

# Results of triple muscle (sartorius, tensor fascia latae and part of gluteus medius) pedicle bone grafting in neglected femoral neck fracture in physiologically active patients

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## ABSTRACT

**Background:** Femoral neck fractures are notorious for complications like avascular necrosis and nonunion. In developing countries, various factors such as illiteracy, low socioeconomic status, ignorance are responsible for the delay in surgery. Neglected fracture neck femur always poses a formidable challenge. The purpose of this study was to evaluate the results of triple muscle pedicle bone grafting using sartorius, tensor fasciae latae and part of gluteus medius in neglected femoral neck fracture.

**Materials and Methods:** This is a retrospective study with medical record of 50 patients, who were operated by open reduction, internal fixation along with muscle pedicle bone grafting by the anterior approach. After open reduction, two to three cancellous screws (6.5 mm) were used for internal fixation in all cases. A bony chunk of the whole anterior superior iliac spine of 1 cm thickness, 1 cm width and 4.5 cm length, taken from the iliac crest comprised of muscle pedicle of sartorius, tensor fascia latae and part of gluteus medius. Then the graft with all three muscles mobilized and put in the trough made over the anterior or anterosuperior aspect of the femoral head. The graft was fixed with one or two 4.5 mm self-tapping cortical screw in anterior to posterior direction.

**Results:** 14 patients were lost to followup. The results were based on 36 patients. We observed that in our series, there was union in 34, out of 36 (94.4%) patients. All patients were within the age group of 15-51 years (average 38 years) with displaced neglected femoral neck fracture of  $\geq 30$  days. Mean time taken for full clinicoradiological union was 14 weeks (range-10-24 weeks).

**Conclusion:** Triple muscle pedicle bone grafting gives satisfactory results for neglected femoral neck fracture in physiologically active patients.

**Key words:** Avascular necrosis, neglected femoral neck fracture, nonunion, triple muscle pedicle bone graft

**MeSH terms:** Avascular necrosis of bone, femoral neck fractures, grafting, bone screws

## INTRODUCTION

A neglected femoral neck fracture is defined by Myers *et al.* in one which treatment is delayed for  $>30$  days.<sup>1</sup> Early hospital admission within 6 h

reduces the mortality in femoral neck fracture and longer time surgery has shown more postoperative complications.<sup>2,3</sup>

In developing countries, various factors such as illiteracy, low socioeconomic status, ignorance and poor medical facilities are responsible for the delay in surgery.

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Still the management protocols for neglected femoral neck fracture in physiologically active patients have not been clearly described. Despite the advancement in surgical technique, instrumentation and imaging modalities, complications like nonunion (10-30%) and avascular necrosis (AVN) 15-33% are still evident.<sup>4,5</sup> Muscle pedicle grafting is used for providing additional blood supply along with anatomical reduction and stable fixation to minimize complications like AVN. Here we present the results of triple muscle pedicle bone grafting (Sartorius, Tensor fascia latae and part of Gluteus medius) in neglected femoral neck fracture (fracture of  $\geq 30$  days) in physiologically active patients.

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## MATERIALS AND METHODS

50 neglected femoral neck fractures treated by internal fixation and triple muscle pedicle bone grafts between 1992 and 2012 constitute this retrospective study. All cases were operated by senior surgeon (SCG). Anteroposterior and lateral views in 15° of internal rotation were taken to visualize the whole neck. We excluded patients having pathological fracture, chronic systemic disease (e.g. metabolic disease and ankylosing spondylitis), injury time interval less than 30 days, age more than 60 years and those patients who could not be followed for more than 2 years. All patients were kept on skeletal traction, preoperatively for 2-3 days to overcome the soft tissue contractures.<sup>6</sup>

## OPERATIVE PROCEDURE

All patients were operated on a standard fracture table in the supine position under C-arm control. Smith-Peterson approach was used in all cases with careful isolation of lateral cutaneous nerve of thigh. Anterior capsule was opened with a T-shape incision. Since all cases were neglected fractures, there was absorption and gap in the femoral neck. Fibrous tissue was removed, margins freshened and drilled till bleeding bone was achieved. Due to late presentation (vulnerable for nonunion), we maintained a valgoid reduction but within the limits of Garden's index.<sup>7</sup> After achieving reduction, deep fascia and vastus lateralis were separated and two to three cancellous screws (6.5 mm) were used for internal fixation in all cases. Since majority of tensor fascia latae are clinically Type I (muscle having single vascular pedicle according to the of Mathes and Nahai classification) muscle, so for its vascular augmentation, we used a small part (up to 30%) of gluteus medius (without compromising its function) too.<sup>8</sup> Same incision was extended superiorly to take a muscle pedicle graft from the iliac crest.

