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Implant of choice in the management of intertrochanteric fractures in south Indian rural population - A comparative study

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Abstract
Background: Intertrochantric fractures are common in elderly osteoporotic patients due to trivial trauma and in young due to high energy trauma. The ultimate goal in the management of intertrochanteric fracture is early mobilization of patient to prevent morbidity. Early mobilization primarily depends on the implant used & stability of the surgical construct. Dynamic Hip Screw (DHS) has been considered as the gold standard device in treating these fractures but has short comings & pit falls. Trochanteric Fixation Nail (TFN) is a relatively newer device which is biomechanically sound & allows early weight bearing with much better results compared to DHS.
Aims and Objectives: This study aimed to compare the results regarding functional outcome, the rate of union and complications in intertrochanteric fractures treated with DHS (DYNAMIC HIP SCREW) and TFN (Trochanteric Fixation Nail) in patients with trochanteric fractures among south Indian rural people
Methodology: In this prospective study, total of 40 patients were randomized to the tfn group [group a (n = 20)] and the dhs group [group b (n = 20)]. All relevant perioperative information and complications were recorded and assessments of functional outcome were made.
Results: In the present series - 40 cases of Intertrochanteric fractures were treated by trochanteric fixation nail and dynamic hip screw, 20 cases in each. Out of 40 there were 26 male and 14 female cases. Minimum age was 33 years, maximum age 85 years. Slip and fall accounted for 80% of cases. BOYD and GRIFFIN type II fracture accounted for majority of cases. Mean duration of hospital stay was 15.2 days in TFN & 16.6 days in DHS group. Length of incision was small 5-6cm in TFN group compared to 10-12cm in TFN. Mean time for full weight bearing was 12.6 weeks for TFN group and 15.8 weeks for DHS group. Radiological union was 12-14 weeks in TFN group and 15-16 weeks in DHS group. Good to excellent results were seen in 90 % of cases in TFN group and 80% of cases in DHS group.
Conclusion: From this study, we consider TFN as better alternative to DHS in the treatment of intertrochanteric fractures but technically difficult procedure which requires more expertise compared to DHS. As a learning curve the TFN procedure is steep but with experience gained from each case operative time, radiation exposure and intraoperative complications can be reduced in each case of TFN.

Keywords: Intertrochanteric fracture, trochanteric fixation nail, dynamic hip screw

Introduction
The incidence of the trochanteric fracture has been rising with an aging population in many parts of the world and the number of hip fractures is expected to increase year after year[1]. Though conservative treatment yields good results it necessitates prolonged immobilization leading to complications like bed sores, deep vein thrombosis, fracture disease and pulmonary embolism. Another feature of conservative regime is the possibility of varus drift and shortening inspite of adequate period of immobilization. Therefore surgery is the mainstay of treatment. The goal of treatment is fracture reduction so that near anatomic alignment and normal femoral anteversion are obtained. S urgical treatment with stable fixation allows early mobilization and reduces complications.
There are two main types of fixations for trochanteric fractures-the extramedullary plate fixation and intramedullary nail. Dynamic hip screw (DHS) or sliding hip screw (SHS) has been the gold standard implant in treating trochanteric fractures.
However, when compared with the intramedullary implants DHS has a biomechanical disadvantage because of a wider distance between the weight bearing axis and the implants. The trochanteric fixation nail introduced by the AO group has become prevalent in treating trochanteric fractures in recent years Although there were several reports showing benefits of

trochanteric fixation nail, it was still associated with technical failures. The cost of TFN is also much more than DHS. Therefore, the purpose of this study to find out if there is a significant difference between TFN and DHS fixation in treating trochanteric fractures in rural population. The hypothesis is that TFN fixation is more effective than DHS fixation in terms of decreasing operation time and blood loss, as well as reducing hospital stay, wound complication and mortality.

Materials and methods

The present study consists of 40 patients with intertrochanteric fractures of femur who were treated with DHS or TFN in Department of Orthopaedics Surgery at Raja Muthiah Medical College, Annamalai University, Chidambaram during the period of June 2016 to September 2017. All the 40 patients were selected by numeric alternative allocation in order to prevent bias.

Inclusion Criteria

- Adult Patients with Boyd and griffin type I, II, III, IV trochanteric fractures.

