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PROXIMAL FEMORAL NAIL VERSUS DYNAMIC HIP SCREW FOR INTERTROCHANTERIC FRACTURES – A COMPARATIVE STUDY

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ABSTRACT

The present study includes the clinical outcome of intertrochanteric fractures treated with proximal femoral nail (PFN) and dynamic hip screws (DHS).This study focuses on Comparative study of PFN and DHS in the management of fractures of intertrochanteric region.The main goal of the treatment is to achieve best anatomical, stable reduction along with early mobilization of the patient and to prevent deformity of the limb especially at the hip and to achieve fracture union by using two different kind of internal fixation modality devices in similar type of fractures

Keywords
proximal femoral nail (PFN) and dynamic hip screws (DHS), intramedullary fixation, andropause , intertrochanteric fracture

INTRODUCTION

The number of intertrochanteric fracture cases has been increasing significantly especially in the elderly population mostly because of trivial trauma like slip and fall, increasing life span and sedentary life style due to urbanization[1]. Incidences of intertrochanteric fracture in young individual are mainly due to high velocity injuries like road traffic accident, fall from height etc . [2]

Intertrochanteric fractures are more common in the female gender population compared to male population probably because of the post-menopausal osteoporosis risk factor [3]. In the current generation it was found out that andropause is one of the risk factors for intertrochanteric fracture in elderly male population and usually occurring after the 6th decade of age, compared to female elderly population which occurs above 5 th decade of age [4].Treatment of intertrochanteric femoral fractures requires orthopaedic surgeon with considerable experience, good surgical training and technique in order to prevent complication like implant failure and to get patients back to the ambulatory status [5].

Intertrochanteric femoral fractures can be managed by conservative or surgical methods and there will be union of the fracture site since the vascularity of the bone will not be affected severely. But this might lead to certain complications like malunion, followed by deformities like external rotation and varus at the fracture site, leading to shortening of limb, restriction of the movements at the hip and difficulty in walking, if treated by the conservative line of management [6].In the surgical line of management of intertrochanteric femoral fractures there are generally intramedullary fixation and extramedullary fixation devices [7]. The dynamic hip screw (DHS) along with side plate are commonly used extramedullary fixation device and it is the most commonly used device for treatment of intertrochanteric femoral fractures [8]. Proximal femoral nail (PFN) and gamma nail are commonly used intramedullary fixation devices, but previous studies have shown that the gamma nail may lead to higher incidence of postoperative femoral shaft fracture [9].Current guidelines are in favour of intertrochanteric femoral fractures being managed by proximal femoral nailing (PFN), biomechanically it is better as the proximal femoral weight bearing is shared by the calcar[10].

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PFN as a device are more stable under loading with a shorter lever arm, thus the distance between the nail and the hip joint is considerably reduced compared to the plate in a DHS, this reduces the deforming forces across the implant[11], further they also have an additional rotational stability compared to dynamic hip screw implant which is only a collapsible device.Even with the advances of surgical technique, nursing care and anesthesia, intertrochanteric femoral fractures has been greater cause of morbidity and mortality in older or elder individuals[12]. The present short term prospective study shall aim at a comparison between DHS and PFN.

MATERIALS AND METHODS

Study location: The Department of Orthopaedics in SREE BALAJI MEDICAL COLLEGE AND HOSPITAL,Chromepet, Chennai.

Study type: Prospective comparative study.

1. Study duration:
JULY 2017 to DECEMBER 2019. This study shall be spread over a period of 30 months, but recruitment of new patients shall stop by DECEMBER 2018 so that the minimum follow up period shall be 12 months. Thus the study recruitment period is of 18 months and the study period was spread over a period of 30 months.

2. Study subjects:
40 intertrochanteric fracture patients. Of which patients were randomly divided into PFN groups & DHS groups consisting of 20 in each who satisfied the inclusion criteria.
Study tools: Patients inclusion and exclusion criteria are given below:-

Inclusion criteria:
- Both men and women were included.
- Patients in age group 30 to 90 years were included.
- Patientswithonlyintertrochantericfractureswere included.
- Patients with less than 15 days of injury were included.
- Patients whose are surgical fit under ASA grade I to III were included.

Exclusion Criteria:
- Patients not fulfilling the above inclusion criteria were excluded.
- Patients with less than 30 years or more than 91 years of age were excluded.
- Patients with pathological fracture and polytrauma were excluded.
- Patients with open injury were excluded.
- Patients who's surgical fitness is ASA grade IV were excluded.
- Patient not giving consent for the study were excluded.

