

OUTCOME OF MESH ENVELOPE BONE GRAFTING FOR TRAUMATIC SEGMENTAL BONE DEFECTS

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ABSTRACT

Background: Long bone defects treatment is a technically demanding procedure in orthopedic surgery and may require bone graft pieces, which are loosely applied to the bone and few pieces can spill over in the surrounding area, resulting in failure in obtaining beneficial effects. The vicryl mesh envelope around the bone graft may be a solution. **Objective:** To determine the role of mesh regarding bone graft containment and union in long bone defects of > 4cm. **Methodology:** This experimental study was conducted in orthopedic department of Lahore General Hospital, Lahore from 1st January 2012 to 31st December 2014. Total 28 cases were included in the study and randomized into two equal groups. Fourteen patients were managed with vicryl mesh (group A) while 14 patients were treated routinely without the use of vicryl mesh envelope (group B). Data was entered and analyzed by using SPSS version 18.0. **Results:** The mean age of all the patients was 29.11±6.16 years. The mean age of patients in group A was 29.71±6.56 years and in group B was 28.50±5.92 years. There were 20 (71%) male patients and only 8 (29%) female patients presented with long bone defects. Most of the patients were managed with dynamic compression plating i.e. 20 (71.43%). In group A, 1 (7.1%) patient developed infection and re-operation was done while in group B 6 (42.9%) patients has infection and re-operation was executed to eradicate it. The difference was significant for post-operative infection between both groups (p-value=0.029). **Conclusion:** This study concluded that there was significant difference between both techniques in graft containment, consolidation and graft failure. Patients managed with vicryl mesh have better outcome than without vicryl mesh. **Key words:** Long bone, Defect, Bone graft, Vicryl, Mesh, Union.

INTRODUCTION

Bone is an alive composite tissue composed of mineral and organic parts. Outer 1/3 of the bones are supplied by periosteal vessels and inner 2/3 of the bones are supplied by nutrient vessels.¹ Bone loss is not an uncommon phenomena in modern orthopedic trauma but this is not addressed in Gustilo classification.² Robinson et al, in later years classified the bone loss after trauma in tibia fractures and this classification can be applied to long bones in whole human injuries.³ Different methods for the treatment of bone defects are bone grafting, vascularised fibular graft, bone distraction and compression osteogenesis. These different techniques are not always available in remote and under developed areas of Pakistan.⁴

Autogenous bone grafting is widely used procedures for bone union and mild bone defects. Its advantages are that there is no rejection reaction, no availability problem and easy approach for retrieval. Only minor disadvantages are that there is post operative scar pain, cosmetic problem and not suitable for large defects.⁵ The non vascularized fibular graft is not suitable in areas where bed is infected and patients have leg length discrepancy. However it provides easy retrieval and early patient range of motion. Postoperatively long duration of protection of graft by brace is required.⁶ The distraction

osteogenesis by ilizarov method provides one – stage surgery. However, it requires long duration of treatment as one cm of leg lengthening needs almost three months.⁷ The vascularised free fibular graft provides required bone length, less time for union, available pedicle size and minimal donor site defect. However it is technically demanding, lengthy procedure and requires full administrator support.⁸ Fibula and ilium are the most common sites used as free vascularized grafts for severe long bone defects.⁹ The mesh envelope use in bone grafting is very rarely used despite common use of bone grafting. Only few studies are reported in literature about impaction grafting.¹⁰ Impaction bone grafting is widely reported after its use in total hip and knee arthroplasty.^{11,12} Impaction grafting provides stable, well aligned and complete bone healing on short term basis in different scanty studies.¹³ As it is simple, easy learning curve and no availability problem, so this study was planned determine the effect of mesh envelope in traumatic segmental bone defects of > 4cm.

METHODOLOGY

This experimental study was conducted in orthopedic department of Lahore General Hospital, Lahore from 1st January 2012 to 31st December 2014. This study was completed in 36 months. All the patients with traumatic segmental bone defects of long bones up to

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4cm in both male and female patients were included in the study. All the patients with active infection, defects involving epiphyseal area and surgically unfit patients were excluded from the study. A total of 28 patients, with 14 in each group were included in this study.

