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EFFECT OF FEMORAL NECK LENGTH RESTORATION ON FUNCTIONAL OUTCOMES OF PATIENTS WITH INTERTROCHANTERIC FRACTURES: A COMPARISON BETWEEN DYNAMIC HIP SCREW AND PROXIMAL FEMUR NAIL

Orthopaedics

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ABSTRACT

Intertrochanteric fracture occurring in osteopenic bone is the most common type of proximal femur fracture in old age. Neck length collapse is associated with improper fixation leading to shortening and impaired abduction mechanism. We followed up a cohort of 206 patients for a period of 4 years. The patients were classified into two groups, Dynamic Hip Screw (DHS) and with Proximal Femoral nailing (PFN) techniques. Harris Hip Score and sequential radiographs were used to compare functional outcome and degree of femoral neck collapse respectively between groups. DHS group had a higher degree of Moderate (24.04%) as well as Severe (18.27%) collapse as compared to the PFN group which had a 18.62% of Moderate and a 6.86% of Severe collapse. Using Harris Hip Score, higher percentage of Excellent outcomes (58.82%) were observed in PFN group compared to DHS group (11.54%). Our findings indicate that the PFN is a superior implant than DHS as far as restoring the femoral neck length is concerned and correspondingly provide much better functional outcomes. This also shows that restoring femoral neck length is in general associated with better functional outcomes in patients suffering from intertrochanteric fracture.

KEYWORDS

femoral neck length, intertrochanteric fractures, dynamic hip screw, proximal femoral nail.

INTRODUCTION

Femoral neck is a cylindrical structure connecting head and shaft at an angle of 130 (+/- 5 degree) in anteverted position of 5 to 15 degree.[1-4] Greater and lesser trochanters are the protuberances at proximal femur having attachment of muscles of hip joint. Intertrochanteric crest is the bony ridge connecting the two trochanters posteriorly. Trabeculae arranged in the neck offers tensile strength among which primary tensile, principal compressive, secondary compressive and secondary tensile trabeculae keep the joint stable.[3,4] Intertrochanteric fracture is the most common type of proximal femur fracture.[5] Factors associated with this type of fracture include sex, age, increased comorbidity, less ambulatory activity etc.[5-7] Most of the cases (around 95%) are associated with a simple fall from height leading to trauma over Greater trochanter.[7] Postero-medial bony contact is the cornerstone in stability in IT fracture[8,9] depending on which Evans classification isolates stable and unstable type of fracture. The Boyd and Griffin classification[10] differentiates IT fractures on the basis of extension of fracture line and degree of comminution. The widely accepted AO/OTA classification[11] has been utilized in this study. Implants designed for fixation allow controlled collapse and sliding which results in improved bony contact and union.[12] Dynamic Hip screw is the widely accepted implant of choice for stable type Intertrochanteric fracture (AO /OTA type 31.A1 and A2). On the contrary, cephalo-medullary nail such as proximal femoral nail gives good result in unstable type of fracture (AO/OTA type 31.A3).[16-18] Neck length collapse is associated with improper fixation leading to shortening and impaired abduction mechanism due to alteration of lever arm.[14] Significant collapse (>10 mm) causes poor post-operative functional outcome, delayed ambulation which may increase morbidity particularly in aged population.[14-15]

The degree of collapse of femoral neck is measured in case of DHS and PFN by amount of sliding of the screw in follow up radiographs taken in antero-posterior view of hip joint with femur which has been standardized with magnification index in comparison with immediate post-operative radiograph.[18,19] In some cases where magnification index is not applied it is measured by comparing the diameter of barrel of DHS plate in x-ray view with original diameter and multiplying the collapsed length in x-ray with the factor derived from the aforesaid ratio.[20,21] In case of Proximal Femoral nailing same method is followed except that instead of Richard screw the distal neck screw (8 mm) is used. Neck length collapse has been classified as mild (<5mm), moderate (5-10mm), severe (>10mm) and the result grouped according to that.[22]

Fig. 1. AO/OTA Classification for Intertrocanteric Fractures

AIMS AND OBJECTIVES:

To prove that-

1. Restoration of femoral neck length in intertrochanteric fracture fixation is associated with improved functional outcomes.
2. Proximal femoral nail is a better implant to restore the femoral neck length as compared to dynamic hip screw.

