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Comparison of the functional outcome of trochanteric fixation nail (TFN-180 mm) versus short proximal femoral nail (short PFN 250 mm) for fixation of intertrochanteric fractures

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Abstract
Introduction: Pertrochanteric fractures are devastating injuries that most commonly affect the elderly. There are various forms of internal fixation devices used for Trochanteric Fractures; of them, the most commonly used device is the Dynamic Hip Screw with Side Plate assemblies. In unstable fracture patterns, intramedullary devices such as the PFN appear to have a biomechanical advantage over extramedullary devices.
Aim: To compare the functional outcome of Trochanteric Fixation Nail (TFN-180mm) versus short Proximal Femoral Nail (short PFN 250mm) for fixation of intertrochanteric fractures.
Material and Methods: A prospective study was conducted at Queen's NRI Hospital, Visakhapatnam, Andhra Pradesh, India, on patients with intertrochanteric fracture of the femur the follow-up was recorded in 6 weeks, three months, six months. Observations are recorded in age, sex, affected side, post-Operative pain using the Visual Analogue scale Functional outcome assessed through the Harris Hip score and complications were recorded.
Results & Conclusion: A total number of 30 cases of stable and unstable inter trochanteric fractures were treated with closed/ open reduction and internal fixation with short PFN and TFN with 15 in each group. Our study has a total female predominance of 2:1. The mean age for short PFN candidates was 67.46 years, it was 69.66 years for the TFN group. The average Harris Hip Score for the TFN group was 80.66 and PFN was 79.80. Indicating the functional outcome for both intramedullary devices were the same. Short PFN was associated with a more recurring complication of anterior thigh pain, which was seen more predominantly in the females.

Keywords: Short PFN, TFN, elderly, intertrochanteric, pertrochanteric fractures

Introduction
As the boon for medical services has been noticed, this has resulted in the growth of the average life span of the elderly, but this population have not been spared from the repercussions that comes with the same such as osteoporosis and high incidence of hip fractures. Hip fractures fall into these two categories as intracapsular and extracapsular fractures. Extracapsular (EC) fractures includes intertrochanteric and subtrochanteric fractures. EC Fractures are also known as Pertrochanteric fractures. Pertrochanteric fractures are devastating injuries that most commonly affect the elderly and also in young, have a tremendous impact on both the health care system and society in general. These fractures are common in the elderly people as the tendency to fall increases with the patient's age and are increased by various factors such as poor vision, decreased reflexes and existing musculoskeletal pathology, whereas Trochanteric fractures occur in the younger population due to high velocity trauma. The incidence of trochanteric fractures is more in the female population compared to the male due to osteoporosis. There are various forms of internal fixation devices used for Trochanteric Fractures; of them the most commonly used device is the Dynamic Hip Screw with Side Plate assemblies. In unstable fracture patterns, intramedullary devices appear to have a biomechanical advantage over extramedullary devices, lowering the forces imposed on the implant due to the shorter lever arm of the fixation.

The present study aimed to compare the Trochanteric Fixation nail with the short proximal femoral nail, to determine if the use of the nail decreased postoperative pain, improved function, and lowered the post-operative complications in patients with a trochanteric fracture with either stable or unstable pattern.

Materials and Method

A prospective study was conducted at Queen's NRI Hospital, Visakhapatnam, Andhra Pradesh, India, on patients with intertrochanteric fracture of the femur who fulfilled the inclusion criteria from a period of September 2019 to January 2021. Clearance from Institutional Ethical and Scientific committee was taken prior to initiation of the study and the outcomes were recorded radiologically and functionally.

Inclusion Criteria: a) Adult patients with inter trochanteric fracture femur with or without subtrochanteric extension. b) Age group above 30 years of age. c) All sexes. d) Patients with no signs of active infection. e) No specific duration of illness. f) Patient willing to participate.