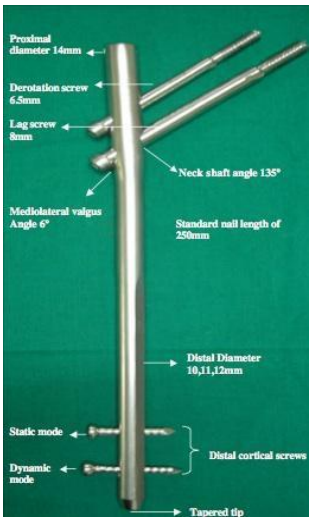
Exclusion Criteria

- Open fractures
- Pathological fractures
- Pediatric fractures
- Patients associated with polytrauma**.**

As soon as the patient with suspected trochanteric fracture was seen, necessary clinical and radiological evaluation was done and admitted to ward after necessary resuscitation and splintage with either skin or skeletal traction. All the routine investigations were done as follows: haemogram, blood urea, serum creatinine, blood sugar level, serum electrolytes, blood group, HIV, HBsAg, HCV, Chest X-ray and ECG. All the patients were evaluated for associated medical problems and were referred to respective department and treated accordingly. Theses patients were operated on after anaesthetic assessment.

We followed standard technique for fixation of DHS as recommended by AO[2]. The clinical and radiological assessment was done in all cases. Informed consent was taken in each patient. The minimum follow up period was 3-6 months months with follow up at 4 weeks, 8 weeks, 12 weeks, 20 weeks and 6 months in both groups. Results were assessed based on Harris Hip Scoring System (Modified). The primary comparative parameter were clinical and radiological union of the fracture.

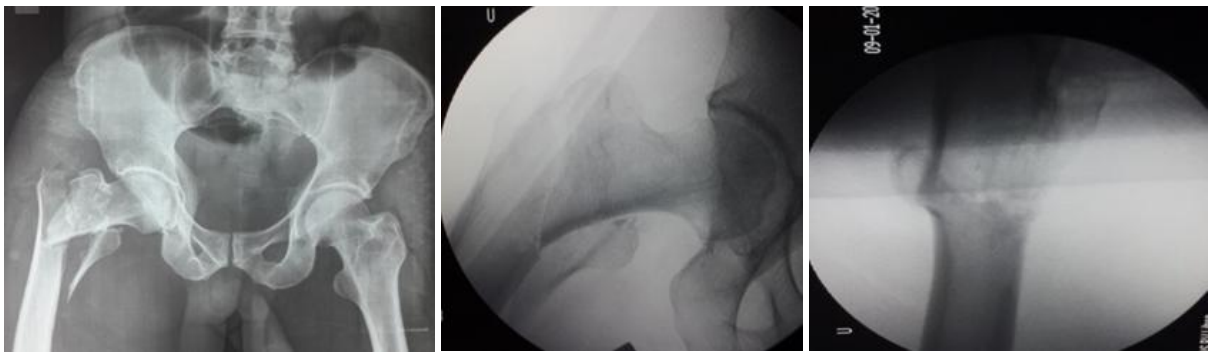
Surgical Procedure



The TFN used in the study was a Stainless Steel nail of 180 mm in length and 10, 11, and 12 mm in diameter, which was inserted into the medullary canal. Two cervical screws were inserted in the femoral head-neck fragment. These screws provide rotational stability. The TFN can be distally locked with 2 locking bolts. Surgery was performed with the patient in the supine position on a fracture table, with the injured extremity slightly adducted to facilitate insertion of the implant. Fracture fixation which was performed according to the surgical technique described by Campbell's Operative Orthopaedics. After surgery, the patients were mobilized and given standard rehabilitation instructions by a physiotherapist.