3. To prove that Proximal femoral nailing in intertrochanteric fractures has better functional outcomes than dynamic hip screw surgery.

MATERIALS AND METHODS:

The study was conducted in a prospective manner with following criteria for cohort selection:

Inclusion Criteria imposed were,

1. Age >/= 60 years
2. AO/OTA type 31.A1, A2, A3
3. Anesthetically fit
4. No neurovascular deficit prior to fracture
5. No Pathological fracture
6. Patients with isolated unilateral intertrochanteric fracture

Exclusion criteria used were,

1. Age < 60 year
2. Not AO/OTA Type 31.A1, A2, A3
3. Anesthetically unfit
4. Patients with any neurovascular deficit pre-operatively
5. Pathological fracture
6. Patients with poly-trauma with multiple fractures including bilateral intertrochanteric fractures
7. Patient managed with Hemi/ Total Hip arthroplasty for intertrochanteric fractures
8. Patients lost to follow up
9. Patient developing infection at operative site needing implant removal/revision surgery

We followed up a cohort of 206 patients (82 males and 124 females) with the above mentioned specifications operated in between January 2014 to January 2017 who were operated by DHS or by PFN and followed up in OPD basis. The implant choice during surgery was according to the surgeon's preference. Closed manipulation under anaesthesia was done in a fracture table for PFN. Intramedullary nail (9-12 mm diameter) was fixed proximally by lag screw (8.00 mm size of length varying from 70 to 100mm) and a derotation screw(Hip pin 6.4 mm length varying from 60 mm to 85 mm) and distally by locking 4.9 mm bolt. Dynamic Hip screw was fixed under open reduction technique in a standard fracture table under anaesthesia by using 4 to 8 hole plate (short/long barrel) from 125 to 135 degree with Richard screw with length varying from 75 mm to 100 mm. For all the cases Tip Apex Distance was measured to be < 10 mm. The study was carried out prospectively with review of the pre-op, immediate post-op and follow up radiographs taken at the end of 1, 3, 6 months and further till union of fracture. The degree of fracture collapse was determined by comparing the immediate post-operative x ray with that of a 6 month follow up x ray. The observed collapse was categorized as Mild (<5mm), Moderate (5-10mm) and Severe (>10mm). The observed collapse was calculated as a mean of 3 readings done independently by three orthopaedic surgeons to rule out inter-observer bias.

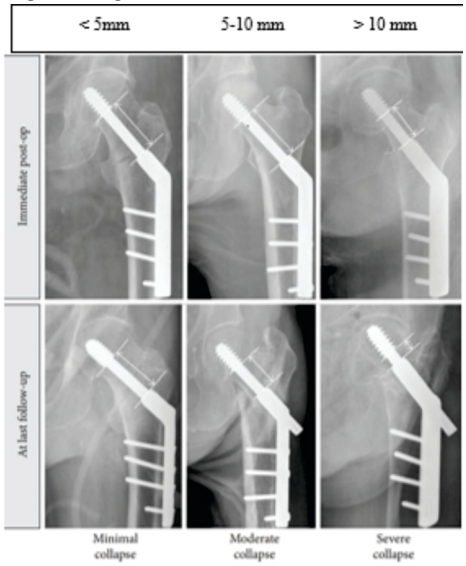


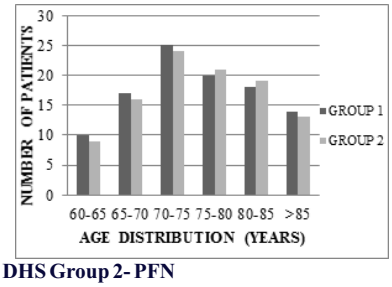
Fig 2. Measuring and Classifying Neck Collapse on a Plain Radiograph

The functional outcome was determined using the standard Harris Hip Score. The Harris Hip Score was categorized as Poor (<70), Fair (70-79), Good (80-89) and Excellent (>90) for better comparison. The interviewer who assessed the patients was blinded as to the operative procedure used in the patients in order to rule out any selection or observer bias. The patients were classified into two groups, Group 1 comprising of those patients managed with Dynamic Hip Screw and Group 2 comprising of those managed with Proximal Femoral nail. These two groups were then compared for degree of collapse as well as functional outcome using Harris Hip Score and the findings co-related by a team which was blinded as to which group comprised of which implant.

