Functional Outcomes of Superior Gluteal Nerve Injury After Nailing of Proximal Femoral Fractures

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Abstract

Background: Painful limbing after proximal femoral nailing is commonly noticed due to weakness of hip abductors. It may result from mechanical failure of the abductor muscle, malunion with coxa vara or valga, or injury of superior gluteal nerve (SGN).

Objectives: To estimate incidence of SGN injury after hip proximal femoral nailing and investigate its correlation with hip functional outcomes.

Patients and methods: This retrospective study was conducted on 20 patients presented to Qena university hospital during the time from (July 2018) to (July 2019) with abductor lurch after proximal femoral nailing for more than 3 months.

Results: No statistically significant correlation between operated and non-operated sides in terms of functional score and neck shaft angle. There was a statistically significant correlation between muscle power, neck shaft angle and Harris Hip Score (HHS) with evidence of patients with MRC scale less than V and patients with abnormally high or low neck-shaft angle had significantly lower functional scores. Two patients had SGN injury with significantly lower functional scores with SGN injury compared to patients with normal EMG.

Conclusion: SGN injury is a rare complication after nailing of proximal femoral fractures associated with poor functional outcomes.

Keywords: Proximal femoral fracture (PFFs); Proximal femoral nailing (PFN); Superior gluteal nerve (SGN).

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Introduction

Proximal femoral fractures (PFFs) are common with advancing age. Proximal femoral nail (PFN) is now increasingly used to fix unstable fractures. Studies have demonstrated that muscle strength deficit is significantly high after PFFs **(Carneiro et al., 2013).**

Boldin et al. (2003) found that hip muscle isometric strength for the fractured leg was significantly decreased one week and 6 months postoperatively. Besides, abductor weakness and trendelenburg gait are common in patients treated with PFN, but this complaint is often overlooked. Although significant improvement in muscle function after at least 6 months of physiotherapy was demonstrated by previous studies **(Burnet and Pidcoe, 2009)**, some patients still suffer from residual abductor lurch postoperatively. we postulated that injury to superior gluteal nerve (SGN) would contribute significantly to hip abductor dysfunction. Thus, we aimed to determine incidence of SGN injury after PFN and its correlation with patients' clinical outcomes.

Patients and methods

Study design

This study is an observational retrospective study conducted on 20 patients presented to Qena university hospital between (July 2018) and (July 2019) with abductor lurch after PFN for more than 3 months postoperatively.

Inclusion criteria: Patients above 40 years old with abductor lurch as a complication for proximal femoral nail with fully united fracture.

Exclusion criteria: Patients with neurological disorders preoperatively as hemiplegia, poliomyelitis, patients with delayed union or non- union, patients with muscle dystrophic diseases (myasthenia gravis), patients with gait abnormality, pathological fractures, polytraumatized patients and patients who refused to participate in the study.

Clinical examination

1) Harris hip score (HHS).
2) Medical Research Council (MRC) scale.
3) Trendelenburg gait: assessed using modified McKay criteria. These criteria measure pain symptoms, gait pattern, Trendelenburg sign status, and the range of hip joint movement.

Radiological evaluation

1) Fracture union.
2) Neck shaft angle: the angle between the femoral neck axis and the anatomical axis of the proximal femur.

Neurological evaluation

Electromyography (EMG) was carried out to examine the SGN for all patients.

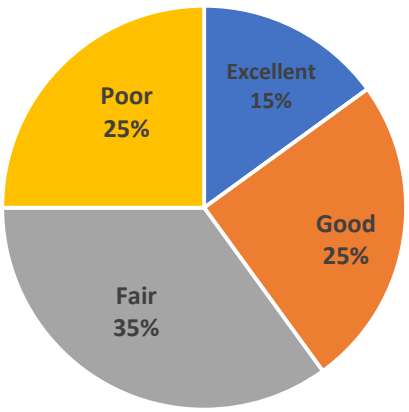
Results

HHS was used to evaluate patients' functional outcomes. The average score of the operated limb was 75 ± 10, ranged from 70 to 85, while the average score of the non-operated side was 80 ± 7, ranged from 75 to 90. There was no statistically significant difference between both sides in terms of functional score (P > 0.05). (**Table.1**) Forty percent of patients had satisfactory outcomes (15% excellent and 25% good). Sixty percent of patients had unsatisfactory outcomes (35% fair, and 25% poor). (**Fig.1**).

Table 1: Functional outcomes (N=20)

Harris hip score	Value	Range
Operated side	75 ± 10	65 – 85
Non-operated side	80 ± 7	75 - 90
P value	0.342	

Figure 1 Harris Hip Score



Patients with MRC scale less than V had poor functional results. Significant correlation was found between muscle power and HHS (correlation coefficient 0.6, P value < 0.05).

The distribution of HHS differed significantly among patients with normal neck shaft angle, patients with coxa vara, and coxa valga (P < 0.05). Patients with abnormally high or low neck-shaft angle had significantly lower functional scores as shown in (**Table.2**).

Table 2: relation between HHS and neck shaft angle (N=20)

Neck Shaft Angle	Mean ± SD	Range	P value
Normal	80 ± 2	79 – 85	0.004
Coxa Vara	70 ± 3	65 – 75	
Coxa Valga	72 ± 2	68 – 74	

Two patients showed evidence of SGN injury in terms of abnormal EMG. HHS was significantly low in patients with SGN injury compared to patients with normal EMG (P value < 0.05) as demonstrated in (**Table.3**).