Steps in Trochanter Fixation Nailing

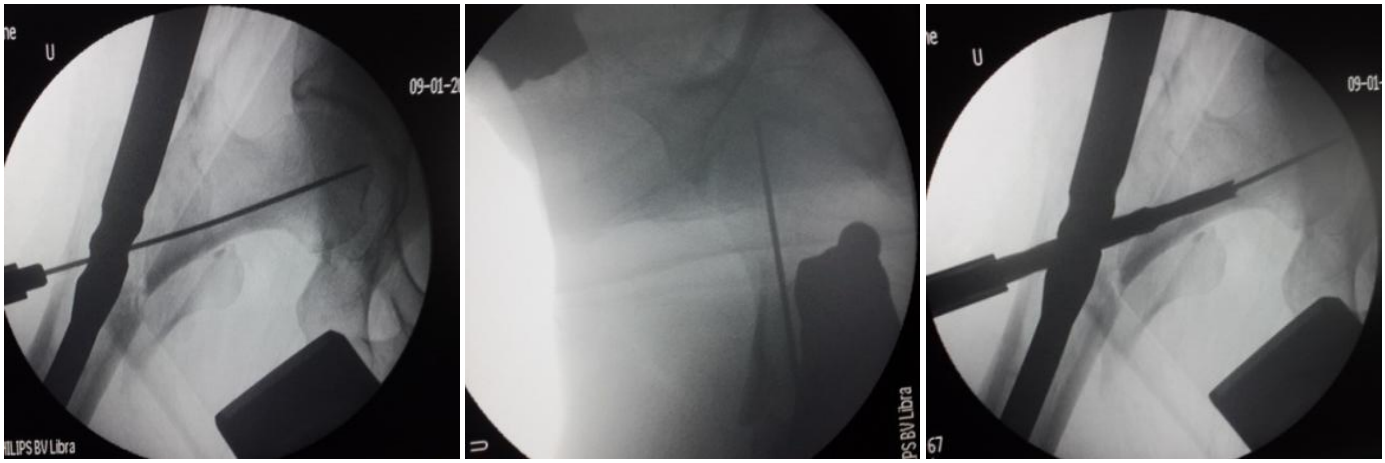
1. Using image intensification a closed reduction was performed to s near anatomical position as possible.



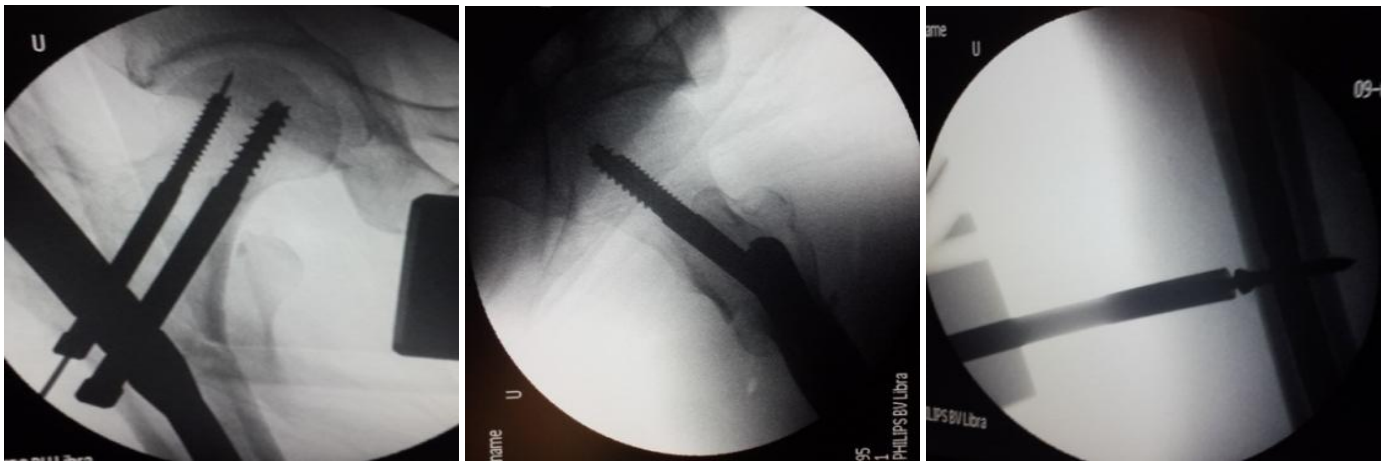
2. 4-5cm incision was made just proximal to the greater trochanter. A fossa finder was positioned on the medial tip of the greater trochanter and advanced within the canal till the level of the lesser trochanter.

3. Guide wire was advanced in the medullary canal and the canal was reamed. TFN was loaded in zig and gluided along the guide wire.