A rectangular bony chunk of the whole of the anterior superior iliac spine (ASIS) of 1 cm thickness, 1 cm width and 4.5 cm length was selected over the iliac crest comprising of muscle pedicle of Sartorius, tensor fascia late and part of gluteus medius. Then we marked the periphery of graft by surgical skin marker pen or cautery and drilled it with K-wire and with the help of osteotome graft was taken out [Figures 1 and 2].

Then we prepared the trough over the anterior or anterosuperior aspect of the femoral head and neck and the graft with all the three muscles mobilized and put into the trough. In those cases where femoral neck was more absorbed, part of greater trochanter also used for making the trough, to adjust the bony chunk. We fixed the graft with one or two 4.5 mm self-tapping cortical screw in anterior to posterior direction. We harvested some more cancellous bone, from the graft site (Iliac crest) and filled the fracture

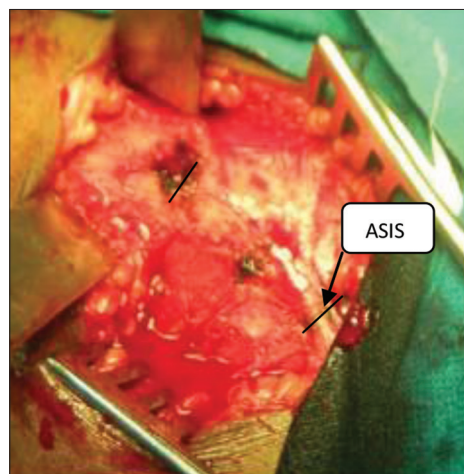
site to maintain the femoral neck length. Then we under C arm positioning of the screw and wound closed in layers.

Postoperatively as soon as the patients reported a pain free state, quadriceps drill and strengthening exercise were started. In 16 patients we applied spica cast for 6 weeks because we were not fully satisfied either with stable fixation or bone quality. After 2 months of surgery partial weight bearing (after seeing the X-ray) allowed with auxiliary clutches and full weight bearing when sound clinicoradiological union achieved. Postoperatively patients were followed up initially at 3, 6 and 12 weeks and then at every 6 months for next 2 years and thereafter yearly. The functional outcome was evaluated by Salvati and Wilson score,<sup>9</sup> time taken for full osseous union, AVN, coxa vara and shortening.

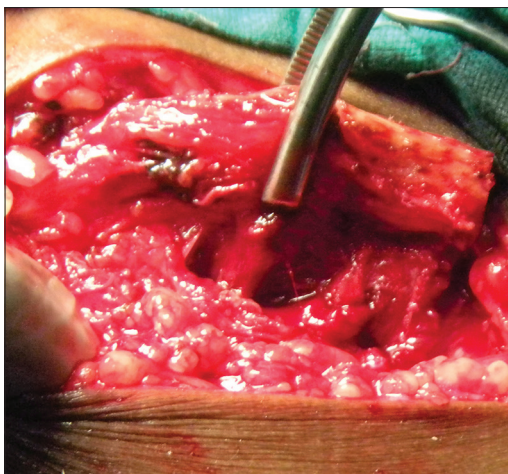
## RESULTS

This study, there were 34 males and 16 females. We included the patients of less than 60 years of age with neglected femoral neck fracture. The right side was involved in 30 and left side in 20 cases. The most common mode of trauma was road traffic accident ( $n = 33$ ) followed by slip on the ground while walking ( $n = 9$ ) and fall from the height ( $n = 8$ ). Three patients had associated injuries, fracture left calcaneus ( $n = 1$ ) and fracture of right humerus ( $n = 2$ ). There were 26 Garden type III and 24 Garden type IV.

