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A comparative study of surgical management of intertrochanteric fractures using dynamic hip screw (DHS) and proximal femoral nail (PFN)

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Abstract
Intertrochanteric fractures are common fractures seen in patients over 60yrs of age, mostly due to trivial trauma. Incidence has increased primarily due to increasing life span & more sedentary life style brought by urbanization. As conservative methods resulted in higher mortality rates and complications, Stable Internal fixation and early mobilization has been the standard method of treatment. DHS with side plate assembly is most commonly used device for fixation of intertrochanteric fractures, The latest implant for management of intertrochanteric fracture is PFN. This implant is a cephalomedullary device and has many potential advantages. In view of these conditions, this study is taken up to compare the results of DHS and PFN in the treatment of intertrochanteric fractures. Studies have shown that when compared to DHS, PFN had certain advantages.
Aims and objectives: To compare surgical treatment of intertrochanteric fractures of femur with PFN and DHS with respect to fluoroscopic time, duration of surgery, post operative shortening and functional outcome.

Keywords: Inter-trochanteric fractures, DHS, PFN

Introduction
Intertrochanteric fractures, common fractures of the geriatric population, most commonly due to trivial trauma [1]. Incidence of intertrochanteric fractures has increased progressively over a period of time primarily due to increasing life span with advancements in medicine & more sedentary life style brought by urbanization. In younger population, these fractures occur due to high velocity trauma. These fractures are more in females compared to males due to postmenopausal osteoporosis. Mortality ranges between 15% -20%.
Intertrochanteric fractures can be managed by conservative or operative methods. Conservative methods were the treatment of choice until 1960 before the introduction of new fixation devices [1]. As conservative methods resulted in higher mortality rates and complications like decubitus ulcer, urinary tract infections, pneumonia, thromboembolic complication, due to immobilization these methods have become obsolete now[3]. Stable Internal fixation and early mobilization is the present standard method of treatment[4].
Factors determining the mobility and strength of implant assembly depends on bone quality, fragment geometry, reduction, implant type & implant placement [4-6]. Surgeon can control only the quality of reduction, choice of implant and its placement.
The type of implants used for the fixation of intertrochanteric fractures can broadly be divided into Extramedullary devices- DHS and Intramedullary devices- PFN.
DHS with side plate assembly is most commonly used device for fixation of intertrochanteric fractures [7-9]. It is a non collapsible fixation device, which permits the proximal fragment to collapse or settle on the fixation device seeking its own position of stability. The latest implant for management of intertrochanteric fracture is PFN [19, 20]. This implant is a cephalomedullary device and has many potential advantages being intramedullary, with efficient load transfer, shorter lever arm resulting in less transfer of the stress & less implant failures. Advantage of controlled impaction is maintained, sliding is limited by intramedullary location, so less shortening & deformity, shorter operative time, less soft tissue dissection and less blood loss.

In view of these conditions, this study is taken up to compare the results of DHS and PFN in the surgical management of intertrochanteric fractures based on the type of fracture, choice of implant, condition of the patient and bone.

Aims & Objectives

To compare the results of operative management using two different kind of internal fixation modality devices either PFN or DHS, to achieve fracture union and to determine the rate of union, complications, operative risks and functional recovery and outcomes. Compare the results obtained and determine the effectiveness of PFN in comparison to DHS in treatment of intertrochanteric fractures.

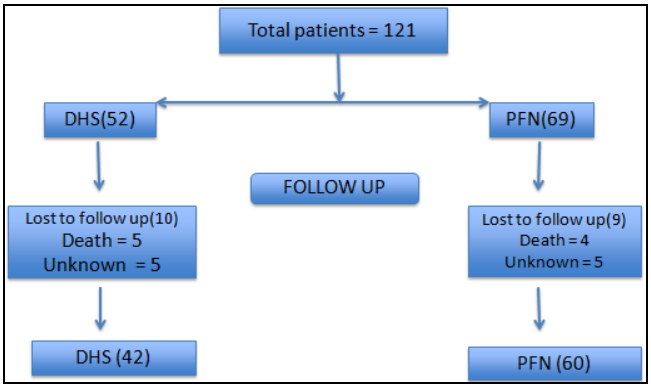
Patients & Methods

The present study consists of 121 patients with intertrochanteric fractures of femur who were treated with DHS and PFN at our hospital from year 2015- 2019. All the patients were followed up at regular interval postoperatively.

Inclusion Criteria: Patients Age >20 years, Isolated IT fractures & medically fit Boyd & Griffin classification Type 1,2,3 or OTA classification 31- type A1, A2, A3.

Exclusion Criteria: Patients who are medically unfit for surgery, pathological fractures, Inability to walk before sustaining fracture and inability to comply with rehabilitation protocols were excluded.

Management of patients: As soon as the patient with suspected IT fracture, necessary clinical and radiological evaluation was done and admitted to ward after necessary resuscitation and splintage using skin traction.



Algorithm showing total number of cases in each group.