All the patients were divided into two groups. Patients with vicryl mesh bone grafting were included in group A and without mesh in group B. The patients were randomly allocated to either Group A or Group B using random tables after the inclusion criteria were met. Demographic data including age, gender, mode of injury, types of fixation, graft containment, graft consolidation, radiological union, graft failure and postoperative infection was recorded. Sharrad criteria for fracture union that bridging callus across at least three of four cortices on the anteroposterior and lateral radiographs and clinically with no pain by stressing the fracture or on walking was used. Proforma designed for this study was used for data collection.

All patients meeting the inclusion criteria were examined and investigated routinely to confirm diagnosis. After taking informed consent from many patient, size and geometry of bone defect was measured from standard antero-posterior and lateral radiographs and template.

A corresponding sized vicryl mesh was prepared and got sterilized by ethylene dioxide; double packing of this mesh was done and stored. Then surgery was planed. The fracture fixation was managed with open reduction and internal fixation with plate and screws or intramedullary nail. After fixation of fracture internally either by plate or intramedullary nail, bone graft was taken from iliac crest, chewed and placed in the defect, vicryl mesh was encircled around this graft. Vicryl mesh was strengthened and fixed with an additional vicryl sutures. Surgical incision was closed after homeostasis.

All the patients were flowed up monthly for four months. The required information was collected by a questionnaire. The data was analyzed by using SPSS version 18. A formal approval from the ethical committee of the hospital was obtained. The data collected from the hospital was confidential and used for statistical analysis only.

RESULTS

A total of 28 cases with segmental bone defects were enrolled in the study. They were randomly

divided into two groups. Each group contains 14 cases. The mean age in group A was 29 ± 6 years and B 28 ± 5 years. Femur was affected bone in 7(25%) patients, humerus 6 (21.4%), radius 4(14.3%), radius plamulna 1(3.5%), tabia 7(25%) and tabia plus fibula 3(10.7%).

Table I: Mode of fixation among both groups

Mode of Fixation	Group		Total
	With vicryl mesh (Group A)	Without vicryl mesh (Group B)	
DCP	9 (64.2%)	11 (78.5%)	20 (71.4%)
Nail	4 (28.5%)	3 (21.4%)	7 (25%)
AMP	1 (7.1%)	0	1 (3.6%)
Total	14 (100%)	14 (100%)	28 (100%)

Table II: Outcome in both groups

Graft Containment good at visit				
Visits	Group		Total	P-value
	With vicryl mesh (Group A)	Without vicryl mesh (Group B)		
1	14 (100%)	14 (100%)	28	1.00
2	14 (100%)	4 (28.5%)	18	0.000*
3	14 (100%)	1 (7.1%)	15	0.000*
4	14 (100%)	1 (7.1%)	15	0.000*
Graft consolidation present at visit				
	Group		Total	p-value
	With vicryl mesh	Without vicryl mesh		
1	0	0	0	1.00
2	11 (78.6%)	2 (14.3%)	13	0.000*
3	12 (85.7%)	4 (28.6%)	16	0.001*
4	12 (85.7%)	7 (50%)	19	0.022*
Union present at visit				
	Group		Total	P-value
	With vicryl mesh (Group A)	Without vicryl mesh (Group B)		
1	0	0	0	1.000
2	11 (78.6%)	1 (7.1%)	12	0.000*
3	12 (85.7%)	7 (50%)	19	0.043*
4	12 (85.7%)	10 (71.4%)	22	0.357 NS
Graft failure present at visit				
	Group		Total	P-value
	With vicryl mesh (Group A)	Without vicryl mesh (Group B)		
1	0	0	0	1.000 NS
2	1 (7.1%)	1 (7.1%)	2	1.000 NS
3	2 (14.3%)	3 (21.4%)	5	0.622 NS
4	2 (14.3%)	4 (28.6%)	6	0.357 NS
Infection				
Infection	Group		Total	P. Value
	With vicryl mesh	Without vicryl mesh		
Yes	1 (7.1%)	6 (42.9%)	7 (25%)	0.02
No	13 (92.9%)	8 (57.1%)	21(75%)	
Total	14 (100%)	14 (100%)	28 (100%)	
Redo-operation				
Redo operation	Group		Total	P. Value
	With vicryl mesh	Without vicryl mesh		
Yes	1 (7.1%)	6 (42.9%)	7 (25%)	0.29
No	13 (92.9%)	8 (57.1%)	21 (75%)	
Total	14 (100%)	14 (100%)	28 (100%)	