Out of 50 patients, 14 were lost to followup. We present the evaluation of 36 patients from this series. There were 24 males and 12 females in the study [Table 1]. The mean injury operation interval was 56 days (range 40-78 days) and they were followed up for an average of 4.5 years (range 2-14 years). Average time taken for surgery was 52 min (range 45-65 min) and mean blood loss was 170 ml (range 145-200 ml), (estimated by visual method by



**Figure 1:** Peroperative clinical photograph showing demarcation of anterior triple muscle pedicle bone graft. Arrow is at anterior superior iliac spine (ASIS)



**Figure 2:** Peroperative clinical photographs showing mobilization of muscle pedicle graft from anterior superior iliac spine

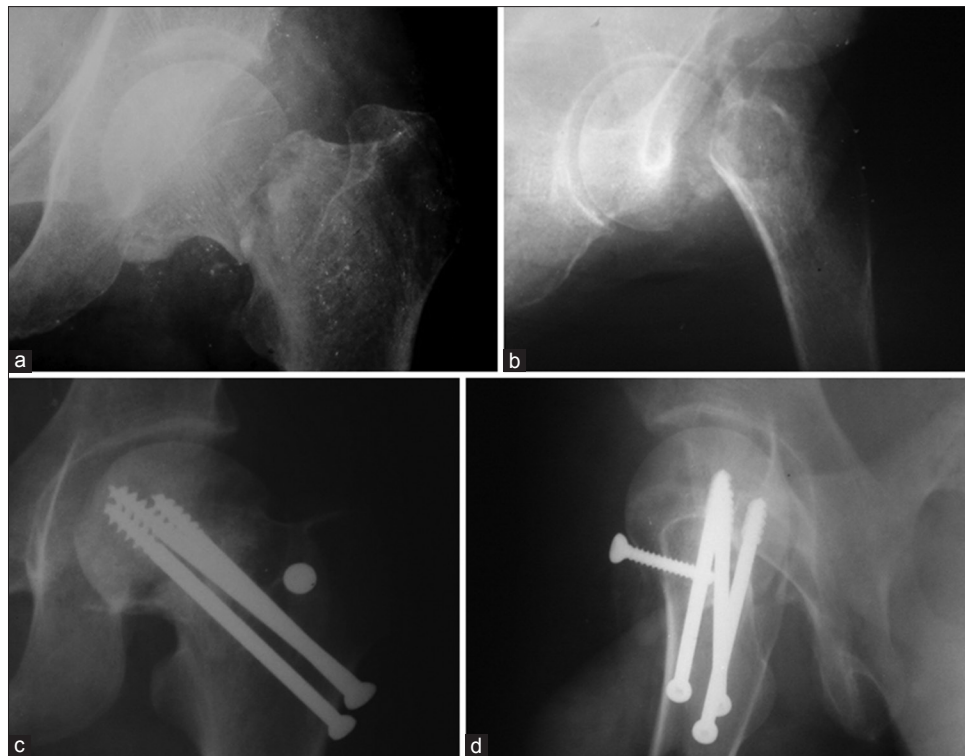
observing sponges and suction).<sup>10</sup> Mean time taken for full clinico-radiological union was 14 weeks (range 10-24 weeks, SD = 3). Clinically painless range of movements and radiological osseous union (obliteration of the fracture site) were taken as criteria of union. Limb length discrepancy occurred in all patients. In spite of achieving the femoral neck length by internal fixation and cortico-cancellous grafting, there was an average of 1 cm (range 0.5-1.5 cm) of shortening due to fracture collapse. Union was achieved in 34 out of 36 (94.4%) patients [Figure 3]. Amongst the united cases, 2 patients developed coxa-vara.

Nonunion occurred in two (5.5%) patients. Out of these 2 cases, one patient was managed by girdlestone excision arthroplasty and the second case was managed by hemiarthroplasty. Overall 5.5% ( $n = 2$ ) patients showed

