximal and distal joints. Addition of intramedullary fibular strut graft along with iliac crest cancellous graft adds to the stability of the fixation and its viability. Intramedullary presence of fibular strut graft increases the cortical hold by two folds and acts as an internal splint.
Keywords:*Atrophic nonunion, Humerus, fractures, Fibular, Iliac crest*

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I. Introduction:

The rise in road traffic accidents andgradual increase of people living in urban areas has lead to increased incidence of trauma, both in upper and lower limbs more in adults[1]. Incidence of humeralfractures is 3-5%. It has a bimodal age group of distribution. Prevalence of traditional methods of conservative therapy and non compliance to modern conservative therapy has lead to increased incidences of non union of the humeral fractures[2]. Although humerus fractures respond very well to non surgical methods, prevalence of traditional method of conservative therapy has become a hindrance[3].Atrophic type of non union humeral fractures generally have gross osteoporosis, lysis and sclerosis of the bone ends and associated stiffness of the proximal and distal joints, therefore, posing a challenge for internal fixation and attaining union at fracture site[4,5].These fractures can be managed by various methods of surgical treatments with principle being open reduction, freshening of edges, stabilisation, with either plate and screw or interlocking nails or external fixator, but the presence of osteoporosis puts a challenge during any stabilization method and presence of sclerotic non viablefrcature ends makes it more challenging[6]. So adjunct procedures to stabilization of humeral fractures becomes a necessity in the presence of osteoporosis and decreased bone viability. We have used intramedullary

fibular strut graft along with iliac crest graft in adjunct to internal fixation with locking compression plates in the fixation of humerus. Patients were followed for 15 to 18 months and evaluated clinically and radiologically.

II. Patients And Methods:

Prospective study was done at AIIMS BHUBANESWAR, DEPT OF ORTHOPAEDICS during the period ofOctober 2016 toSeptember 2018. Inclusion criteria: 1) Atrophic non union of Humerus managed conservatively, 2) Closed fractures. Exclusion criteria: 1) Active infection or chronic discharging sinus 2) Previously operated patients. Shaft of humerus was considered asthe part of the humerus that is 2cm below the surgical neck and 3cm above the olecranon fossa[7].Seven patients withatrophic non union humeral fractures were included in our study and were treated surgically by open reduction internal fixation and intramedullary fibular strut graft along with iliac crest cancellous graft. They were followed for 15 to 18months.In all the patients fractures united successfully with good return of functionality of the limbs measured by DASH score. Average age of the patients was 49.57years ranging from 40-55 years. Out of the seven patients three patients had non union at middle third of shaft, two at proximal third, and twoat distal third. All the patients initially had taken treatment from the traditional bone setters. All patients presented with abnormal bony mobility and stiffness around the elbow and shoulder with limitation of activities of daily living. Patients were put on mobilisation exercises for the elbow preoperatively. Average duration between presentationand trauma was 22.14 months.Pre operative DASH score was 75$\pm$3.10.Patients underwent surgery under general anaesthesia.Regional anaesthesia was given to reduce the post operative pain. The proximal fractures were approached through anterior deltopectoralapproachin supine position with head end of table elevated anda bolster put under the ipsilateral pelvis. Two of the middle third fractures and distal third fractures were exposed through posterior approach with lateral decubitus position elbow hanging free and onemiddle third fracture through anterolateral approach in supine position like in deltopectoral approach.In all the fractures,ends were freshened and nibbled to get viable fracture end up to presence of punctuate haemorrhage (paprika sign).After reaming the humeral canalof the fibular graft was inserted in the medullary canal. Fibular strut grafts were harvested at the middle third up to a length averaging from 8 to 12 cm in full thickness. They were thentrimmed or splitteddepending upon the humeral canal diameter. In proximal and distal third fractures it was used in toto after inserting one end into the distal fragment then inserting the upper end into the humeral head maintaining the reduction and calcar height. In the middle third we used it after splitting in the middle. Internal fixation was done with locking compression plates and the remaining gap at the fracture ends was filled up by cancellous grafts harvested from iliac crest. Length of the plate was decided in theintraoperative period to achieve max stability. Arms were immobilised with shoulder immobiliser for three weeks during which active wrist and finger movements were allowed. Shoulder and elbow mobilisation exercises were started gradually after three weeks. Patients were allowed to do their non weight bearing normal daily activities like buttoning of shirt, washing and bathing etc after four weeks. After three months patients were allowed to gradual weight lifting. Two out of seven patients were given PTH (teriparatide) therapy in preoperative period and waited for three months before going for surgery and four patients in post operative period were administered PTH therapy after second postoperative day and continued for three months. Patients were followed up at two weeks, six weeks, three months, sixmonths and then every six months and were examined clinically and radiologically at every follow up.

III. Results:

All the fractures united clinically and radiologically at a period between three months to six months. No patient developed any wound complication. Fibular strut well incorporated inside the medullary canal (fig.a,b,c). Average shortening of the limbs was 23.28 mm.None of the patients had any neurovascular complication nor had any pain at the fracture sites. One patient had stiffness at the shoulder joint and one at the elbow joint. Implant related complications like implant loosening or breakage or screw breakout were not reported in any of the patients. Two of the patients had complained of pain at iliaccrest graft site which eventually subsided at the end of three months. No complication was noted at the donor site of the fibular strut graft. There is significant improvement of patient function at the end of one year DASH score 7.62$\pm$ 1.32. The values for the dash score (pre and post operative 0ne year) have been presented in table 1.

