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Evaluation of neck shaft angle achieved immediately after surgical fixation of intertrochanteric fracture

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Abstract

Background: The angle between femur neck and the long axis of shaft is known as neck shaft angle which plays vital role in stability, control of lateral balance, walking and hip movements. The main goal was to compare the NSA in intertrochanteric fracture of femur immediately after the surgical fixation using either Dynamic Hip Screw or Proximal Femoral Nail. In the elderly among all of the hip fractures approximately half are intertrochanteric fractures and out of which approximately 50% of fractures are unstable.

Method: X-ray of pelvis with both hips was taken prior to fixation and after fixation, done either with PFN or DHS and morphometric measurements were taken.

Result: The mean neck shaft angle restored after fixation with PFN (131.10 ± 7.24 degree) was almost similar to that of normal side (129.58 ± 5.79 degree) whereas it was more with DHS (141.65 ± 9.78 degree).

Conclusion: Restoration of Anatomical NSA is more achievable with PFN as compared to NSA.

Keywords: Neck shaft angle, intertrochanteric fracture, proximal femoral nail, femur

Introduction

The angle between femur neck and the long axis of shaft, NSA, is known as "neck shaft angle," "femoral carrying angle", "angle of inclination," "cervico-diaphyseal angle", and "collo-diaphyseal angle". NSA plays vital role in stability, control of lateral balance; walking and hip movements^[1]. According to a study on Indian population average femoral NSA is approximately 135 degree. Coxa-valga is defined as a condition with NSA of more than 135 degree whereas angle less than 120 degree is defined as coxa-vara^[2]. High velocity trauma is one of the commonest causes trochanteric fractures in the younger population, whereas often a trivial trauma results in trochanteric fractures in the elderly population. Trochanteric fractures are more common in the female population compared to the male due to osteoporosis^[3]. The dynamic hip screw (DHS) is one of the most widely used and successful implants for the treatment of stable intertrochanteric fractures with the controlled sliding and collapse concept. "Boyd and Griffin, in 1949, classified proximal femur fractures into Stable (two parts), Unstable comminuted, unstable reverse obliquity and Unstable intertrochanteric with sub trochanteric extension. Intertrochanteric fractures are defined as "Fractures occurring in the region extending from the extracapsular basilar neck region to the region along the lesser trochanter proximal to the development of the medullary canal"^[4]. Two primary options for treatment of intertrochanteric fractures are intramedullary fixation and extramedullary fixation. For extramedullary fixation, dynamic hip screw (DHS) is one of the most commonly use device and now become a standard implant in management of these types of fractures. For intramedullary fixations proximal femoral nail (PFN) and Gamma nail are the two commonly used devices. It has been observed that varus angulations and medial collapse at the fracture site usually occurs with loss of fixation. The main goal of this study is to compare the NSA in surgically fixed intertrochanteric fracture of femur immediately after the surgical fixation.

Method

This prospective study included all the patients admitted in Orthopedics ward which are diagnosed clinically and radiologically as a case of Intertrochanteric Fracture.

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Routine investigations and pre anesthetic checkups was done and surgery carried out under general or spinal anesthesia. Clinical and radiological examination was conducted immediately, post operatively.

Place and Duration of Study

Study was carried out at the Department of Orthopedics, at SHRI MAHANT INDIRESH HOSPITAL from October 2020 to May 2022. It included 105 patients above 20 years of age with unilateral Intertrochanteric fractures. Patients with all diseases or fractures which affect the NSA were excluded.

Procedure

X-ray of pelvis with both hips Antero-posterior view was taken prior to fixation and after fixation of fracture done

either with Proximal Femoral Nail or dynamic hip screw using standard protocol with a film-focused at a distance of 100 cm, and beam centered on symphysis pubis with hips in 15 degrees of internal rotation in the supine position. Fracture classification was done on the basis of BOYD & GRIFFIN classification for intertrochanteric fractures pre-operatively. Morphometric measurements were done on Digital X-ray. NSA on non-operated limb was measured during admission in ward. NSA on the operated limb was measured immediately after surgical fixation of intertrochanteric fracture. The data was analyzed with SPSS software version 20.0. Interpretation and analysis of obtained results was carried out using descriptive statistics. Student T-Test was used for comparison of various parameters pertaining to continuous data.