4. Guide pins were advanced into the femoral head. Correct length of pins were measured by the calibrated reamer.



5. Screws were placed in the both center of the head or slightly inferiorly within 5 to 10mm of subchondral border. Distal locking was done (either one or two)



6. The was introduced through more anterior entrance portal on the greater trochanter after proper alignment on zig
7. Anatomic curvature, rotation, and blunt nail tip would help to avoid distal cortex anterior penetration.
8. It was better to put at least one screw in the dynamic slot (to control rotation and also allows some axial impaction). In very unstable fractures, two distal locking screws would provide better fixation. Short nails had external jigs for easier locking.

Case Illustrations: Pre-operative and post operative x-rays

At 8 weeks follow up

Pre & Post operative x-rays with complications-Z effect

Post-operative regimen

- Drain removal -3rd Post operative Day
- In bed quadriceps exercise – from 3rd Post operative Day
- Mobilization with walker - from 8th Post operative Day
- At 13 days - suture removal and discharge

Rehabilitation

- Toe touch walking – 3 weeks
- Partial weight bearing - 4 weeks Post-operative
- Full weight bearing – 6-8 weeks Post-operative

Follow-up

• At 4 weeks – follow up X-rays and partial weight bearing.
• At 8 & 12 weeks - follow up X-rays and full weight
• At 6 months - follow up X-rays and assessment

Patient Assessment

Intra-operatively, blood loss was measured from the number of mopping pads used and the quantity in suction unit. The time required for closed reduction of the fracture, the operating time and the fluoroscopy time were recorded. The demographic data (age and sex), perioperative information and length of hospital stay were recorded for each patient.

Patients were followed up for a minimum of 6months. Functional outcomes were assessed using the Harris Hip scoring system. Patient outcome scores were categorized as excellent (≥ 90), good (89 – 80), fair (79 – 70) or poor (≤ 70). Radiographic evaluation was done for fracture union, extent of fracture collapse, medial displacement, neck-shaft angle alteration, implant failure and change in implant position. Radiographic fracture union was defined as the presence of bridging callus on antero-posterior and lateral radiographs.

Statistical Analysis

Data was compiled and statistically analyzed. For non-parametric distribution Mann-Whitney U Test & Chi - square tests were used. For parametric data independent samples t test was used. A P-value of < 0.05 was considered to be statistically significant

Observations

Table 1: Age and Sex Incidence in both groups

Age group in years	No. of male patient		No. of female patient		Total	%
	Group A TFN	Group B DHS	Group A TFN	Group B DHS	TFN & DHS combined	TFN & DHS combined
20-40 yrs.	02	00	00	00	02	5
41-60 yrs.	06	08	04	05	23	57.5
61-80 yrs.	06	02	01	03	12	30
>80 yrs	00	01	01	01	03	12.5
Total	25		15		40	100

Table 2: Limb length shortening (cm)

Groups	0	0-1	>1-2	>2-3	>3-4	Total
Group A(TFN)	18	0	1	1	0	20
Group B(DHS)	14	3	2	1	0	20

Table 3: Functional outcome (measured by Modified Harris Hip Score)

Group	Excellent (HHS 90-100)	Good (HHS 60-89)	Fair (HHS 30-59)	Poor HHS<30	Total
Group A	14	04	02	00	20
Group B	10	06	02	02	20

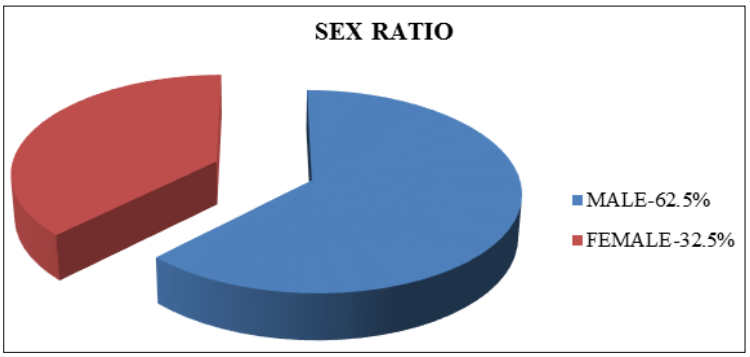
Table 4: Union time in weeks

Groups	<6	6-8	9-10	11-12	13-14	15-18	19-24	Total
Group A	00	00	02	14	02	02	00	20
Group B	00	00	02	04	10	04	00	20

Intepretation & Results

1. Age and sex distribution

In our study maximum age was 85 years and minimum age was 33 years. Most of the patients were between 40- 60 years. Mean age was 58.4 years. There were 25 male (67.5%) and15 female patients (32.5%).