Proforma was created containing patient's history and examination of lower limb and hip were noted. Consent was taken in patient's own language. Radiograph of pelvis with both hips with traction and 150 internal rotation of anterior posterior view and lateral view (if possible) were taken. Skin traction was applied. All presurgical investigations for anaesthesia fitness was done and noted. Side of the fracture, mode of injury, type of fracture, type of surgery planned, if any

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associated comorbidities, Preoperative walking ability using gait ability score [113,114] were noted.

Intra operative details:

Blood loss : We calculated the blood loss after the surgery by measuring the suction apparatus and mop count, fully soaked 1 big abdominal pad contain 50 ml and 1 small gauze blood soaked contain 3 ml of blood.Length of the surgical incision in cm was noted .Duration of the surgery in minutes from the start of the incision till wound closure was noted.Fluoroscopy time: After taking help from the Radiology department from our institution we calculated the intraoperative radiation exposure from C-arm with the help of an formula 10 x 0.987 x number of C-arm shorts taken [per exposure – 10 R/sec, conversion factor roentgen R to Rad or Radiation absorbed dose – 0.987].Post operative x-ray of pelvis with both hips with traction and 150 internal rotation was taken .Follow up was done with the examination hip joint, surgical scar, fracture union and hip range of movements were done at the interval every month till an evidence of radiological union followed by once in 3 months. If any intra or post operative complications were noted.

All the patients were assed with Harris Hip Score [115], Lower Extremity Functional Scale [116] and Postoperative walking ability using Gait Ability Score [113,114] after fracture union and was noted. All the 3 scores have been shown in annexure 2 -4. All the information data collected, at the end the study was statistically analysed and compared with the similar studies done before.

Statistical analysis

The data collected was entered in Microsoft Excel and analyzed using SPSS 21. The demographic data is presented as frequencies, measures of central tendency and dispersion. Appropriate statistical tests of significance (i.e. CHI square test for qualitative data, Independent t test for quantitative data) are used to study the differences between the PFN and DHS groups.

Proximal Femoral Nail (PFN)

In this prospective study in all of our 20 cases we have used Hollow tubular stainless steel intramedullary PFN nails of 240 mm in length. Proximal diameter of PFN nail is 17.0 mm while the distal diameter is of 10,11 and 12 mm enables unreamed insertion. Proximal femoral nail with center collum diaphysis angle (CCD) angles of 1300 & 1350 with 100 of anteversion was used. This nail has anatomical 60 of mediolateral angle. Proximal portion of the PFN can accommodate two screws, proximal most self tapping 6.5 mm hip screw with the available of different lengths ranging from 55 mm - 115 mm this is for rotational stability (ANTI ROTATION SCREW) and self tapping 11.0 mm femoral neck screw with the available in different lengths ranging from 80 mm - 120 mm.

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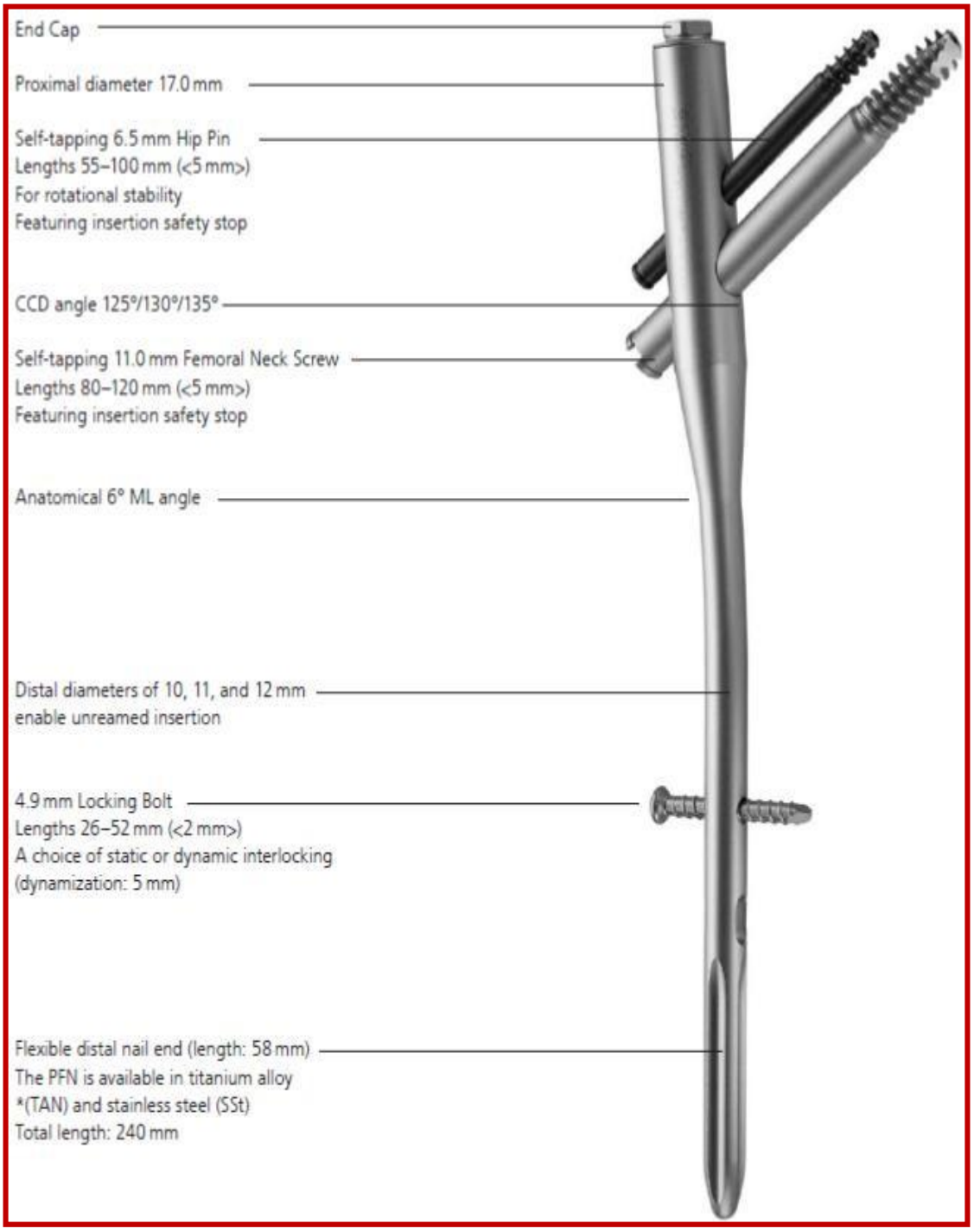

