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Research Article

Assessment of non-union after double fibular bone grafting without cancellous hip screw fixation for the management of neglected femoral neck fractures

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ABSTRACT

Objectives: To determine the frequency of non-union after double fibular bone grafting without cancellous hip screw fixation in treating neglected femoral neck fractures
Study Design: Descriptive case series.
Study Duration: March 2017 to September 2017
Settings: Department of Orthopedic, Aziz Fatima Medical College Hospital Faisalabad.
Materials & Methods: A total of 117 patients with neglected femoral fractures, 20 to 50 years of age of both genders were included. Patients with pathological fractures, aseptic non-union, medical co-morbidity like CLD, CRF, chronic steroid use were excluded. In all patients, double fibular bone grafting without cancellous hip screw fixation was done. All patients were followed on regular intervals pos-operatively and final outcome (non-union) was noted.
Results: Mean age was 35.15 ± 7.64 years. Out of 117 patients, 85 (72.65%) were males and 32 (27.35%) were females with male to female ratio of 2.6:1. Mean duration of fracture in my study was 1.43 ± 0.89 months with majority of patients i.e. 88 (75.21%), were ≤3 months. Non-union was seen in 16 (13.68%) patients while remaining 101 (86.32%) had shown union.
Conclusion: This studyconcluded that frequency of non-union after double fibular bone grafting without cancellous hip screw fixation in treating neglected femoral neck fractures is very low.

Keywords: femur neck fracture, fibular graft, cancellous screw, non-union.

INTRODUCTION

A hip fracture is a femoral fracture that occurs in the proximal end of the femur (the long bone running through the thigh), near the hip.[1]Hip fractures are classified as intracapsular, which includes femoral head and neck fractures, or extracapsular, which includes trochanteric, intertrochanteric, and subtrochanteric fractures. The location of the fracture and the amount of angulation and comminution play integral roles in the overall morbidity of the patient, as does the preexisting physical condition of the individual.[2] Fractures of the proximal femur are extremely rare in young athletes and are usually caused by high-energy motor vehicle accidents or significant trauma during athletic activity. Other causes may

be an underlying disease process such as Gaucher disease, fibrous dysplasia, or bone cysts.[3]

Neglected femoral neck fractures are challenging to treat in young adults (age <60).While there is no defined lag period for such a fracture to be called "neglected," Myers et al introduced the term to indicate a delay of 30 days or more from the injury to seek medical help. Attempts to preserve the femoral head in a young active patient are of at most importance.[4]With delay these factures usually result in non union. The rate of non union is between 10-30% for such neglected fractures.[5,6] Delay in surgery leads to variable degree of neck absorption, proximal migration of distal fragment and disuse osteoporosis. These factors together make it further difficult to achieve close reduction and stable fixation.[6]

Femoral neck non-union in a young adult is an uncommon but serious complication both for the patient involved and in terms of management. It is usually treated operatively with several treatment options having variable success rates.[7] The treatment goals are anatomic reduction, stable fixation, preservation of blood supply to the bone fragments, and early active mobilization to prevent stiffness.[8]

Treatment options include valgus osteotomy and osteosynthesis with or without bone grafting (muscle pedicle, free vascularised, or nonvascularised fibula), hemiarthroplasty, and total hip arthroplasty.[8,9] Nonunion and avascular necrosis are common complications.[10] Fibular bone graft has certain advantages as it prevents the subchondral collapse, acts as a biological implant and as a channel for revascularization. Because of its trephine shape it acts on the principle of Smith Peterson Nail and thus adds to the stability of fracture reduction.[11]

Jaiswal A et al[12] in his study has shown the rate of non-union after double fibular bone grafting without cancellous hip screw fixation as 12.5% in treating neglected femoral neck fractures. The rationale of this study was to determine the frequency of non-union after double fibular bone grafting without cancellous hip screw fixation in treating neglected femoral neck fractures in local population. As non-union is very common complication after treating neglected femur neck fractures and also available literature on this technique was very scarce, so our study would not only add the data in the existing literature but also provide the local stats. On the basis of the results, these particular patients could be provided with a technique with better results and that particular technique with lower rate of non-union could be used as primary therapy for treating these particular types of fractures in order to reduce the morbidity of these patients.