Blood investigations for the surgery were performed, all the patients were evaluated for associated medical problems and were referred to respective department and treated accordingly. Associated injuries were evaluated and treated simultaneously. The patients were operated on selective basis after overcoming the avoidable anaesthetic risks.

Pre - Operative Planning

Dynamic Hip Screw

Length of Richard's screw	Tip of the head to the base of greater tronchanter on AP view X ray subtracting magnification
Neck - Shaft angle	Using goniometer on X ray AP view on unaffected side
Length of side plate	To allow purchase of atleast 8 cortices to the shaft distal to the fracture

Proximal Femoral Nail

Nail diameter	Measuring diameter of the femur at the level of isthmus on an AP X ray
Neck - Shaft angle	Measured on unaffected side in AP X ray using goniometer
Length of the nail	A standard length PFN (250mm).

All the cases included in our study group were fresh fractures that underwent surgery at the earliest possible in our set up. The delay was due to associated injuries and medical condition of the patient. All the patients were operated at an average interval of 6 days from the day of trauma.

Fig 1: showing PFN, DHS fixation.

Observation & Results

The following observations were made from the data collected during the study of 121 cases of intertrochanteric fractures treated by proximal femoral nail and DHS in the Department of Orthopaedics at our Hospital, during period 2015 to 2019.

Of total 121 patients 69 patients were treated with PFN and 52 patients were treated with DHS. 19 patients have lost the followup, of which 10 belong to DHS group, 9 belong to PFN group. So a total of 102 patients were followed for a period of one and half to two years.

The following observations were made from the data collected in our study.

Demographic & Preoperative data

Parameters	DHS (n=42)	PFN (n=60)
Mean Age (40-60yrs)	52.6 yrs	56.9
Sex (M: F)	19:33	28:41
Side (right: left)	32:20	41:28
Type of Injury		
a) Low velocity	32	41
b) High velocity	20	28

Classification Types

Fracture type	Boyd & Griffin Classification	
Type - I	37 (30.57%)	12 (9.91%)
Type - II	12 (9.91%)	32 (26.44%)
Type - III	3 (2.47%)	14 (11.57%)
Type - IV	0 (0%)	11 (9.09%)

Intraoperative Details

Various intra operative parameters like radiographic exposures, duration of surgery and amount of blood loss. Radiographic exposure was more for PFN where closed reduction was done and for comminuted fractures with difficult reduction.

Exposure was more for initial few cases, as we gained experience radiation exposure was reduced. Duration of surgery and blood loss was less for PFN compared to DHS, as we gained experience surgery duration was reduced further for PFN case.

Blood loss was measured by mop count and collection in suction. Blood loss was more for DHS compared to PFN, however exception in case of open reduction for PFN in case of difficulty.

Intraoperative details

Intraoperative details	PFN	DHS
Mean Intraoperative time (mins)	86.7±22.7	104.2±337
Mean radiographic exposure (no of times)	50±10	40±10
Mean blood loss(in milli litres)	120 ± 100	320± 150

Comparatively DHS fixation was technically easier and had lesser intraoperative complications. Reduction was easier as open reduction was performed in all the cases. Improper placement of Richard's screw, varus angulation, drill bit breakage were few complications encountered in DHS fixation.

DHS – Complications

Complications (DHS)	Number of cases	Percentage
Improper positioning of Richard screw	8	15.38%
Varus angulation	5	9.61%
Drill bit breakage	1	1.92%

Fig 2: Showing screw backout.

Difficulty in achieving closed reduction particularly in case of comminuted / displaced fractures, iatrogenic fracture of lateral cortex, failure to place antirotation screw, failure to achieve anatomic reduction as fracture extending to the entry point where nail entry lead to opening up of fracture and prevented anatomic reduction were the few complications encountered in PFN fixation group.

PFN – Complications

Complications (PFN)	Cases	Percentage
Failure to achieve closed Reduction	6	8.69%
Fracture of lateral cortex	3	4.34%
Fracture displacement	6	8.69%
Failure to put derotation Screw	4	5.79%
Failure to lock distally	0	0%
Jamming of nail	0	0%
Drill bit breakage	0	0%
Guide wire breakage	0	0%

Fig 3: Showing complication of PFN nail.

Functional Analysis

In our study the average duration of hospital stay was 10 days. The mean time of full weight bearing was 10.6 weeks for PFN and 14.8 weeks for DHS. All patients enjoyed good, hip and knee range of motion except for 1 patient of PFN who had extensive lateral cortex comminution during surgery and had to be immobilized for prolonged period. All patients were followed up at 6 weeks interval till fracture union, at 12 weeks & at 6 months 9 months & 12 months post operatively. 19 patients failed to attend first follow up & were lost for further follow up (10 cases of DHS & 9 PFN). At each follow up radiographs of upper femur & hip were taken to assess the fracture union, implant failure & screw cut out.

Anatomical Results

Anatomical results were assessed by shortening, hip and knee range of movements and varus deformity.