Fig 12: Proximal Femoral Nail

Measurement of diameter of the nail:- It was determined by placing the radiographic ruler at the level of the isthmus over the anterior posterior x ray of the normal femur. But PFN of all sizes were kept for the surgery of 9 mm to 12 mm size.
The Dynamic Hip Screw has three parts:

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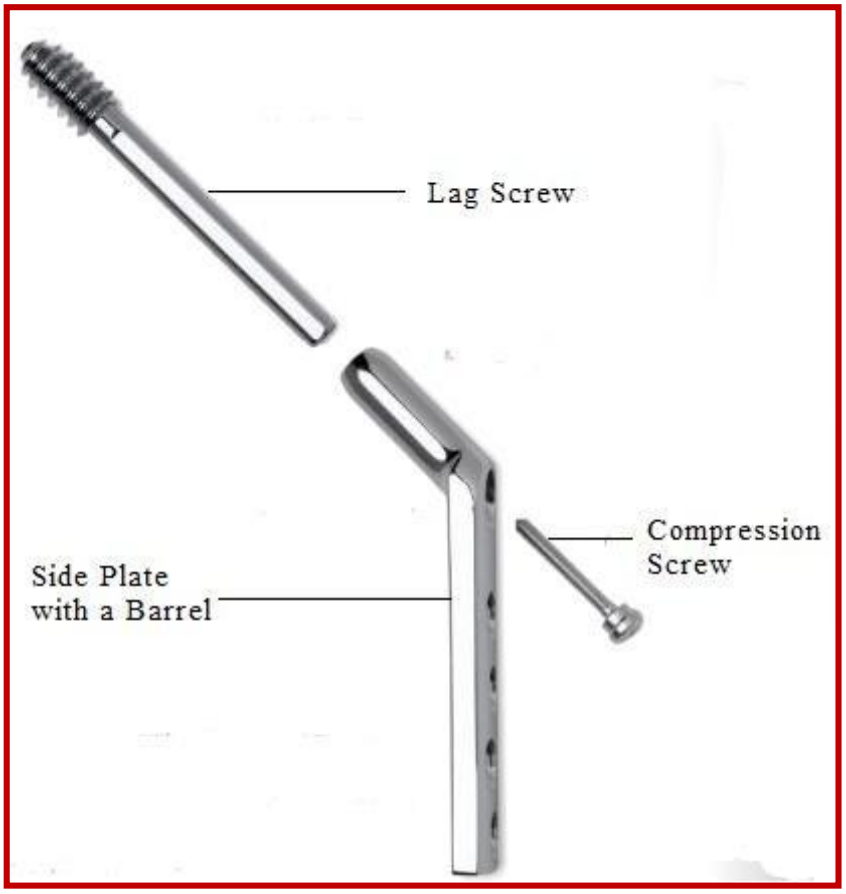
The Lag Screw

It has a blunt proximal tip with broad threads at the proximal end. The diameter of thehreaded part is 12.5 mm. The length of the threaded part is 22 mm.