OPERATIONAL DEFINITIONS:

1. **Neglected Femoral neck fractures:** all patients with femoral neck fracture (assessed on AP, Lateral view of radiography as break in continuity of bone) of >1 month duration was taken as positive.
2. **Non-union:** was defined as the absence of obvious healing radiologically (x-ray) at 3 months after the injury on both views (AP and lateral) by the absence of Trabecular continuation across the fracture line.

MATERIAL AND METHODS

Study design: Descriptive, case series study.

SETTING: Department of Orthopedic Surgery, Aziz Fatima Medical College Hospital Faisalabad.

Duration of study: March 2017 to September 2017.

Inclusion Criteria:

1. All patients with neglected femoral fractures (as per-operational definition).
2. 20-50 years of age.
3. Both genders.

Exclusion Criteria:

1. Aspectic non-unions.
2. Pathological fractures (assessed on history).
3. Significant medical co-morbidity like CLD, CRF, chronic steroid use (assessed on history and medical record).
4. Patients not willing to be included in the study.

Data collection procedure:

After permission from the ethical review committee, total number of 117 patients who were presented to the outdoor or emergency Department of Orthopedics, Aziz Fatima Medical College Hospital Faisalabad, fulfilling the Inclusion/Exclusion criteria were selected. Informed written consent was taken from every patient after explaining the nature, aims and risks of the procedure. In all patients, double fibular bone grafting without cancellous hip screw fixation was done by the consultant orthopedic surgeon (with at least 5 years post-fellow ship experience).

All patients were followed on regular intervals pos-operatively and final outcome (non-union) was noted by the researcher at the end of 3 months. All this information was collected through pre-designed Performa.

Statistical analysis:

The data collected was entered in computer software SPSS version 20. Mean and standard deviation were calculated for age, height, weight, BMI and duration of fracture. Frequency and percentage were calculated for the gender, diabetes mellitus (yes/no) and non-union (yes/no). Chi-square test was used to compare study variable i.e. non-union, in both groups and p-value ≤0.05 was taken as significant.

Effect modifiers like age, gender, duration of fracture, BMI (obese (≤30kg/m^2)/non-obese (>30kg/m^2)) and diabetes mellitus (yes/no) were controlled through stratification and post stratification chi square was applied. P-value ≤0.05 was considered as significant.

RESULTS

Age range in this study was from 20 to 50 years with mean age of 35.15 ± 7.64 years. Majority of the patients 48 (41.03%) were between 30 to 40 years of age as shown in Table I.

Out of 117 patients, 85 (72.65%) were males and 32 (27.35%) were females with male to female ratio of 2.6:1 as shown in figure 1.

Mean duration of fracture in my study was 1.43 ± 0.89 months with majority of patients i.e. 88 (75.21%), were ≤3 months as shown in Figure 2.

Distribution of patients with status of co-morbid conditions is shown in Table II.

All the patients were treated by double fibular bone grafting without cancellous hip screw fixation. Non-union was seen in 16 (13.68%) patients while remaining 101 (86.32%) had shown union as shown in figure 3.

Stratification of non-union with respect to age groups & gender has shown in Table III & IV respectively which showed statistically no significant difference among different groups. Table V has shown the stratification of non-union with respect to duration of fracture which also showed statistically no significant difference among different groups.

Stratification of non-union with respect to BMI & diabetes mellitus has shown in Table VI & VII respectively which showed statistically no significant difference among different groups.

Table-I: Distribution of patients according to Age distribution (n=117).

Age (in years)	No. of Patients	%age
20-30	41	35.04
31-40	48	41.03
41-50	28	23.93
Total	**117**	**100.0**

Figure 1: Distribution of patients according to gender (n=117).