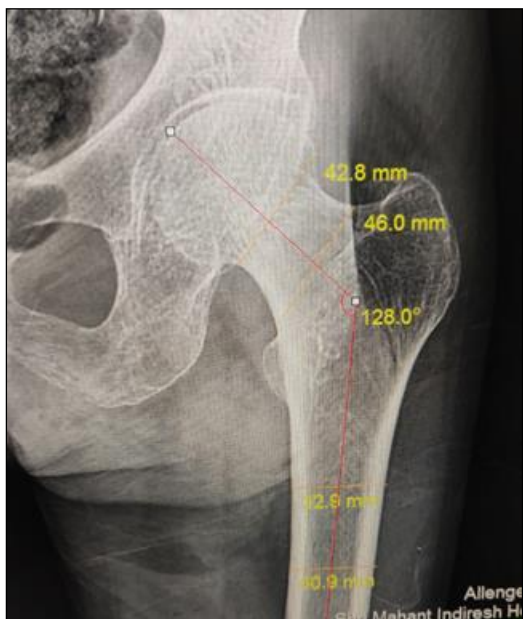


Fig 1: Illustration of measuring Neck Shaft Angle of Femur in Normal Hip

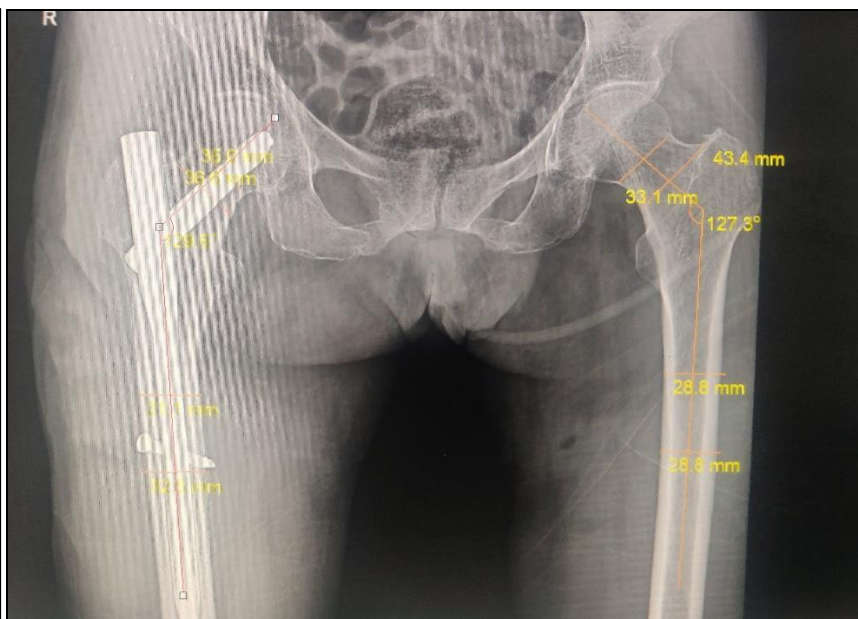


Fig 2: Illustration of Neck Shaft Angle of Femur in Post op X-ray

Results

There were 15 cases (14.29%) which underwent fixation with Dynamic Hip screw and 90 case (5.71%) which underwent fixation with Proximal Femoral nail. There was a female predilection in the study with 67.6% cases. On comparing mean and standard deviation values, the mean neck shaft angle of normal side is 129.65 ± 5.76 degree and that of the operated side is 132.56 ± 8.42 degree. It was seen that the operated side showed increase in the neck shaft angle. The one-way t-test signifies P-value 0.001 which was statistically significant.

Table 1: Mean neck shaft angle of normal side and operated side after dynamic hip screw fixation of intertrochanteric fracture.

Side	Mean	SD	SEM	P-Value	Significance
Non operated	130.12	5.76	2.52	0.001	Significant
Operated	141.65	9.78	1.48		

Table 1: Showing the difference in the mean neck shaft angle of the normal side (130.12±5.76 degree) and the operated side (141.65±9.78degree) after DHS in intertrochanteric fracture with the p value 0.001. Table 2. Mean neck shaft angle of normal side and operated side after proximal femoral nail fixation in intertrochanteric fracture.