Table II shows outcome among both groups and relevant significant level. There were 20 (71%) male patients and only 8 (29%) female patients presented with long bone defects. There were 21 (75%) patients with defect of long bone on left side while 7 (25%) patients had defect of long bone on right side. Most of the patients were managed with dynamic compression plate 20 (71.43%). Intramedullary nailing was done in 7 (25%) patients and Austin Moore prosthesis (Custom made with intramedullary nail) was done only in 1 (3.57%) patients. The mode of fixation and bone grafting is shown in Table I.

DISCUSSION

Traumatic segmental bone defects are a challenging modality of treatment for orthopedic surgeons. Many treatment options are available according to the size of the defects. Mild defects are treated by cancellolus autogenous bone grafting and moderate to severe defects need either free vascularized grafts or distraction osteogenesis.^{14,15} Different authors and researchers in the world are trying to get a palatable solution for this difficult problem. Each of the previously carried out procedures are not without complications.¹⁶ Recently a method for segmental bone defects in the form of temporary cement spacer followed by bone grafting may prove to be a good treatment option.¹⁷ In the present study, lower extremity injuries were most common (60.8%) with tibia and femur being involved in even percentage of patients. Similarly in another study authors concluded that in 68% of the patient's tibia was having segmental bone loss and femur was involved in 22% of the patients.¹⁸ This study was conducted on traumatic bone defects of less than 4 cm because autologous bone grafting is still the treatment of choice for defects up-to 5 cm. The popularity of technically demanding and complicated free vascularized fibula has minimized in the recent past.¹⁹ In the present study, graft consolidation and union was achieved in >85% of patients at 12th week post operative period and graft containment was 100% in the mesh bone graft group. While the union with distraction osteogenesis was achieved in defects of 7cm at an average duration of 6-12 months in different national and international studies.²⁰ Vicryl mesh bone graft has many advantages including biocompatibility, incorporation of adjuncts, axial loading, single – stage and

usefulness for meta-physeal and diaphyseal defects.²¹ The union of fractures without mesh grafting yields poor results as in this series and also in another study where the duration was > 7months.²²

Different authors are using biodegradable materials for traumatic segmental bone defects but these materials are still at investigational stage.²³ Dynamic compression plating was used in 70.5% of patients in present study and intramedullary nailing in 25% of patients. Costi et al in concluded in invitro study that impaction bone grafting with nailing is much superior to simple bone grafting biomechanically.²⁴ Bone graft containment, consolidation and union without mesh bone grafting were 7%, 50% and 71% in the present study. All these parameters were improved significantly with mesh bone grafting as reported by clinical studies.^{25,26}

In the present study redo-operations and post-operative infections were significantly higher in patients where no mesh bone grafting. As more than 40% of patients were suffering from these complications. Flierl et al concluded in their study 9% revision bone grafting and 12.4% postoperative infections in their 182 patients in 2013.²⁷ The main use of mesh grafting was in total hip arthroplasty,²⁸ total knee arthroplasty²⁹ and dentistry³⁰ in previous decades. National and international literature is too much scanty about use of mesh grafting in traumatic segmental bone defects.³¹

CONCLUSION

It is concluded from this study that treatment of long bone defects by bone grafting with vicryl mesh envelope carries a statistically significant and better outcome as compared to bone grafting without mesh in graft containment, consolidation and failure. The technique is recommended for safe use and further long-term studies.

Conflict of interest

The authors have declared no conflict of interest.

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