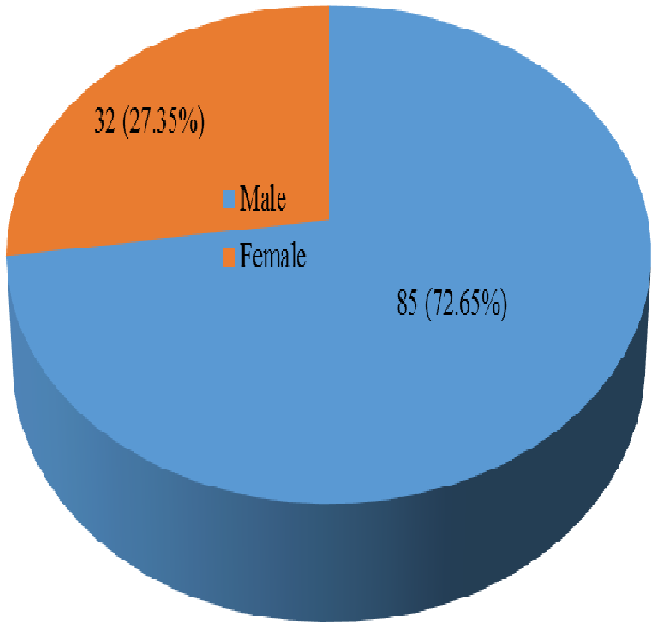

Figure 2: Distribution of patients according to Duration of fracture (n=117).

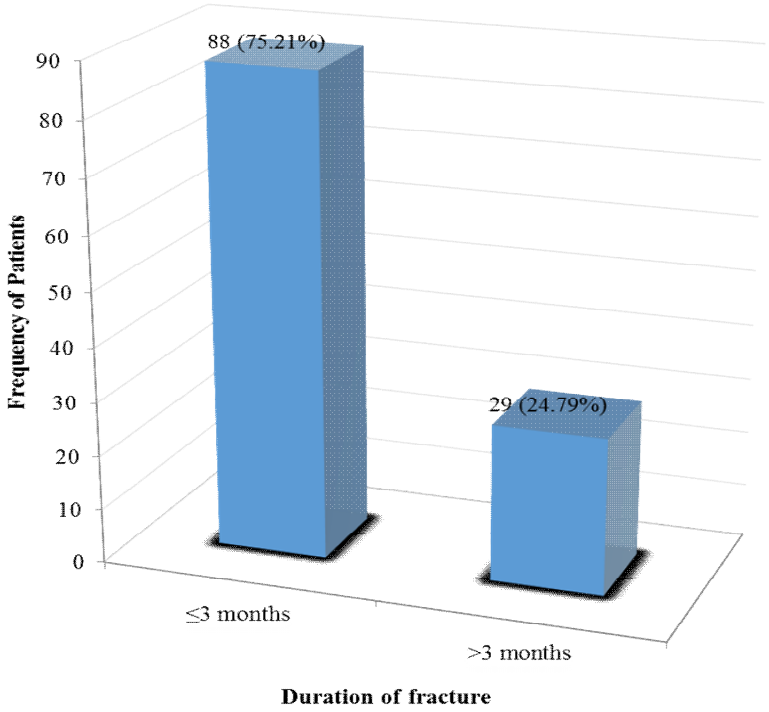

Table II: Distribution of patients with status of co-morbid conditions (n=117)

Confounding variables		Frequency	%age
Diabetes Mellitus	Yes	90	76.92
	No	27	23.08
BMI	<30 kg/m^2	65	55.56
	>30 kg/m^2	52	44.44

Figure 3: Distribution of patients according to Non-union (n=117)

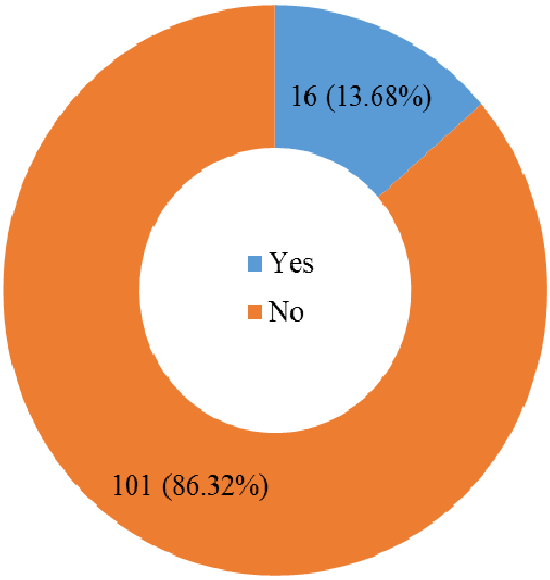

Table III: Stratification of Non-union with respect to age groups.

