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Free Fibular Graft Augmentation in Delayed Fixation of Fracture Neck of Femur in Young Adults.

Dr. Thejaswi.S.G*[1], Dr. B.G.Sagar[2], Dr. Sunil Kumar PC[3]

[1]*Assistant Professor Department of Orthopaedics Sikkim Manipal Institute of Medical Sciences. Sikkim.*
[2]*Professor Department of Orthopaedics Mysore Medical College and Research Institute. Karnataka.*
[3]*Associate Professor Department of Orthopaedics Mysore Medical College and Research Institute. Karnataka.*
**corresponding author: Dr. Thejaswi.S.G*

Abstract:
Introduction: *This clinical study was conducted to assess the long term follow up results of using free fibular graft to augment fracture fixation with cannulated cancellous screw or dynamic hip screw as a treatment option for femoral neck fractures in young adults who presented after 24 hours of injury but within 3 weeks.*
Methods: *A prospective study was conducted on the patients of femoral neck fractures managed with multiple cancellous screws or dynamic hip screw with fibular graft. Patients aged between 15 and 50 years, having Gardens type III or IV fracture with duration of injury less than three weeks were included in the study. They were assessed for radiological outcome and functional outcome using modified Harris Hip Score.*
Results: *Twenty two cases were operated between day 2 to day 21 after sustaining injury. The mean time of union was 3.4 months. 19 fractures united uneventfully. 2 fractures went in for non union and one developed AVN of femoral head. According to Harris Hip Score,14 patients scored 'excellent', 3 patients scored 'good', 3 scored 'fair', and 'poor' score was recorded in 2 patients.*
Conclusions: *Delay in surgery as a contributing factor for development of complications in fracture neck of femur cannot be ruled out with the present literature available. Using a free fibular graft as an adjunct to the implant construct helps in reducing the rates of non-union and AVN. However, this cannot be a substitute for the proper surgical precision that is required in treatment of fracture neck of femur. Further prospective studies involving large sample size are required.*
Keywords: *Fresh fracture neck of femur, Multiple cancellous screws, Free fibular graft*

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I. Introduction

Fracture neck of femur is considered as one of the three most common fractures seen in elderly, other two being vertebral fractures and distal radius fracture[1]. Incidence of fractures around hip has increased among young adults due to a rising incidence of high-energy trauma. Femoral neck fractures in young adults is considered as a separate group because of its relative rarity and associated complications of aseptic necrosis and non-union in this age group reported in the literature[2]. Following three criteriawere recommended for successful treatment of femoral neck fractures in young adults: (a) fixation must be achieved within 12 hours of injury or as soon as possible; (b) anatomic reduction must be obtained through closed manipulation or open reduction, if necessary; and (c) the fracture should be stabilized with some form of multiple screw fixations[3].Among many other factors, timing of surgery plays a key role in union of fracture neck of femur. After the landmark report by Swiontkowski and colleagues[4] in 1984 this fracture came to be known as "orthopaedic emergency". However, the controversy of delay in surgery affecting the fracture neck of femur union still persists and there are not enough conclusive reports to disprove its role in causing non-union or avascular necrosis of femoral head.

In a country like India, these fractures rarely present to hospital immediately and in many set ups fixation within 12 hours of injury might not be possible. In view of late presentation and precarious blood supply it is difficult to ensure fracture union withoutcomplications through cannulated cancellous screw (CCS) or Dynamic Hip Screw(DHS) fixation alone. In such situations free fibular graft could bea useful supplement to the construct of implants. Free fibular graft offers not only structural support, but also promotes bone healing.Free fibular graft has been used as a treatment option for non-union or neglected fracture neck of femur. Earlier studies using fibular grafts have shown good results in treatment of non-union[5].

This clinical study presents long term follow up results of using free fibular graft to augmentfracture fixation with CCS or DHSas a treatment option for femoral neck fractures in young adults who presented after 24 hours of injury but within 3 weeks.Outcome was analysed by modified Harris hip scoring system and by radiographs taken during follow up.

II. Methodology

After obtaining 'institutional ethics committee' approval 22 cases of intracapsular fracture neck of femur in adult patients between age group of 15years to 50 years presenting after 24 hours but within 3 weeks,were treated by closed reduction and internal fixation with CCS or DHS and free fibular grafts. Cases were selected among patients operatedat our hospital between January 2011 to October 2013.