DEMOGRAPHICS:

The total sample size was 206. Group 1 included 104 patients while Group 2 included 102 patients. As per the exclusion criteria, only patients more than equal to 60 years of age were included in the study. These fractures when presenting in the younger patients are usually associated with co morbidities which can act as confounding factors in the outcomes. Age distribution of the patients is given in Chart-1.

Chart-1 Age Distribution Of Cohort



***Group 1- DHS Group 2- PFN**

The sample included 82 males and 124 females found to be consistent with the demographics of intertrochanteric fractures. Sex distribution of the patients is given in Table-1.

Table-1 Sex Distribution

SEX DISTRIBUTION	GROUP 1	GROUP 2
MALE	45 (43.27)	37 (36.27)
FEMALE	59 (56.73)	65 (63.72)
TOTAL	104	102

*Figures in brackets indicate percentages

The patients presenting to our setup predominantly had two modes of trauma, fall (including fall from height as well as fall due to slipping) and road traffic accident (RTA). Table-2 shows the distribution of the patients according to mode of trauma.

Table-2 Mode Of Trauma

MODE OF TRAUMA	GROUP 1	GROUP 2
RTA	9 (8.65)	15 (14.70)
FALL	96 (92.31)	87 (85.29)
TOTAL	104	102

*Figures in brackets indicate percentages

It shows that a total of 183 out of 206 (88.84%) patients included in the study had fall as a mode of trauma as compared to only 23 (11.16%) reporting RTA as mode of trauma. This was very low because poly-trauma which was an exclusion criteria. Table no 4 shows the distribution of AO/OTA classification of fractures.

Table-3 AO Classification Of Cohort

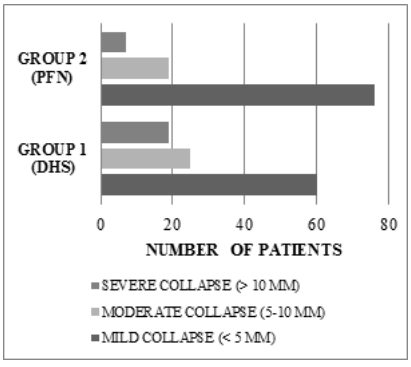
AO CLASSIFICATION	GROUP 1	GROUP 2
A1	28 (26.92)	31 (30.39)
A2	49 (47.11)	53 (51.96)
A3	27 (25.96)	18 (17.64)
TOTAL	104	102

*Figures in brackets indicate percentages

This distribution implies that of the three types of AO/OTA fractures included in the study A2 type was the most common (102 out of 206, roughly 49.52% of the total).

RESULTS:
Our study was a prospective cohort study in which we followed up a total of 206 patients with intertrochanteric fractures presenting to our institute over a span of 4 years starting from January 2014 to January 2018. Patients were classified into two comparable groups. Group 1 included patients with intertrochanteric fractures of the femur operated with DHS screw (Sliding Hip Screw) while Group 2 included patients treated with Short Proximal Femoral Nail (PFN). Chart 2 shows the comparative study of the radiological collapse of the femoral neck.

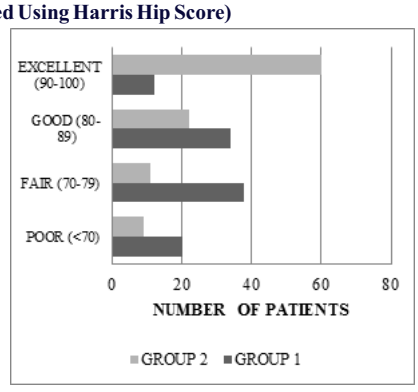
Chart-2 Radiological Outcomes Of Fixation At 6 Month Follow-up (measured Using Femoral Neck Collapse)



The DHS group had a higher degree of moderate (24.04%) as well as severe (18.27%) collapse as compared to the PFN Group which had 18.62% of moderate and a 6.86% of severe collapse. The difference was more prominent in the severe collapse category with the DHS group (18.27%) reporting significantly higher values as compared to the PFN group (6.86 %). In the Mild collapse category PFN group reported higher values (72.38%) as compared to the DHS group (57.69%). It was worthwhile to note that, in the mild collapse category, about 80% of the PFN group patients had a collapse of less than 3mm with 60% of the DHS group reporting collapse in the 3-4 mm range.