2. Nature of

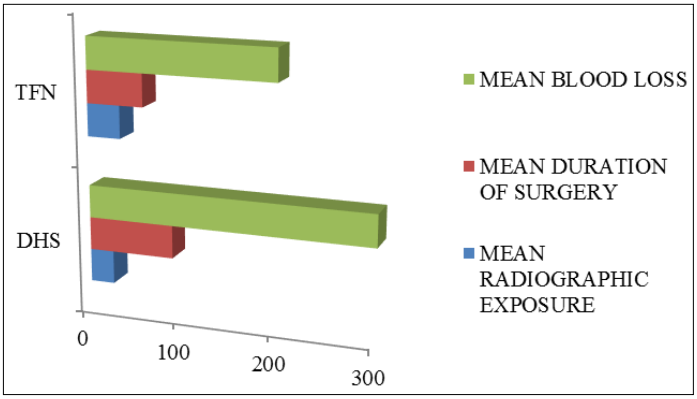
Type of Fracture	Number of Cases	
TFN	DHS	TFN
Type 1	8	8
Type2	10	10
Type 3	1	1
Type 4	1	1
Total	20	20

5. Time of surgery

All the patients were operated at an average interval of 4.5 days from the day of trauma.

6. Intra Operative Details

Blood loss was measured by moping pad count (each fully soaked moping pad contain approximately 50ml of blood) and collection in suction. External blood loss was more for DHS compared to TFN and in TFN there was more blood loss where open reduction was performed.



Intraoperative Details	DHS	TFN
Mean Radiographic Exposure (no of shots)	24.3	36.2
Mean Duration of Operation (in minutes)	92.4	61.7
Mean Blood loss (in milli litres)	300	200

7. Intra operative complications

Intra operative complications included with DHS	Number of cases	Percentage
Varus angulation	2	10%
Intra operative complications included with TFN.	Number of cases	Percentage
Failure to achieve closed reduction	1	5%
Fracture of lateral cortex	1	5%
Failure to put derotation screw	1	5%

In our study there was difficulty in achieving closed reduction in one case of displaced fracture, where open reduction was done. There was iatrogenic fracture of the lateral cortex of proximal fragment in 1 out of 20 cases of TFN. This had occurred in initial case probably due to wrong entry point and osteoporotic bone. We had no difficulties in distal locking. All the cases were locked distally with at least one locking bolt. There were no instances of drill bit breakage or jamming of nail. Failure to put derotation screw was due to zig implant mismatch which was rectified subsequently by changing the external zig.

8. Infection

Post-operative complications included one case of infection among the TFN patients for whom the head screw was removed and the infection settled down.

9. Delayed complications

Delayed complication among DHS group

Complications	Number of cases	Percentage
Shortening of >1cm	3	15%
Varus Malunion	1	5%
Persistent hip pain	1	5%
Restriction of hip movements	1	5%

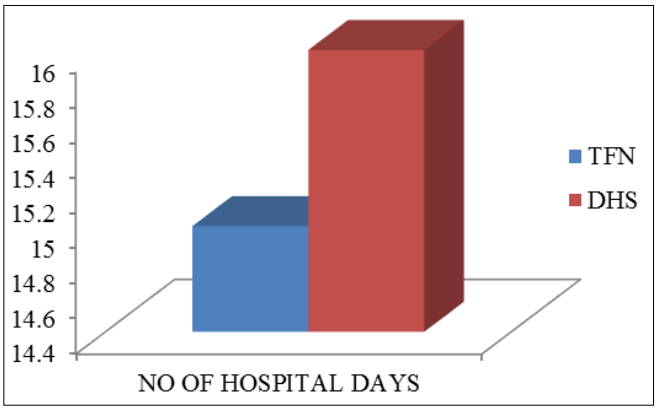
There were no cases of screw cutout & nail breakage. There was no case of non-union or implant failure.