Dynamic Hip Screw (DHS)

Fig 13: Dynamic Hip Screw



The pitch of the thread is 3 mm. The diameter of the shaft of the lag screw is 8 mm. The inner surface of the distal end of the shaft is threaded for the application of the compression screw. It comes in keyed and non keyed shape system. Keyed sliding hip screw had better rotational stability of the femoral head than a non keyed system.

The Side Plate with a Barrel

The barrel for the lag screw to slide through it, is available at an 1200 to 1500 angle to the plate but for all our cases 1350 was used. Length of the barrels are available in two sizes: The standard barrel with 38 mm and short barrel with 25 mm in length. The side plate is a 4 holed or a 5 holed plate for fixation to the shaft of the femur.

The Compression Screw

It is 19 mm in length, and is screwed into the distal end of the lag screw after the side plate is fixed.

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1. Results

The following analysis was made after collecting data for this prospective comparative study of 40 intertrochanteric fractures patients in the Department of Orthopaedics of Sree Balaji Medical College and Hospital, Chromepet, Chennai, during the period from JULY 2017 to DECEMBER 2019.

Table 2 : Distribution of cases Age wise.

AGE(YEARS)	PFN 'n' (%)	DHS 'n' (%)	TOTAL 'n' (%)
30 – 40	1(5.0%)	1 (5.0%)	2 (5.0%)
41 – 50	2 (10.0%)	2(10.0%)	4 (10.0%)
51 – 60	2 (10.0%)	3(15.0%)	5 (12.5%)
61 – 70	8 (40.0%)	5(25.0%)	13(32.5%)
71 – 80	5 (25.0%)	8(40.0%)	13(32.5%)
81 – 90	2 (10.0%)	1 (5.0%)	3 (7.5%)
TOTAL	20(100.0%)	20(100.0%)	40(100.0%)

'n' – number of patients% - percentage

Table 3: Distribution of cases Sex wise

SEX	PFN 'n' (%)	DHS 'n' (%)	TOTAL 'n'(%)
FEMALE	9(45.0%)	12 (60.0%)	21(52.5%)
MALE	11(55.0%)	8 (40.0%)	19(47.5%)
TOTAL	20(100.0%)	20(100.0%)	40(100.0%)

'n' – number of patients% - percentage

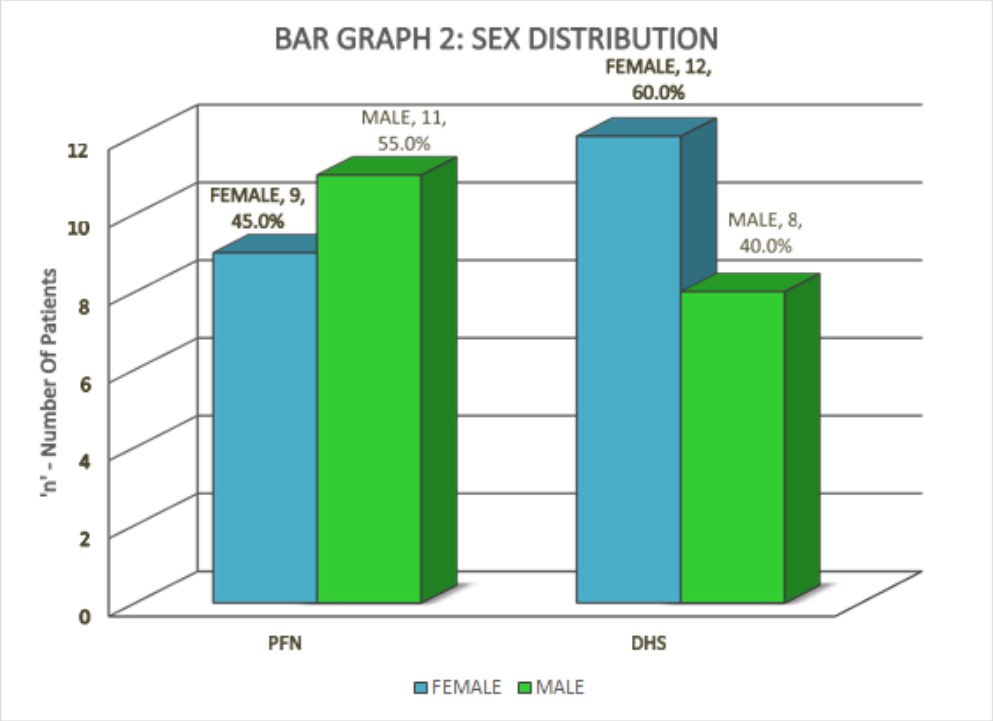

Table4:DistributionofcasesaccordingtoModeof Injury:

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MODE OFINJURY	PFN 'n'(%)	DHS 'n'(%)	TOTAL 'n'(%)
FALL FROMHEIGHT	2 (10.0%)	2 (10.0%)	4 (10.0%)
TRIVIAL FALL	17 (85.0%)	16 (80.0%)	33 (82.5%)
ROAD TRAFFICACCIDENT (RTA)	1 (5.0%)	2 (10.0%)	3 (7.5%)
TOTAL	20 (100.0%)	20 (100.0%)	40 (100.0%)

'n' – number of patients% - percentage

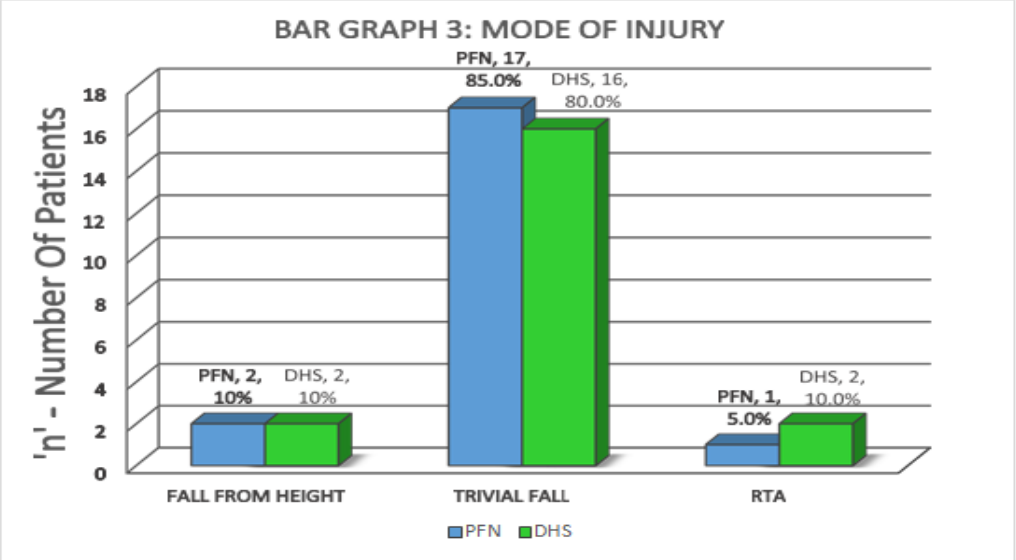
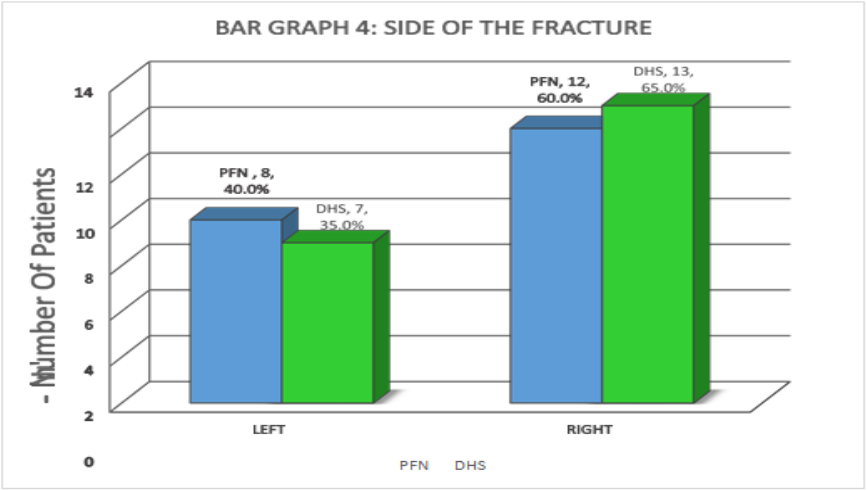


Table 5: Distribution of cases according to the Side Of fracture:

SIDE OFFRACTU 12RE	PFN'n' (%)	DHS'n' (%)	TOTAL'n' (%)
LEFT	8 (40.0%)	7 (35.0%)	15 (37.5%)
RIGHT	12 (60.0%)	13 (65.0%)	25 (62.5%)
TOTAL	20 (100.0%)	20 (100.0%)	40 (100.0%)



'n' – number of patients% - percentage

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Table 6: Distribution of cases according to the Revised AO fracture classification:

Revised AO CLASSIFICATION	PFN 'n' (%)	DHS 'n'(%)	TOTAL 'n' (%)
31A1.2	6 (30.0%)	5 (25.0%)	11 (27.5%)
31A1.3	7 (35.0%)	8 (40.0%)	15 (37.5%)
31A2.2	5 (25.0%)	5 (25.0%)	10 (25.0%)
31A2.3	2 (10.0%)	2 (10.0%)	4 (10.0%)
TOTAL	20 (100.0%)	20 (100.0%)	40 (100.0%)

'n' – number of patients% - percentage

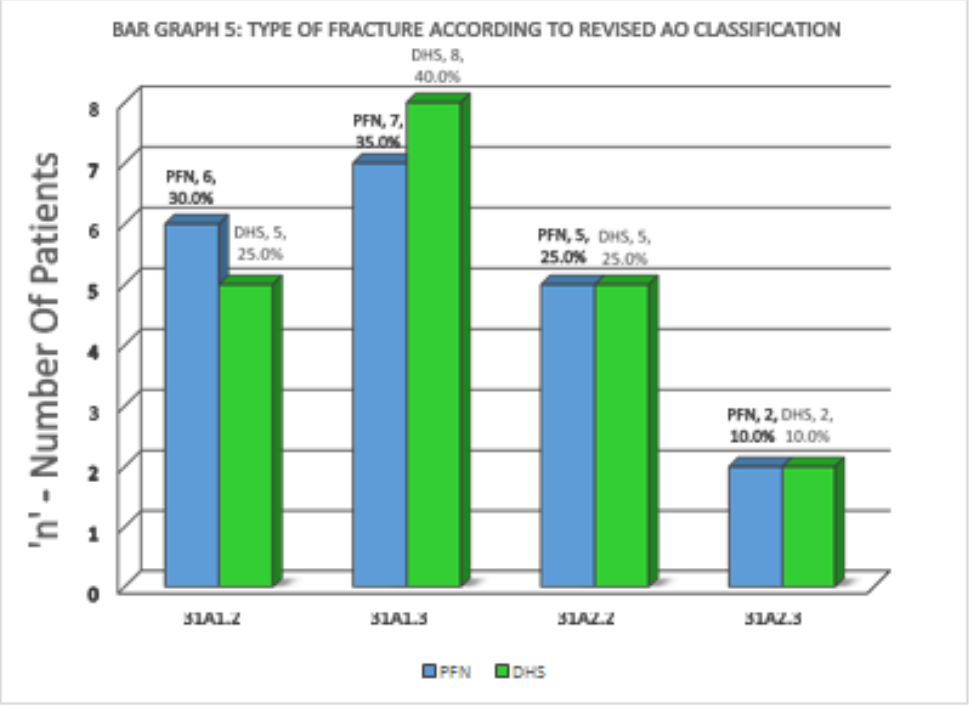

Table7:IndexofOsteoporosisaccordingtoSingh's index:

SING'S INDEX	PFN 'n' (%)	DHS 'n' (%)	TOTAL 'n' (%)
GRADE 1	0 (0.0%)	0 (0.0%)	0 (0.0%)
GRADE 2	5 (25.0%)	5 (25.0%)	10 (25.0%)
GRADE 3	5 (25.0%)	9 (45.0%)	14 (35.0%)
GRADE 4	7 (35.0%)	4 (20.0%)	11 (27.5%)
GRADE 5	3 (15.0%)	2 (10.0%)	5 (12.5%)
GRADE 6	0 (0.0%)	0 (0.0%)	0 (0.0%)
TOTAL	20 (100.0%)	20 (100.0%)	40 (100.0%)

'n' – number of patients% - percentage

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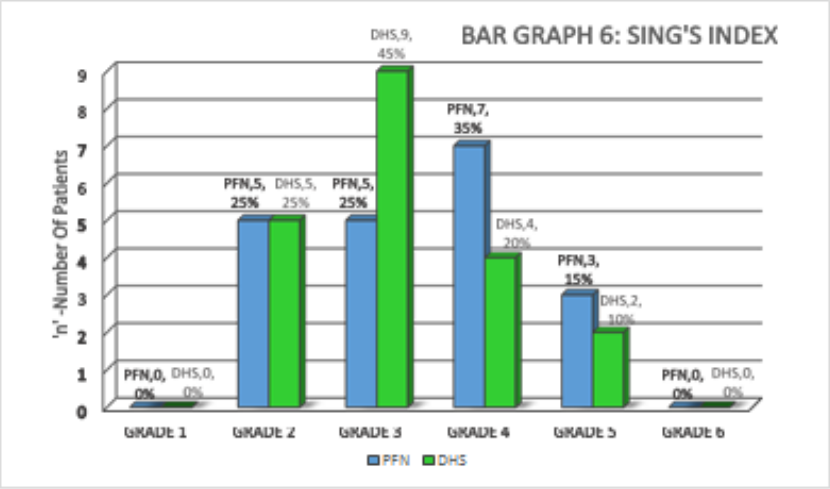