Next, we compared the Harris Hip Score in the two groups to compare them in terms of functional outcomes (Chart-3). Even in this category, the PFN group reported a higher percentage of Excellent (58.82%) outcomes as compared to the DHS group (11.54%). On the other extreme, the DHS group reported a very high Poor Harris Hip Score (19.23%) as compared to the PFN Group(8.82%). Now, if we compare the two charts, we see that the trends indicate that PFN restores the femoral neck length much better than the DHS and also has correspondingly more Excellent functional outcomes.

Chart-3 Functional Outcomes Of Fixation At 6 Month Follow-up (measured Using Harris Hip Score)



DISCUSSION:
Surgical management is the best modality of management of intertrochanteric fractures. There are mainly two accepted fixations in intertrochanteric fractures, which are plate fixation and intramedullary nailing.[15-17] The Dynamic Hip Screw with plate and the Proximal Femoral nail are presently the most commonly used.[18-21]

Dynamic hip screw (DHS) was the standard implant used in fixation of intertrochanteric fractures.[13-17] DHS has a biomechanical disadvantage because of a wider distance between the weight bearing axis and the implants.[22] DHS was relatively contraindicated in view of its extensive surgical dissection, blood loss and surgical time required for this procedure.[16-20] The implant also fails in extremely unstable and the reverse oblique fractures.

The long PFN offer certain distinct advantages[16-20]:
1. The implant acts as a buttress against lateral translation of the proximal fragment.
2. The implant is stronger at resisting the bending force due to the intramedullary location of nail and lag screw junction.
3. It has a shorter lever arm.
4. It is a load sharing device.
5. It is a more biological method of fixation than DHS.

The proximal femoral nail (PFN) has become the standard of care in treating trochanteric fractures.[13-16] Although there were several reports showing benefits of proximal femoral nail[16-20], it was still associated with technical failures in the past.[24-26]

Werner-Tutschku et al.[18] have already shown that complications during intra-operative period and post-operative period were more frequently associated with DHS as compared to the PFN with fixation in varus being more likely in the case of DHS. Nuber S et al[19] and Zhang et al.[28] in their study also found PFN to be a superior implant than DHS and recommended PFN in fixation of comminuted Intertrochanteric fractures. Pajarinen J et al[20] also found that PFN patients could return back to functional efficiency faster than those operated with DHS which could be related to the minimally invasive nature of the surgery causing minimal soft tissue injury. Zhao C et al [29] also found that PFN was a superior implant than DHS in unstable fractures.

Our findings are also in agreement with the above studies, leading us to conclude, that PFN is a superior implant than DHS as far as restoring the femoral neck length is concerned. The PFN Group has better functional outcomes using the Harris Hip Score as an instrument of comparison. The results also show that restoring femoral neck length is in general associated with better functional outcomes in patients suffering from intertrochanteric fractures.

CONCLUSION:
Our demographic data indicates that the epidemiology of intertrochanteric fractures in India co-relates to that of the West. The age and sex distribution recorded in our study mimics that mentioned in the standard western texts. From the radiological data, we can conclude that PFN better restores the femoral neck length as compared to the DHS and is correspondingly associated with better functional outcomes in patients suffering from intertrochanteric fractures of the femur. Our data also leads us to believe that restoration of femoral neck length can be a good indicator of improved functional outcomes following fixation of intertrochanteric fractures of the femur.

INDICATIVE XRAYS:
CASE 1:
68 year old male had a fall from height; managed with proximal femoral nail.

PRE-OP XRAY

IMMEDIATE POST-OP XRAY

6 MONTH FOLLOW-UP XRAY

CASE 2: 74 year old female had a fall from standing height; managed with dynamic hip screw

PRE-OP XRAY

IMMEDIATE POST-OP

6 MONTH FOLLOW-UP XRAY

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