**Table 1: Clinical details of patients**

Case	Age (in years)	Sex	Side	Mode of injury	Average delay (in days)	Followup (in years)	Shortening (in cm)	Union time (in weeks)	Garden type	Result
1	32	Female	R	RTA	54	4	1	11	III	Union
2	51	Female	R	RTA	78	3	0.5	24	IV	Union
3	34	Male	R	RTA	42	2.5	1	10	III	Union
4	15	Male	R	Slip	40	3.5	1.5	15	IV	Union
5	38	Female	R	RTA	44	3.5	1	13	IV	Union
6	40	Female	R	Fall	70	5	1	11	IV	Union
7	30	Female	R	RTA	68	5	1.5	16	III	Union
8	34	Female	R	Slip	66	4	1	16	III	Union
9	35	Male	R	Fall	65	3.5	0.5	20	IV	Union
10	44	Male	R	Slip	43	4	1	15	IV	Union
11	40	Female	L	RTA	41	5	1.5	14	IV	Union
12	50	Male	L	RTA	59	4	1.5	18	IV	Union
13	50	Male	L	RTA	54	4	1.5	13	III	Union
14	45	Male	L	Fall	55	3	1	10	IV	Union
15	38	Female	L	Slip	48	14	1.5	15	IV	Union in varus
16	32	Male	R	Slip	50	5	1	14	III	Union
17	30	Male	R	RTA	54	4	0.5	16	III	Union
18	43	Male	R	RTA	57	4	1	12	III	Union
19	44	Male	R	RTA	41	3	1	14	III	Union
20	42	Male	R	RTA	44	8	1	12	III	Union
21	40	Male	R	RTA	45	7	1.5	17	IV	Union
22	46	Male	L	Slip	49	4	0.5	12	III	Union
23	40	Male	L	RTA	56	5	1	20	IV	Union
24	43	Female	L	RTA	77	6	0.5	16	IV	Union
25	30	Female	L	RTA	71	4	1	14	IV	Union in varus
26	32	Male	L	Fall	66	4	0.5	16	IV	Union
27	34	Male	L	RTA	69	4	1	12	III	Union
28	30	Male	R	RTA	61	2	1	10	IV	Nonunion
29	50	Male	R	RTA	43	3	0.5	12	IV	Union
30	40	Male	R	RTA	55	3	1	13	III	Union
31	17	Male	L	RTA	59	5	1	12	IV	Union
32	30	Male	L	RTA	64	4	1	15	IV	Union
33	44	Male	R	RTA	55	4	1	14	III	Nonunion
34	46	Female	R	RTA	50	5	1	13	III	Union
35	38	Female	R	Fall	52	5	1	12	IV	Union
36	32	Male	R	Fall	55	5	0.5	18	III	Union

RTA=Road traffic accident



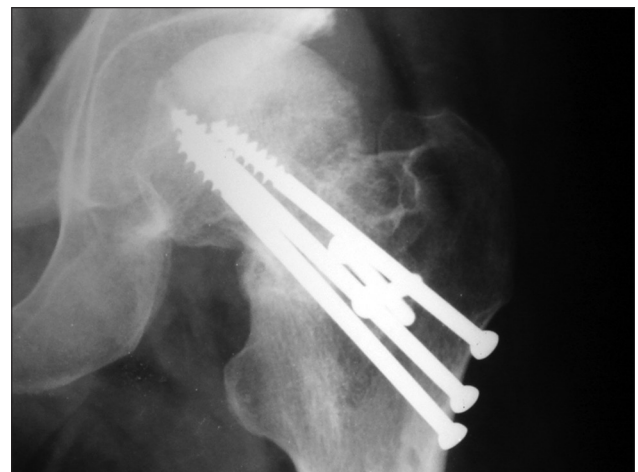
**Figure 3:** X-ray left hip joint (a) Anteroposterior view of 55 years old patients with 5 weeks old trauma showing fracture neck of femur (b) Lateral view of same patient showing old fracture neck of femur (c) Postoperative x-ray anteroposterior view after 14 weeks of followup of same patient showing implant *in situ* and union (d) Lateral view after 14 weeks of followup showing implant *in situ* and union

features of AVN of the femoral head (as assessed by plain radiography) of Ficat grade 2 [Figure 4], but they remained asymptomatic and fortunately both did not progress and revascularized at the end of further followup. Functional outcome analyzed by Salvati and Wilson score<sup>9</sup> showed excellent result in 17, good in 6, fair in 6, and poor result in 7 patients. All patients were advised to do abductor strengthening exercise. The abductor's power and trendelenburg test were assessed (objectively) in all cases in followup. Persistent pain and restricted range of movement was present in only two cases, in which nonunion occurred.

## DISCUSSION

Neglected femoral neck fracture in young adults always poses a formidable challenge. In our scenario, low socioeconomic status, remote location of medical facilities and illiteracy were the main reasons for the delay from injury to the index procedure. These fractures are notorious for complications like AVN and nonunion.<sup>11</sup> Resorption, osteopenia and proximal migration have also been contributory factors for nonunion, AVN and implant failure in management of neglected femoral neck fracture.