Table 2: Showing the mean neck shaft angle of normal side (129.58 ± 5.79 degree) and operated side after proximal femoral nail fixation (131.10 ± 7.24 degree) in intertrochanteric fracture with p value 0.04

Side	Mean	SD	SEM	P-Value	Significance
Normal NSA	129.58	5.79	0.61	0.04	Significant
Operated NSA	131.10	7.24	0.76		

The mean neck shaft angle of the normal side was 128.19 ± 5.49 degree and the mean neck shaft angle of operated side was 132.22 ± 8.35 degree in males with p value 0.004 which was statistically significant.

The mean neck shaft angle of the normal side was 130.35 ± 5.79 degree and the mean neck shaft angle of operated side was 132.72 ± 8.51 degree in females with p value 0.02 which was statistically significant

Discussion

Intertrochanteric (IT) fractures are commonly seen in elderly population with osteoporosis. Early and adequate fixation is very important in these patients so as to mobilize them at earliest and prevent complications of recumbence. Surgical anatomy of proximal femur with special reference to trabecular pattern is important aspect while dealing with I.T. fractures. Implant-bone mismatch could result in an unnecessary removal of bone stock in order to fit a particular implant. Other than the relatively larger size of implants,

other parameters such as the neck shaft angle, neck length and width were also reported to be different.

In the present study, the statistical analysis showed the mean neck shaft angle of normal side 130.12 degree and angle restored after Dynamic Hip Screw fixation (DHS) was 141.6 degree. The mean neck shaft angle of normal side was 129.58 degree and angle restored after Proximal Femoral Nail (PFN) was 131.104 degree which is in co-relation with the results of the study conducted by J. Pajarien *et al.*,^[5]. They concluded similar result where they measured from the uninjured and injured hip in 48 patients with a per-trochanteric femoral fracture treated with the Dynamic Hip Screw (DHS) or the Proximal Femoral Nail (PFN). Their mean neck shaft angle of normal side was 128.0 degree and angle restored after DHS was 134.5 degree. Their mean neck shaft angle of normal side was 125.5 degree and angle restored after PFN was 125.3 degree. The most important finding of the present series was that the mean neck- shaft angle decreased in both treatment groups. This decrease was more distinct in the DHS group, but the difference in patients treated with the PFN was not significant.

In a study conducted by MJ. O'Malley *et al.*, the mean neck shaft angle of the normal side was 133 degree and angle restored after intramedullary hip screw fixation was 129 degree. Our results are not at variance from their study. It might be due to the anatomical variations in different population.

In another study conducted by Barwar N *et al.*, showed that there is a high incidence of coxa vara or coxa valga in fixation with standard dynamic hip screw and restoration of neck shaft angle could often not be achieved. Our results are comparable with their study.

In a study conducted by SJ. Lin *et al.*, in 25 patients the pre-operative average neck shaft angle was 139 degree (ranging from 135-141 degree) and postoperative average neck shaft angle achieved was 130-degree (Range: 122-135 degree) after fixing with the Less Invasive Stabilizing System (LISS).

In another study conducted by A. Tucker *et al.*, in 77 patients the pre- operative mean neck shaft angle was 132.97 ± 7.78 degrees and post-operative mean neck shaft angle was 126 ± 8.62 degrees after using Martin's plate.

The design of hip implant has evolved drastically as lessons were learnt from the many and various post-surgical complications. The information on proximal femoral NSA presented in this study could be used as a guideline to design a more suitable implant for the Indian population, which covers most South East Asian countries".

Limitations of the study

COVID-19 pandemic vastly affected the number of patients reporting to the hospital, surgical intervention and subsequent follow-up of the patients.

Conclusions

There was no significant difference in the neck shaft angle of males and females. The mean neck shaft angle of the normal side in our population is 129.65 ± 5.76 degrees which is less in comparison to the neck shaft angle of 130 ± 5 degrees as described for western population in a text book of Rockwood and Green's Fractures in Adults (2nd volume, 8th edition, 2014, page 2040). The mean of the neck shaft angle restored after fixation of the intertrochanteric fracture with Proximal Femoral Nail was almost similar to the mean of the neck shaft angle of the normal side. The mean of the neck shaft angle restored after fixation of intertrochanteric fracture with

standard Dynamic Hip Screw was more as compared to the mean neck shaft angle of the normal side.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee.

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