2.1 Surgical techniques:

All patients were operated under spinal anaesthesia and over traction table.Closed reduction of fracture was attempted, and reduction was confirmed using fluoroscopic image intensifier. Cannulated cancellous screws were inserted into the neck over the guide wires passed through aiming device. In an ideal condition two screws were used. In cases where neck width was less one screw was used. In fractures which seemed to be unstable or basicervical, DHS was preferred for better stability. Free fibular graft of pre-calculated length was harvested either from ipsilateral leg or contra lateral leg. Through one of the guide wire that was put through the aiming device a drill hole was made using a small triple reamer and peg of fibula was inserted into it under image intensifier guidance.

2.2 Follow Up:

Patients were followed up at 3 weeks,and monthly till 6 months and yearly for three years. Non weight bearing crutch walk was allowed immediately after surgery and partial weight bearing was allowed after 4 weeks. Standard X-rays were taken at monthly intervals till radiological union was obtained. At the end of three years patients were evaluated according to Harris hip scoring system(HSS)and graded as,Poor for score <70,Fair for score between 71-80, Good for score between 81-90 and Excellent score between 91-100.

III. Results:

The study group comprised of 18 males and 4 females. Average age of study group was 33.7 years. Out of 22 cases, 12 fractures were of Garden's type III, 9 were type II andone case of type IV. 16 out of 22 cases were operated between day 2 to day 7 after injury and 6 patients were operatedbetween day 8 to day 21. All cases were reduced by closed manoeuvre and 20 fractures were fixed with CCS and free fibular graft and 2 were fixed with DHS and free fibular graft.

3.1 Radiological outcome:

Fracture union was seen in 19 patients with trabecular continuity being established completely between proximal and distal fragments without any complications. Mean time for union was found to be 3.4 months. 2(9%) fractures went into non-union which required further surgical intervention [Fig 1,2,3,4]. Main reason for non-union in these cases were short fibular graft in one case which failed to give enough stability and severe posterior comminution in another case. On long term follow up one patient developed AVN of hip.

There was no statistically significant difference in mean time for union or complication rate among fractures that were operated within one week and after one week.

3.2 Functional outcome:

The average HSS in this study was 87.8. With scores ranging from 53.9 to 99.9. In this study, 14 patients scored 'excellent', 3 patients scored 'good', 3 scored 'fair', and 'poor' score was recorded in 2 patients. There was no statistically significant relation between age of fracture and final HSS however it was noted that only (6.25%) cases who presented within one week had poor results as compared to 33.3% in case of fractures presenting after 1 week of trauma [Table1].

IV. Discussion

Femoral neck fractures in young adults are considered as a challenge to orthopaedic surgeons in view of the treatment options and high rates of complications such as non union and AVN. The controversy regarding when to fix this fracture and the influence of delay in surgery and rates of complication persists even today. Among the various treatment options that have evolved over the years, internal fixation with cannulated cancellous screws is used widely as the mode of treatment for fracture neck of femur in young adults. Literature also supports use of DHS in fixing intracapsular fracture neck of femur[6]. In view of the late presentation of patients in a developing country like ours, the union and functional outcome after fixation of this fracture brings in a special interest. This study was conducted in that aspect to treat the fracture with internal fixation and using fibular graft as an adjunct to encourage better result.

Although fracture neck of femur is considered to be an emergency[7], delay in seeking treatment and delay inside hospital is expected in a developing country like ours. Studies done in similar set up have also shown considerable delay between trauma and surgery. Study by Upadhyay et al recorded a mean time of 47 hrs to 52 hrs before ORIF and CRIF[8]. In our study mean duration between trauma and surgery was 4.02 days.

In 1984 Swiontkowski and colleagues[4] reported that by following their institutional protocol of immediate reduction and internal fixation they could get low rates of AVN (20%) and no symptomatic non-union in 27 patients aged 15-50 years. Following this paper, fracture neck of femur was labelled as "orthopaedic emergency". Ever since then, several reports have been published supporting the correlation between time interval to surgery and the outcomes of non-union and AVN. There have been several studies which suggest there is positive correlation between delay in surgery and development of AVN and non-union[9]. Similarly, there are studies which state that there is no correlation with delay in surgery and development of complications[8,10]. However thereported rates of AVN is 16 -23% and for non-unionit is10 -25%[8,10]. David A. Forsh in his review article[11]concludes that the current best evidence suggests a lack of an association, but is limited to retrospective observational cohorts that are far underpowered to reach meaningful conclusions. Hence the controversy regarding the delay in surgery as a contributing factor for development of complicationsstill persists.