Initially conservative modalities were in trend for treating a femoral neck fracture. It was the Smith-Peterson who introduced the triflanged nail to fix the femoral neck



**Figure 4:** X-ray left hip joint anteroposterior view showing avascular necrosis changes in femoral head

fracture.<sup>12</sup> Later on Kings used the fibula as a strut graft to fix the femoral neck fracture, along with Smith-Peterson nail.<sup>13</sup> Realignment osteotomy converts the shearing forces into compressive forces which modify the mechanical environment and facilitate the union. Murray's, Blount and Dickson have analyzed the result of realignment osteotomy.<sup>14-16</sup> However the long term functional results of realignment osteotomy were found modest due to persistent pain, early osteoarthritis (which occur due to increase in contact pressure) and difficulty in replacement surgery after osteotomy.

Bone grafting has evolved as a modality to treat these fractures with predictable results in the long term. In this study our preference is anterior muscle pedicle bone grafting with internal fixation. Anatomical reduction, maintenance of neck shaft angle and articulo-trochanteric (i.e. neck length) distance along with augmentation of vascularity of neck of femur are the mainstay of treatments in neglected femoral neck fractures in young adults. Muscle pedicle graft provides further blood supply to the femoral head by acting as a vascular inlay graft, so it enhances the osteosynthesis if used along with internal fixation in neglected femoral neck fracture.<sup>17</sup> Quadratus femoris muscle pedicle graft was first time used by the Judet, to treat these fractures. Thereafter further encouraging result was published by Meyers *et al.* and Baksi by using similar methods.<sup>18-20</sup> Baksi stated that muscle pedicle graft hastens the osteosynthesis of ununited fractures even in the presence of AVN changes of the femoral head.

The study of Massie<sup>21</sup> reveals that the incidence of NU and AVN are directly proportional to the delayed treatment of displaced femoral neck fracture. In a study by Hirata *et al.* by using dynamic magnetic resonance imaging, they found that after 48 h of the femoral neck fracture there was absent perfusion in the femoral head in 19/36 patients, and among 19 patients, 10 succumb to AVN and rest 9 destined to NU.<sup>22</sup>

Liu *et al.*<sup>23</sup> treated the femoral neck fractures (fresh fractures) by an anterior approach to avoid further damage to the posterior blood supply. They used sartorius (single muscle pedicle bone graft) and Sartorius with Tensor fascia latae (double muscle pedicle bone graft) and found that double muscle pedicle bone graft has shown better results.<sup>23</sup> Our study seems better than this study because our all cases were neglected femoral neck fracture and included a greater no of cases.

In comparison to the posterior approach to the hip where the position of the patient is more cumbersome for the procedure, the mentioned anterior approach is relatively easier and posterior capsular blood supply is not hampered, as well as image intensification can be used easily. As we know that greater is the grade of the fracture greater is the posterior comminution and in our series, most of the patients (56%) were in grade four. So we assumed that anterior approach and triple muscle pedicle bone grafting (with corticocancellous bone grafting) probably would have better results. Our results are better than the results of muscle pedicle bone grafting procedures done by posterior approach.<sup>20,24</sup> Moreover our results are comparable to results of other series of muscle pedicle bone grafting done by an anterior approach.<sup>25</sup>

In literature, vascularized/nonvascularized bone grafting has been used for treatment modalities for osteosynthesis of neglected femoral neck fracture. Osteosynthesis done by vascularized fibula and iliac bone graft have given superior results, but they need meticulous microvascular surgery with which most of the orthopedic surgeons are not well versed, but on the contrary nonvascularized fibular graft surgery is a less technically demanding surgery. Moreover the study by Anderson and Green<sup>26</sup> have reported mild ache and ankle swelling as minor morbidities associated with partial fibular graft surgery.

Good results of vascular bone grafting are due to early revascularization and enhancement of the survival of marrow as well as osteogenic cells in the ischemic femoral head.<sup>27</sup> Our result of union (94.4%) is comparable to results of Nagi *et al.* (90%) and Sandhu *et al.* (88%)<sup>28,29</sup> but inferior than the vascularized bone graft surgery,<sup>30</sup> where the union rate is 100%.

In comparison to the developed countries where the western commode is compatible with a replaced hip joint, in our country the scenario is different, where it is habitual for most of the population to defecate in such a lavatory which entails the squatting position. Moreover squatting and cross leg sitting is of utmost important in our culture (i.e. during worship etc.) which needs a viable biological head in the acetabulum. So in such a situation, osteosynthesis becomes our prime goal to achieve mobile, painless, and stable biological hip joint.

To conclude triple muscle pedicle bone grafting is a very promising surgery for management of neglected femoral neck fracture in physiologically active patients. It promotes the healing and reduces the complications like AVN and NU. This procedure has predictable results and does not involve any special instruments or techniques.

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