Table 16: Summary of Results

PARAMETERS	PROCEDURE	N	Mean	Std.Deviation	P -VALUE
AGE	PFN	20	66.00	12.528	0.869
	DHS	20	65.35	12.321	
SING'S INDEX	PFN	20	3.40	1.046	0.430
	DHS	20	3.15	0.933	
PREOPERATIVE WALKING ABILITY-GAIT ABILITY SCORE	PFN	20	1.30	0.470	0.267
	DHS	20	1.15	0.366	
LENGTH OF THEINCISION	PFN	20	8.20	0.951	0.000
	DHS	20	15.90	1.373	
DURATION OF THESURGERY	PFN	20	72.25	8.025	0.004
	DHS	20	81.50	10.773	
BLOOD LOSS	PFN	20	128. 50	26.611	0.000
	DHS	20	342. 50	56.835	
FLUOROSCOPY TIME	PFN	20	254. 1525	34.76692	0.000
	DHS	20	150. 0240	23.22460	
HARRIS HIP SCORE	PFN	20	85.30	6.752	0.226
	DHS	20	82.25	8.783	
LOWER EXTREMITYFUNCTIONAL SCALE	PFN	20	65.90	12.435	0.929
	DHS	20	66.20	8.276	
TIME OF UNION INWEEKS	PFN	20	12.20	2.936	0.185
	DHS	20	14.90	3.156	
POSTOPERATIVE WALKING ABILITY-GAIT ABILITY SCORE	PFN	20	1.75	0.910	0.191
	DHS	20	2.15	0.988	

N – number of patients

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DISCUSSION

Management of Intertrochanteric fractures has been a major task for orthopaedic surgeons not only for achieving bone union but also for return of patient's optimal function in short duration of time with less complications. The main aim for any orthopaedic surgeons is to get early mobilization, early return of patient's daily activities. This is achieved by surgical management with internal fixation which permits faster rehabilitation and a better chance for functional recovery and hence it has become a treatment of choice in intertrochanteric fractures. There are numerous types of implants available like sliding nail or screw plate, fixed nail plate devices, intramedullary implants, the compression hip screw is most commonly used and still remains the gold standard for some orthopaedic surgeons but lately fixing with closed intramedullary nailing technique have gained more popularity.In this prospective study we tried to evaluate and quantify our analysis in the surgical management of intertrochanteric fractures by using Dynamic Hip Screw
(DHS) and Proximal femoral nail (PFN) implants and comparing the results between these two groups. This case series was conducted on forty patients of intertrochanteric fractures who came to our casualty or outpatient department of Orthopaedics in SREE BALAJI MEDICAL COLLEGE AND HOSPITAL, chromepet, Chennai, during the period from JULY 2017 to DECEMBER 2019 of which 20 cases were treated by PFN and 20 cases by DHS.In our study of 40 cases most of patients the age group range from 5th to 8th decade of life. PFN group had majority of cases of 8 patients (40%) between 61 to 70 years of age and in DHS group of again 8 patients (40%) between 71 to 80 years of age. Totally in two age groups i.e 61 to 70 years and 71 to 80 years had majority cases of 13 each (32.5%). 66.00 is the Mean age in years for PFN group and 65.35 is the Mean age in years for DHS group. Mean age in years for both PFN and DHS groups combined is 65.67 and hence this signifies that low energy trauma like trivial fall or fall at home is involved in these age groups[17 - 20]. Our study was compared to Mohanty SP et al; [11], R.C Gupta et al;[15] ,G.S Kulkarni et al; [12] and majority of patients were in geriatric age population. Some of the other studies are:

Table 17: Age distribution from other studies

Study conducted by	Average age in years
Boyd and Griffin[47]	69.7
Scott[124]	73.3
Wade and Campbell[125]	72.0
Gupta RC[122]	51.2
Mohanty SP[121]	61.7
G.S Kulkarni[123]	62

The Hip joint are weight bearing joints is already a weakened part due to osteoporosis as the age advances, which cannot resist any stress. The calcar is atrophied along with the space between the bony trabeculae is enlarged and loaded with fat. Measures must be taken to correct or prevent osteoporosis and also to be freed from any potential danger like slippery floor, poor lighting etc to be initiated for those patients who are vulnerable to fall and fracture.In the present study there was a female preponderance of 21 (52.5%) cases in our patients and majority of them were in 5th -7th decade of life. 19 (47.5%) cases were male patients. In PFN group majority was in male category of 11 (55.0%) cases but DHS had majority of female 12 (60.0%) cases. In the study conducted by Cleveland et al; [12] had 87.7% of female patients and according to them female