With this background many studies have been taken up recently to address the probable consequences of delay in surgery. One among them is using free fibular graft as an adjunct to the fracture fixation with cannulated cancellous graft. Mohammad Zahid et al[12] in their study used cannulated cancellous screws and free fibular graft in fractures which had posterior comminution. They reported that 27 of the 33 patients (87%) achieved bone union after a mean of 4.7 (range, 4.2–7) months. 6 of their patients developed non-union and none had avascular necrosis of head of femur. In a similar study on long term follow up of young patients with fracture neck of femur operated with CCS and free fibular graft Sudhir Singh et al[13]reported 100% union in their 37 patients by the end of 1 year and 2 patients(5%) developed AVN.Contrary to these studies a study done by Sanjay Kumar et al[14] comparing fracture fixation with multiple screws with and without free fibular graft .In their study of fractures presenting after 24 hrs they recorded a total non-union rate of 13%(11 out of 87) among which 6 (out of 45) were in the group of fractures fixed with screws alone and 5(out of 42) were in the group fixed with screw and fibular graft. They mention that the reason for non-union being early weight bearing, noncompliance of patient and improper screw placement in 2 patients, which are modifiable risk factors.

Our present study also shows similar lower rates of non-union (9%) and lesser rate of AVN(4.5%) when fibular graft was used as an adjunct. It can be noted that these studies, including our present study have demonstrated a considerable lower rate of AVN as compared to the previous reports of 16 to 23% and non-union rates of up to 25%[Table 2][8,9,10,11].

Mean HHS in our study was 87.8 which is similar to 87.1 obtained by Roshan and Ram et al in their study using cannulated cancellous screws and fibular graft[15]. In this study we could obtain a final functional outcome of collective of 'excellent' and 'good' in 77.2% of cases (63% and 13.3% respectively). This result isbetter than what was reported by Zahid et al[12] where they obtained collective 'good' to 'excellent' in 54% patients and Sanjay Kumar et al[15] where they had excellent results in 28.5% in the group where free fibular graft was used and 66.6% where fibular graft was not used. Previous studies done by Goyal et al could obtain a result of 'good' in 68% of patients[16] and Nagi et al had a result of 'good' in 75% of patients[5]where HHS was not used as a functional scale.

In our study no donor site morbidities were noted as compared Sanjay Kumar et al[14] donor site complications of incision site pain, temporary extensor hallucis weakness and increased blood loss as compared to multiple screw fixation alone.

V. Conclusion:

Treatment of fracture neck of femur in young adults is controversial and various methods are evolving. Delay in surgery as a contributing factor for development of complications in fracture neck of femur cannot be ruled out with the present literature available.Thus, using a free fibular graft as an adjunct to the implant construct help in reducing the rates of non-union and AVN. However, this cannot be a substitute for the proper surgical precision that is required in treatment of fracture neck of femur. Further prospective studies in this regard involving large sample size are required.

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Table 1: Summary

Mean age			33.7years
Male: Female			18:4
Mean time for union			3.4months
Radiological outcome:			
Union			19(86%)
Non union			2(9%)
AVN			1(4.5%)
Functional outcome:			
Mean HHS –			87.8
	Delay in surgery		
	2-7 days	>7days	Total
Excellent	9	5	14
Good	2	1	3
Fair	3	0	3
Poor	0	2	2

Table 2: Complication rates in previous studies on delayed fixation of fractures.

Study	**Procedure**	**Non union rate**	**AVN rate**
Mohammad Zahid et al[12]	CCS + fibular graft	18%	0
Sudhir Singh et al[13]	CCS + fibular graft	0	5%
Sanjay Kumar et al[14]	Group A: CCS Group B: CCS+fibular graft	13% 11%	6% 4%
Haideukewych et al[10]	CCS	10%	20%
Butt MF et al[17]	CCS	9%	13%

Figure 1: immediate post-op(case1)

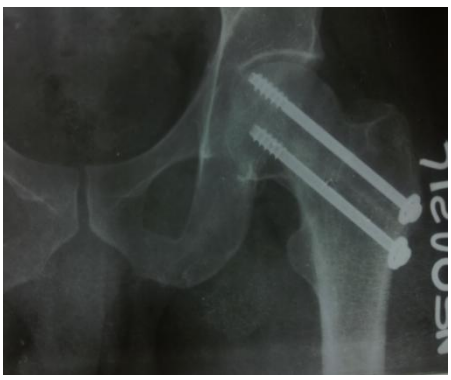

Figure 2: union after 4 months (case 1)

Figure 3: union after 4 months (case 2)

Figure 4: non union