Table 1

Sl no	Age	Sex	Side	Duration since injury	Site of fracture	Shortening in mm	Approach taken	Pro op Dash score	Post op 1 year Dash score
1	55	F	Left	24	UPPER 1/3rd	30	DELTOPECTRAL	78.3	7.5
2	52	M	Left	18	MIDDLE 1/3rd	20	POSTERIOR	76.7	6.7
3	48	F	Right	15	MIDDLE 1/3rd	18	ANT LATERAL	74.2	8.3
4	52	M	Right	36	DISTAL 1/3rd	25	POSTERIOR	75.8	9.2
5	46	F	Left	18	UPPER 1/3rd	20	DELTOPECTRAL	77.5	6.7
6	54	M	Right	24	MIDDLE 1/3rd	30	ANT LATERAL	73.3	9.2
7	40	M	Left	20	DISTAL 1/3rd	20	POSTERIOR	69.2	5.8

Figure

Figure a:showing preoperative, six month follow up (AP & LAT radiograph) and clinical photo of the patient with atrophic non-union at proximal third shaft humerus fracture.

Figure b:showing preoperative, six month follow up (AP & LAT radiograph) of the patient with atrophic non-union at middle third shaft humerus fracture.

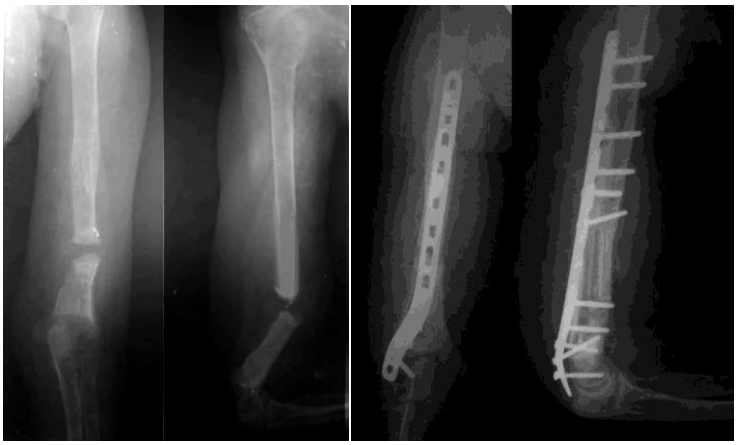

Figure c: showing preoperative, six month follow up (AP & LAT radiograph) of the patient with atrophic non-union at middle third shaft humerus fracture.

IV. Discussion:

Though humeral fractures can be managed very well either nonoperativelyor surgically attaining good union but the prevalence of traditional based conservative therapy has increased the incidence of non union[3]. The use of traditional practice in the management of humeral fractures creates unwanted complications like gross osteoporosis of the bone, devitalisation of the surrounding tissues, excessive fibrosis at the fracture ends, scarring of skin and superficial tissues leading to increase blood loss during the surgery. The cause of osteoporosis is improper immobilisation, tight compression bandage, long standing non union leading to disuse of the limbs and associated poor general condition of the patients[2]. Although fixation of fresh osteoporotic fractures is not that worrisome, fixation in non union with osteoporosis is a challenge to the surgeon for getting proper alignment at the fracture sites, proper positioning of the implant and fixation. Osteoporosis causes significant reduction of pullout strength of the screws increasing the chance of fixation failure[6].A number of methods of managing non union fractures of the humerus havebeen suggested each having its own drawback[7,8,9]. Internal fixation with interlocking nail is not appropriate for non union fractures as they do not provide adequate compression at fracture site. Some of the surgeons are in favour of using Ilizarov and bone transport for non union humerus fractures but its complexity, technical difficulty and reduced stability in osteoporotic bones makes it less preferable. Some studies demonstrated the use of hydroxyapatite coated screws or use of screws along with methyl methacrylate in order to increase the pull out strength of the screws and increasing the strength of the construct, but it is non biological in comparison to fibular strut , adds to the cost of treatment in our set up where patient affordability is a major issue[10]. Use of vascularised fibular graft is a noble technique, but at the same time it is technically demanding and depends on the availability of the logistics[11].

In our study group we had put two of the patients on PTH therapy preoperatively but there was no evident increase in bone density at the fracture site as patients were not able to move the limb. Post operatively four patients were administered PTH therapy, which showed better result in the form of increase in the cortical thickness, increased consolidation at the end of three months. Intramedullary fibular strut graft increases the mechanical stability of the fixation as well as is osteoconductive in nature. In the fixation of proximal humerus it helps in maintainingcalcar height and preventing varuscollapse. Studies have shown that it increases the viabilityofthe headand reduces the incidence of avascular necrosis of head of humerus[12]. Presence of intramedullary fibular strut increases the purchase from two to four cortices resulting in increased pull out strength. Intra osseous presence of the fibular strut may help in union by helping the creeping substitution and preventing collapse.Filling the fracture ends with cancellous graft harvested from the iliac crest provides the osteoconductive, osteoinductive,and osteogenic properties increasing the chances of union.

V. Conclusion:

Though there are several methods of fixation, management of atrophic nonunion of fracture shaft of humerus is technically demanding due to gross osteoporosis, reduced viability of bone ends and associated stiffness of proximal and distal joints. Addition of intramedullaryfibular strut graft along with Ileac crest cancellous graft adds to the stability of the fixation and its viability. Intramedullary presence of fibular strut graft increases the cortical hold by two folds and acts as an internal splint. Educating the patients to avoid traditional based conservative therapy and to adhere to modern therapy will reduce such complications.

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