Table3.Relation between HHS and EMG (n=20)

EMG	Mean ± SD	Range	P value
Normal	82 ± 3	78 – 85	0.001
Acute denervation	67 ± 4	65 – 75	

Discussion

Our series included 20 patients who underwent proximal femoral nailing among the 20 patients, 11 patients were males, while nine patients were females representing 55% and 45% respectively in opposite to **(Sonmez et al., 2017)** who has 34 patients with female predominance 62 % and Nitin wale et al. who has 65 patients.

On the other hand the mean age in our study is 67.5 years which is lower than that noticed in other studies e.g. **(Sonmez et al., 2017)** in their study the mean age is 82 years.

Analyzing the mechanism of injury in the current study revealed that four different mechanisms of injury. 30 % of the patients presented with simple fall to the ground at home. This is in agreement with the mechanism of injury reported by which shows **(Gadegone and Salphale, 2007)** 35% of the fractures were due to domestic falls. Whether 25% of the patients fell from height, 25% had direct trauma, and 20% had road traffic accidents.

Fifty percent of patients had associated comorbidities. Five (25%) patients were hypertensive, three (15%) were diabetic, one patient had COPD and one patient had cardiac problems.

In our study, all patients were evaluated for abductor muscle power and Trendelenburg sign. Muscle power was assessed using MRC scale. The average score was 4 ± 1 (range 1-5). Eight (40%) patients had full abductor muscle power with negative Trendelenburg sign.

On the other hand, twelve (60%) patients experienced abductor muscle weakness and positive Trendelenburg sign. One (5%) patient was grade I, three (15%) patients were grade II, five (25%) patients were grade III, and three (15%) patients were grade IV in comparison of our results with results of **(Sonmez et al., 2017)** who show that Muscle strengths according to the MRC were 2 in one patient, 3 in two patients, and 5 in 22 patients.

On the other hand Immediate Postoperative muscle power was evaluated by **(Lowe et al., 2012)** show that Grade 1 (02 pt.), Grade 2 (27 pt.), and Grade 3 (14 pt.). Most of the patients improved their muscle power grade at 12 weeks with only 02 patients with Grade 3 and 04 patients with Grade 4 power. At 6months follow up only 02 patients had grade 4 power (due to varus malunion) rest all had muscle power Grade 5.

Functional evaluation of our patient postoperative by Harris Hip Score patients show that the average score of the operated limb was 75 ± 10, ranged from 70 to 85, while the average score of the non-operated side was 80 ± 7, ranged from 75 to 90. There was no statistically significant difference between both sides in terms of functional score ($P > 0.05$). Forty percent of patients had satisfactory outcomes (15% excellent and 25% good). Sixty percent of patients had unsatisfactory outcomes (35% fair, and 25%

poor). At the last follow-up, clinical assessment after treatment of the fracture was done using Harris hip score with excellent and good scores accounted for 85% of cases, comparable to that reported by studies of **(Gadegone and Salphale, 2007)** where excellent to good results were seen in 82%, In Harish Kumar jain (135) excellent to good results in 83%.

Radiological evaluation of our patients showed that the average neck shaft angle of the operated side was 127 ± 5, ranged from 110 to 140. The non-operated side had a mean neck shaft angle of 126 ± 2, ranged from 120 to 135. We found no statistically significant difference in neck shaft angle between operated and non-operated sides (P > 0.05). Ten (50%) patients had a neck shaft angle within normal range, while 8 (40%) patients had coxa vara and 2 (10%) patients developed coxa valga **(Herman et al., 2012).**

In study done by **(Sonmez et al., 2017)** the mean neck shaft angle was 131.44° (125-140). Eight patients were walking with support in daily life, of whom only three had positive Trendelenburg sign.

Only two patients showed abnormal EMG demonstrating evidence of SGN injury. Harris Hip Score was significantly low in patients with evidence of superior gluteal nerve injury compared to patients with normal EMG (P value < 0.05).

Previous studies reported on factors contributing to SGN injury during nail insertion. **(Ansari Moein et al., 2005)** introduced an antegrade femoral nail in ten cadavers lying in the supine position. In two of them, the inferior branch of the SGN was found to be at high risk of injury, being <5 mm from the surgical incision in the gluteus medius. A safe area was described by **(Jacobs and Buxton, 1989)** 5 cm proximal to the tip of the greater trochanter. The optimal portal of nail insertion to minimize risk of SGN injury is still controversial. According to **(Khan and Knowles, 2007)**, using the greater trochanter tip as an entry point may reduce the risk of damage to these nerve branches. These results were consistent with another clinical study by **(Ansary Moein et al., 2011)** where five patients in the piriformis fossa group had an abnormal EMG with evidence of acute injury of the SGN directly after operation followed by reinnervation.

Conclusion

The estimated overall incidence of unsatisfactory hip function after Nailing of proximal femoral fractures is 60%. SGN injury is considered a rare contributing factor associated with unfavorable functional results.

Ethical approval

The study protocol was approved by Ethical Committee of Faculty of medicine, South Valley University and written informed consent was taken from each patient.

Conflict of interest

The authors of the study have no conflict of interest related to this publication.

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