Age (in years)	Non-union		P-value
	Yes	No	
20-30	05 (12.20%)	36 (87.80%)	**0.942**
31-40	07 (14.58%)	41 (85.42%)	
41-50	04 (14.29%)	24 (85.71%)	

Table-IV: Stratification of Non-union with respect to Gender.

Gender	Non-union		P-value
	Yes	No	
Male	12 (14.12%)	73 (85.88%)	**0.820**
Female	04 (12.50%)	28 (87.50%)	

Table-V: Stratification of Non-union with respect to duration of fracture.

Duration of fracture	Non-union		P-value
	Yes	No	
≤3 months	09 (10.23%)	79 (89.77%)	**0.059**
>3 months	07 (24.14%)	22 (75.86%)	

Table-VI: Stratification of Non-union with respect to BMI.

	Non-union		P-value
	Yes	No	
Obese	05 (9.62%)	47 (90.38%)	**0.253**
Non-obese	11 (16.92%)	54 (83.08%)	

Table-VII: Stratification of Non-union with respect to diabetes mellitus.

Diabetes Mellitus	Non-union		P-value
	Yes	No	
Yes	04 (14.81%)	23 (85.19%)	**0.844**
No	12 (13.33%)	78 (86.67%)	

DISCUSSION

Femoral neck fracture has a devastating effect on the blood supply of the femoral head, which is directly proportional to the severity of trauma and displacement of the fracture.[13]The intra-capsular hematoma is also implicated with development of avascular necrosis (AVN) of femoral head.[13] Femoral neck fractures in young adults are

associated with higher incidences of osteonecrosis, with the rate reported in the literature from 12% to 86%. Early anatomical reduction and stable internal fixation restores the vascularity and reduces the incidence of AVN.[14] Nonunion and AVN of the femoral head are the main complications following femoral neck fractures. The reasons for such complications include precarious vascularity, shearing forces at the fracture site, inadequate reduction and inadequate fixation.[14] The nonunion (NU) is complicated by resorption at fracture ends leading to significant shortening of the femoral neck.

Some of the authors[15-16] used open reduction of fracture with freshening of fracture surfaces and placed cancellousautograftalongwith fibula. Fibula being cortical bone provides mechanical strength besides stimulating the union and getting incorporated as a biological graft. Once the graft is revascularized, the osteoblasts stimulated by bone morphogenic protein replace the resorbed bone. If this bone is appropriately stressed, the graft acquires sufficient strength to handle the load.[17] Nonvascularized fibular strut graft along with cancellous screws provides a dependable and technically less demanding alternative procedure for neglected femoral neck fractures in young adults. Vascularized fibular graft is reported to give superior result; however, it consists of microvascular anastomosis that is technically more demanding. I have conducted this study to determine the frequency of non-union after double fibular bone grafting without cancellous hip screw fixation in treating neglected femoral neck fractures.

Age range in this study was from 20 to 50 years with mean age of 35.15 ± 7.64 years. Majority of the patients 48 (41.03%) were between 30 to 40 years of age. Out of 117 patients, 85 (72.65%) were males and 32 (27.35%) were females with male to female ratio of 2.6:1. Mean duration of fracture in my study was 1.43 ± 0.89 months with majority of patients i.e. 88 (75.21%), were ≤3 months. All the patients were treated by double fibular bone grafting without cancellous hip screw fixation. Non-union was seen in 16 (13.68%) patients while remaining 101 (86.32%) had shown union. Jaiswal A et al[12] in his study has shown the rate of non-union after double fibular bone grafting without cancellous hip screw fixation as 12.5% in treating neglected femoral neck fractures.