Delayed complication among TFN group

Complications	Number of cases	Percentage
Shortening of >1cm	1	5%
Hip stiffness	1	5%

10. Duration of hospital stay

In our study the average duration of hospital stay was 15.2 days for TFN patients and 16.6 days for DHS patients. The mean time of full weight bearing was 12-14 weeks for TFN and 15-16 weeks for DHS. All patients enjoyed good, hip and knee range of motion except for 1 patient of TFN who had self fall in post op period leading to screw pull out & subsequent infection resulting in screw removal leading to prolonged immobilized for longer period resulting in hip stiffness.



TFN		DHS
Mean duration of Hospital stay (in days)	15.2	16.6
Mean time for full weight bearing (in weeks)	12.25	15.3

11. Radiological Union

Time to healing, defined as the time of the formation or circumferential bridging callus across the fractures. The average time of healing was;
In TFN -12.25 Weeks.
In DHS -15.3 Weeks.

12. Anatomical Outcome

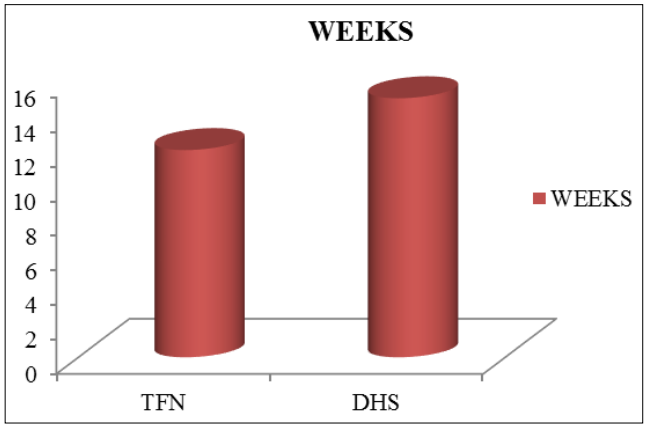
Anatomical results were assessed by shortening, hip and knee range of movements and varus deformity.

Anatomical Result		Number of cases
TFN		DHS
Shortening more than 1cm	1	3
Varus deformity	0	1
Restriction of Hip movement	1	1
Persistent Hip pain	0	1

13. Functional outcome

Interpretation of functional results of DHS&TFN based on modified Harris hip score.

Functional Results		Number of cases	Percentage	
DHS		TFN	DHS	TFN
Excellent	10	14	50%	70%
Good	6	4	30%	20%
Fair	2	2	10%	10%
Poor	2	0	10%	0%



Discussion

While a wide range of intertrochanteric fracture fixation devices have been employed over the years, the choice for optimal fixation device is still controversial. The successful treatment of trochanteric fractures depends on many factors including the patients factor (age, general health, time from fracture to treatment, communition, bone quality, concurrent medical treatment), surgeon factor (competency, stability of fixation) and the implant factor. Sufficient knowledge regarding the biological and biomechanical principle of these devices should be obtained, as both of these intramedullary and extramedullary devices have advantages and disadvantages.

Introduction of the dynamic hip screw in the 60s saw a revolution in the management of inter trochanteric fractures. The device allowed compression of the fracture site without complications of screw cut-out and implant breakage. However, the extensive surgical dissection, blood loss and surgical time required for this procedure often made it difficult for use in the elderly with co-morbidities. The implant also failed to give good results in extremely unstable and the reverse oblique fracture.

The factors most significant for instability and fixation failure are: (i) Loss of poster medial support, (ii) severe communition, (iii) subtrochanteric extension of the fracture, (iv) Reverse oblique fracture. (v) Shattered lateral wall (vi) extension into femoral neck area and (vii) poor bone quality. Osteoporosis is particularly important in the fixation of proximal femoral fractures [3].