Anatomical Result	PFN	DHS
Shortening more than 1cm	5	2
Varus deformity	3	3
Restriction of Hip movement	2	4
Restriction of Knee movement	1	0

Interpretation of functional results of DHS & PFN

Functional Results	DHS	Percentage	PFN	Percentage
Excellent	21	50%	43	71.66%
Good	12	28.57%	13	21.6%
Fair	5	11.90%	3	5.0%
Poor	4	9.52%	1	1.66%

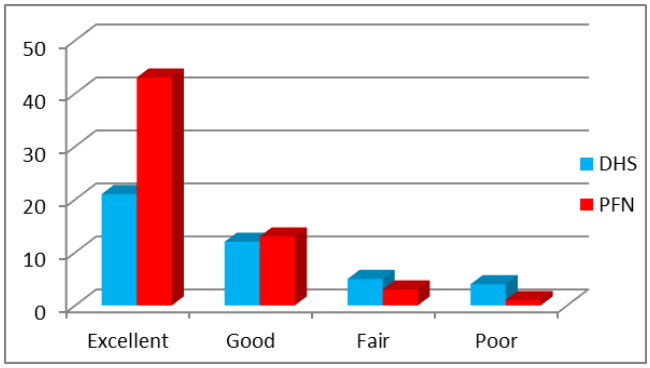


Fig 4:.Results

Discussion

The treatment of intertrochanteric fracture is still associated with some failures. High stress concentration that is subject to multiple deforming forces, high incidence of complications reported after surgical treatment, compels the surgeon to give a second thought regarding selection of proper implant. DHS the most commonly used method of fixation is based on sliding screw system. The AO ASIF in 1996, therefore developed the Proximal Femoral Nail with an antirotation hip screw together with a smaller distal shaft diameter which reduces stress concentration to avoid failures. From mechanical point of view an intramedullary device inserted by means of minimally invasive procedure seems to be better in elderly patients [20].

Closed reduction preserves the fracture heamatoma, an essential element in consolidation process. Intramedullary fixation allows the surgeon to minimize soft tissue dissection, thereby reducing surgical trauma, blood loss, and infection and wound complications [7].

Pajarein and Lindal, of 108 patients of pertrochanteric fractures treated with DHS and PFN, found PFN allowed faster restoration of post operative walking ability when compared with DHS [19].

A study of 20 patients of unstable intertrochanteric fractures treated with PFN and DHS by Barathi and Arshad, was conducted in 2004. They found duration of stay for PFN and DHS were 14 and 22 days, blood loss was 275 and 475ml, persistent hip pain was seen in 3% and 9%

In our study, intertrochanteric fracture was common due to fall from height, age ranged between 16-85 years, (mean age 52.6 years). Females were common contributing to 61.15%. Right sided fractures were common accounting for 71.89%. Type I & II Boyd and Griffin fractures were common, consisted of 40.48%, 36.35% respectively.

Mean frequency of radiaton exposure were 70 and 40 times mean duration of duration of operation 80 and 100 minutes, mean blood loss was 240ml and 320 ml for PFN and DHS respectively. DHS fixation group had fewer intraoperative complications which included improper placement of the screw, varus angulation, and drill bit breakage. Among PFN, open reduction in case of unsatisfactory reduction, iatrogenic fracture of lateral cortex, fracture displaced by nail insertion were few complications reported.

From the study, we consider PFN as better alternative to DHS in the treatment of intertrochanteric fractures but a technically difficult procedure and requires more expertise compared to DHS. With experience gained from each case operative time, radiation exposure, blood loss and intraoperative complications can be reduced in case of PFN fixation group.

Conclusion

In the present study of 121 patients of intertrochanteric fractures, the data was assessed (60 pts PFN, 42pts- DHS) analyzed, evaluated and following conclusions were made.

Intertrochanteric fractures common between 40-60yrs, more common in females due to post menopausal osteoporosis. Early reduction and internal fixation increases patients comfort, facilitates nursing care, helps in early mobilization of patients and decrease hospital stay. Reduction in fracture can be achieved mostly by closed means and fixed by Extramedullary or Intramedullary devices. Type of implant selection depends on fracture pattern. For A1 fractures / type I boyd & Griffin - DHS remains gold standard whereas for A2, A3 fractures / Type II, III Boyd & Griffin PFN is the better choice of implant.

Following advantages were noted in PFN group in comparision with DHS, controlled collapse at fracture site as it is biomechanically sound, closed reduction with minimally invasive approach, prevents excess collapse at fracture site, thus maintaining neck length and two screws placed in neck provides rotational stability.

In PFN entry point determination is crucial particularly in elderly with osteoporotic bones as wrong entry point may result in iatrogenic comminution of lateral cortex and varus collapse.

Fracture union and functional results (ability to sit cross legged, squat, absence of hip pain, independent mobility) were better with PFN compared to DHS. Complications in both PFN and DHS can be avoided with proper patient selection and good preoperative planning.

With experience gained from each case operative time, radiation exposure, blood loss and intraoperative complications can be reduced in case of PFN.

This study concludes that PFN is a better alternative to DHS in management of intertrochanteric fractures but is technically difficult procedure and requires more expertise compared to DHS.

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