Elgafy[18] obtained 100% union and satisfactory clinicoradiographic result at 5-7 years follow up using vascularized iliac bone graft augmented by screw fixation. One or two guide wires are placed to guide a tunnel for fibula. First a tunnel is created by triple reamer and later one or two fibulae are placed (with fixation done by two CCS at least). The use of nonvascularized fibular strut graft is technically less demanding. In the present search thirty-three NUs were reported out of 374 cases while AVN was reported in 11 cases (3%), with an overall complication rate of 11.3%.

Free fibular grafting has been widely studied as a method to introduce both structural support and induce osteogenesis in a neglected femoral neck fracture. The results with this procedure have given non-union rates between 0% and 17% and AVN rates of 0%–33%.[19] Nagiet al[20-21] have reported good results with open reduction and internal fixation combined with free single fibular graft. Nagi et al in a study on 40 patients treated with open reduction, internal fixation and fibular autografting for neglected fracture of the femoral neck reported excellent Hip function in seven patients, good in 21 and fair in seven and reported successful outcome in 87.5%. They reported non-union in 2 cases (5%) and osteonecrosis of femoral head in 5 cases (12.5%). Goyal et al[22] in a series of 15 patient treated by single fibular graft and two cannulated hip screw reported union in 14 cases. They reported good result in 11 and satisfactory result in 2 patients.

The idea of biological fixation by twin fibular graft was put forward by Yadav.[23] In a study on 150 patients with fracture neck femur he showed a total of 88% had excellent to fair results, non-union in 17 and osteonecrosis in 14 cases. Damanyet al[24] in a meta-analysis of 18 articles on

fracture neck femur of 564 patients 15–50 years old, showed an overall non-union rate of 8.9%. They found that with open reduction the rate of non-union increased to 11.2% compared with 4.7% for fractures treated with closed reduction. The overall rate of osteonecrosis in their study was 23%.

In a study[10], 16 men and 6 women aged 18 to 48 (mean, 33) years presented with neglected (>3 weeks old) femoral neck fractures were included. Those with good bone quality (Singh index, >3) underwent closed reduction and valgus osteotomy and fixation with 120º double angle blade plates (group 1, n=8), whereas those with poor bone quality (Singh index, >3) and/or communition of the posterior femoral neck underwent fibular grafting and internal fixation with one or two 7-mm cannulatedcancellous screws (group 2, n=14). Functional outcome was assessed at the 6-month follow-up, according to modified Askin and Bryan criteria. The mean delay in surgery was 12 (range, 4-21) weeks. Patients were followed up for a mean of 19 (range, 12-24) months. The mean time to union was 20 (range, 12-52) weeks. The mean time to full weight bearing was 18 (range, 12-40) weeks. All patients achieved bone union except one in group 1 who had non-union and breakage of the blade plate at week 20 and underwent total hip arthroplasty. Other complications included slippage of fibular graft (n=1), delayed union (n=1), avascular necrosis of the femoral head (n=2), limb length discrepancy (n=3), and superficial infection (n=1). Functional outcome was excellent in 2 patients, good in 17, and poor in 3. Valgus osteotomy and double angle blade plate fixation, and fibular grafting and cancellous screw fixation appeared to be appropriate treatments for neglected femoral neck fractures in adults.[10]

In one study of 40 neglected femoral neckfractures (mean delay, 5.1 months) treated with openreduction and internal fixation with compressionscrews and a fibular graft, 38 patients achieved boneunion.[25] However, after a mean of 58.8 months, therewere collapse of the femoral head (n=5), coxavara(n=11), fibular graft fracture (n=4), screw penetration(n=6), and graft penetration (n=3).[25] Hip function wasexcellent in 7 patients, good in 21, fair in 7, and poorin 5.[25]On the whole it is concluded that frequency of non-union after double fibular bone grafting without cancellous hip screw fixation in treating neglected femoral neck fractures is very low.

CONCLUSION

This study concluded that frequency of non-union after double fibular bone grafting without cancellous hip screw fixation in treating neglected femoral neck fractures is very low. So, we recommend that double fibular bone grafting without cancellous hip screw fixation should be used as primary therapy for treating these particular types of fractures in order to reduce the morbidity of these patients.

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