In the 21st century the AO group developed the trochanteric fixation nail (TFN) as an intramedullary device for the treatment of trochanteric fractures in order to overcome the deficiencies of the extramedullary fixation of these fractures. This nailing has the following advantages compared to extramedullary implant-such as decreasing the moment arm, can be inserting by closed technique(which retains the fracture haematoma an important consideration in fracture healing), decreasing blood loss, infection, minimizing the soft tissue dissection and wound complications. In a clinical multicentric study, authors reported technical failures of the TFN after poor reduction, malrotation or wrong position of screws and poor surgical techniques.

Sliding hip screws have been directly compared with intramedullary fixation in many studies. Early reports on intramedullary implants suggested some substantial advantages in association with this type of fixation, including a minimally invasive surgical technique, shortened operating times, decreased blood loss, improved biomechanics, greater stability of fixation, earlier patient mobilization and shorter lengths of stay. Jones. compared the intramedullary nail (IMN) which involved gamma nail, intramedullary hip screw (IMHS), and PFN with sliding hip screw for treatment of extracapsular proximal femoral fractures. Parker and Handoll *et al* also compared gamma and other cephalocondylic intramedullary nails with extramedullary implants for extracapsular hip fractures in adults [4].

In our series - 40 cases of Intertrochanteric fractures were managed by trochanteric fixation nail and dynamic hip screw (20 cases in each group). Out of 40 there were 25 male and 15female patients. Minimum age was 33 years & maximum age was 85 years with mean age of 58.4 year. Slip and fall accounted for 32(80%), Fall from height: 6(15%), RTA: 2(5%). Right side was involved in 26 cases (65%), left involved in 14 cases (35%). Right was more common than left side. BOYD and GRIFFIN Type I -40%, Type II -50%, Type III-5%, Type IV-5% fracture. Mean duration of hospital stay was 16.6 days for DHS and 15.2 days for TFN. Length of incision was small 5-6cm in TFN group compared to 10-12cm in DHS group. Mean external blood loss 200ml in TFN group and 300 ml in DHS group. Mean time for full weight bearing was 12.25 weeks for TFN group and 15.3 weeks for DHS group. Radiological union was 12.3 weeks in TFN group and 15.5 weeks in DHS group. Good to excellent results were seen in 90% of cases in TFN group and 80% in DHS group.

In this series mean operative time was significantly longer in DHS group that is comparable with the study of P. Bienkowski *et al* and H.M. Klinger *et al*. This difference was probably related to the longer time required to dissect the subcutaneous tissue, iliotibial tract and vastus lateralis muscle and to repair them in the DHS group [5]. In contrary, in TFN group intramedullary reaming was often not required as the nail usually ends before the femoral isthmus. Mean blood loss during surgery was significantly lower in the TFN group. This observation was comparable with the study of J. Pajarinen *et al* and Hu W *et al*.

Greater amount of blood loss could be directly correlated with the longer operative time and the necessity of soft tissue dissection in the DHS group. The radiation exposure due to fluoroscopy was significantly higher in the TFN group; this was attributed to the fact that lateral view of the fractured hip had to be visualized more number of times in cases of TFN. The average hospital stay had been slightly higher in DHS group compared to the TFN group in our study. The observation was comparable with the study of H.M. Klinger *et al* and Di Monaco *et al*. The Factors which actually prolonged hospital stay in both of these groups were coexisting medical illness and the incidence of post-operative complications specially infection.

Regarding complications a case of infection (5%) was statistically similar with the study of S.H.Bridle *et al*. Deep infection often required debridement, hardware removal & delayed post-operative rehabilitation to some extent [6]. Progressive varus collapse was present in the DHS group.

The ideal implant for the treatment of trochanteric fractures would be an easily inserted intramedullary device that allowed controlled impaction across the fracture zone while preventing fracture site rotation. Neck screws must achieve sufficient purchase in the femoral head in order to resist cut-out. The intramedullary nail appears to be superior by maintaining the integrity of the lateral femoral wall. The reason could be that the

nail-screw angle is fixed through the guide system, and if the lateral wall is fractured, the nail itself could have a lateral buttress effect by direct contact of the proximal part of the nail with the neck-head fragment. Intramedullary fixation device (TFN) might therefore be a better implant in these types (unstable) of fractures.