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population are less active and are possible to develop osteoporosis. They also have a wider pelvic compared to male population and are likely to have coxa vara. Some other studies are given below:

Table 18: Sex distribution from other studies

Study	Male'n'	Female'n'
Boyd and Griffith[47]	74	226
Clawson[54]	75	102
Scott[124]	35	65
Murray and Frew[101]	56	46

'n' – number of patients

As majority of our cases were above 50 years of age the main mode of injury was trivial fall of 33 (82.5%) cases while in younger patients road traffic accident (RTA) of 3 (7.5%) cases was the main reason. From PFN group 17 (85.0%) cases were because of trivial fall, 2(10.0%) cases were due to fall from height and only 1(5.0%) case was due to road traffic accident (RTA). In DHS group 16 (80.0%) cases had trivial fall, 2 (10.0%) cases same as from PFN group had fall from height while 2 (10.0%) cases had road traffic accident (RTA). Cummings and Nevitt in 1994[17] gave the possible reason from their observation is that due to insufficient protective reflexes in reducing the energy of falling below a threshold. Lack of local shock absorbers like fat and muscle around proximal femur and also due to osteoporosis or osteomalacia there is an insufficient bone strength.According to Keneth J. Koval et al; study showed that elderly patients had 90% of proximal femur fractures from a trivial fall. In young adults, Hip fractures were seen due to high velocity trauma such as road traffic accidents [18]Horn & Wang observed that mechanism of injury is due to failure of stress resisting forces during sudden bending or twisting movements and is not direct. From a direct trauma on the lateral surface of the thigh it would result in contusion, comminution on the greater trochanter's lateral surface and cause valgus deformity [19].From our study majority had right sided fracture of 25 (62.5%) cases of which 12 (60.0%) cases were PFN group

Bases on the posteromedial cortex intertrochanteric fractures were considered as stable or unstable according to Mervyn Evans. Stable intertrochanteric fractures have intact posteromedial cortex while unstable fractures do not have [12-14]. All patients were classified under Revised AO classification system. Stable fractures were in 31A1 of total 26 (65.0%) cases amongst them 13 cases were in both PFN (65.0%) and DHS group (65.0%). Unstable fractures were in 31A2 and 31A3 group of total 14 (35.0%) cases of which 7 cases were both again of PFN (35.0%) and DHS group (35.0%). Amongst the subtypes out of 40 patients 15 (37.5%) cases were of 31A1.3 type of which 7 (35.0%) cases were PFN group and 8 (40.0%) cases were of DHS group. Isolated single trochanteric fracture type of 31A1.1 were not included as this type included in greater trochanter fracture, the management would be different and we couldn't get any intertrochanteric reverse obliquity 31 A3 type.

To know the degree of osteoporosis Singh's index was used in our study [58]. Since the majority of our patients were of geriatric age group, 14 (35.0%) cases out of 40 patients had GRADE 3 osteoporosis of which 9 (45.0%) cases were in DHS and 5 (25.0%) cases with PFN. Followed by 2nd majority with GRADE 4 osteoporosis of 11 (27.5%) cases in which PFN had 7 (35.0%) majority and DHS had 4 (20.0%) cases. According to Walsh et al; [133] study the mechanical property of fracture callus is negatively a ffected by osteoporosis. From Xu et al; [13] study the

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fracture union is impaired by osteoporosis. Implant failure, screw cut-out etc. are certain complications which are associated in the presence of osteoporosis [15], which can be addressed by medical treatment of the osteoporosis, intramedullary implant fixation and cement augmentation.

CONCLUSION

Our study to compare Proximal Femoral Nail verses Dynamic Hip Screw showed no difference in functional outcome statistically however subjectively and clinically Proximal Femoral Nail showed better results than Dynamic Hip Screw. The Proximal Femoral Nail showed distinct or better superior internal fixation implant than Dynamic Hip Screw in terms of less duration of surgery, less intraoperative blood loss, early rehabilitation and early return to pre injury activity status which can be achieved however fluoroscopy time was more in Proximal Femoral Nail than Dynamic Hip Screw. Osteosynthesis using Proximal Femoral Nail can be used in both stable and unstable intertrochanteric fractures which results in low rate of clinical and mechanical complications. Hence we conclude that both implants are good for intertrochanteric fractures but Proximal Femoral Nail scores better than Dynamic Hip Screw. This is a short term study and involves less numbers. The scope of this study can be made better by increasing the number of cases and duration of study.

Funding: No funding sources

Ethical approval: The study was approved by the Institutional Ethics Committee

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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