A consensus from recently published literature has been emerged that intramedullary nail fixation is associated with a higher complication rate (intraoperative), a higher rate of reoperation and no better outcomes [7]. On contrary, Saudan *et al*. 2002, Stern *et al* 2007, Anglen and Weinstein *et al* 2008, and Parker and Handoll *et al* 2010 have shown no such difference in reoperation rate between the two types of implants.

One meta-analysis of eleven studies that specifically focused on unstable fractures (Orthopaedic Trauma Association classification 31-A3) suggested that the failure rate associated with trochanteric nails was significantly lower than that associated with plate and screw fixation which can be corroborated with our study [8]. It is indicated in some studies that intramedullary devices helps in facilitating early postoperative rehabilitation [9]. Differences in the postoperative recovery and functional outcome between Group A (TFN) and Group B (DHS) can be attributed to postoperative bone stability and invasiveness of each procedure to the hip muscles.

In terms of bone stability, patients undergoing nail fixation had better HHS scores than those undergoing plate fixation as the mechanical axis of the intramedullary nail lies closer to the axis of the femur. Therefore, nail could decrease mechanical bending stress to the implant [10]. The TFN device is implanted through a small incision above the greater trochanter. This entry point causes less damage to gluteus muscle [11]. In our study, there was a significant difference in HHS scores with better functional outcome in the Group A (TFN) in early post-operative phase (4 wks and 8 wks).

Limitations of our study were that it couldn't analysis the outcome of the two implant in more specific fracture type (in reverse oblique fractures & fractures with sub trochanteric extension due to less cases in this category). Furthermore, we have not analyzed about after refractures after implant removal & the duration of study is relatively shorter when compared to other studies.

Conclusion

In conclusion, TFN and DHS are equally effective in the treatment of trochanteric fractures. The TFN is a load-bearing device, reduces iatrogenic tissue trauma and allows for earlier postoperative weight bearing. It is associated with higher radiation exposure compared with the DHS group & technically difficult procedure which requires more expertise compared to DHS. During the learning phase the TFN procedure is steep but with experience gained from each case operative time, radiation exposure and intraoperative complications can be reduced in subsequent cases of TFN. The present study showed that the TFN device can be used effectively to treat trochanteric fractures and may be the best choice particularly in unstable trochanteric fractures.

References

1. Cummings SR, Rubin SM, Black D. The future of hip fractures in the United States. Numbers, costs, and potential effects of postmenopausal estrogen. Clinical Orthopaedics and Related Research. 1990; 252:163-166.
2. Canale ST, Beaty JH. Campbell's Operative Orthopaedics, St. Louis, Mo, USA, 11th edition edition, 2007.
3. Utrilla AL, Reig JS, Mu˜noz FM, Tufanisco CB. Trochanteric gamma nail and compression hip screw for trochanteric fractures: a randomized, prospective, comparative study in 210 elderly patients with a new design of the gamma nail. Journal of Orthopaedic Trauma. 2005; 19(4):229-233.
4. Parker MJ, Handoll HH. Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures. Cochrane Database of Systematic Reviews, no. 1, Article ID CD000093, 2002.
5. Butt MS, Krikler SJ, Nafie S, Ali MS. Comparison of dynamic hip screw and gamma nail: a prospective, randomized, controlled trial, Injury. 1995; 26(9):615-618.
6. Bridle SH, Patel AD, Bircher M, Calvert PT. Fixation of intertrochanteric fractures of the femur. A randomized prospective comparison of the gamma nail and the dynamic hip screw. Journal of Bone and Joint Surgery B. 1991; 73(2):330-334.
7. Goldhagen PR, DR. O'Connor, Schwarze D, Schwartz E. A prospective comparative study of the compression hip screw and the gamma nail. Journal of Orthopaedic Trauma. 1994; 8(5):367-372.
8. The Scientific World Journal. 2013. Article ID 805805, 8 pages http://dx.doi.org/10.1155/2013/805805
9. National Journal of Medical and Dental Research. 2013: 2(1):43-49.
10. Banodha AL, Sharma BDK, Afsar khan. Journal of Indian Orthopaedic Rheumatology Association. 2015; 1(1):12-19.
11. Subhadip Mandal, Nitin Kumar, Utpal Banerjee, Debjyoti Roy, Subhajyoti Mandal. J Orthop Trauma. 2017; 31(1). The 2015 Bovill Award Paper.