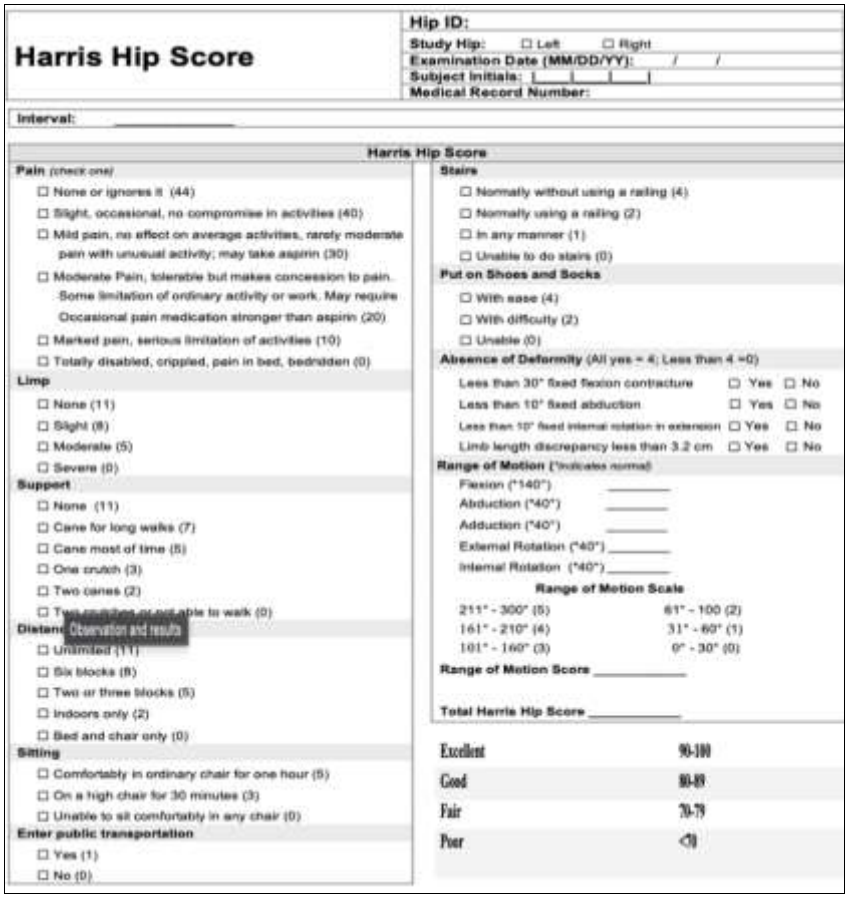
Exclusion Criteria: a) Patient with previous surgeries to the same proximal femur. b) Patients with pathological fractures other than osteoporosis. c) Young patients (less than 30 years). d) Patients with open injuries. e) Patients with neurovascular deficiency. f) Patients medically unfit for surgery. g) Acute active infection of the hip. h) Periprosthetic fractures. i) Patients having deformities or pathologies of other joints of the lower limb have adverse effects on the functional outcomes of surgery. j) Refusal for surgery.

Sample: A total number of 30 cases were chosen for the whole study and surgically managed with closed reduction and internal fixation, 15 of which were TFN for implants and the other 15 were short PFN.

Intervention: after obtaining a thorough history and performing a detailed clinical examination and stabilisation with primary first aid, upon patient's consent admission was given and regular surgical lab tests with additional special tests according to the need per the PAC were done. At the time of surgery under spinal anesthesia, each patient was positioned on the fracture table and closed reduction was performed under fluoroscopic guidance, choice of iv antibiotic was given half an hour prior to incision. Open reduction was thus performed and either of the implants was chosen both 8.0 mm lag and 6.4mm derotation bolts were fixed in that sequence to ensure compression and the tip-apex distance was carefully maintained, distally fixed with 4.9 locking bolt and the position and reduction confirmed under fluoroscopic guidance before jig removal. The closure is performed in layers.

Statistical Analysis: The Pearson's Chi-Square test observed the rate of union (maximum range of movements), complications and functional outcomes in proximal femoral fracture after administration in groups. The comparison was made using the student t test and a p-value of <0.005 was considered significant.

Data Organization: The mean duration between fracture and time of surgery was 7 to 10 days, all patients were operated on under spinal anaesthesia and the mean duration of surgery for both the groups was less than the standard long PFN patient were randomly allocated in each group, the follow up was recorded in 6 weeks, three months, six months. And observations are recorded in age, sex, affected side, post-operative pain, walking ability, Harris hip score, range of motion and complications.



Harris Hip Score

Hip ID:
Study Hip: ☐ Left ☐ Right
Examination Date (MM/DD/YY): / /
Subject Initials: [ ][ ][ ]
Medical Record Number:

Interval: _____

Harris Hip Score

Pain (check one)
- ☐ None or ignores it (44)
- ☐ Slight, occasional, no compromise in activities (40)
- ☐ Mild pain, no effect on average activities, rarely moderate pain with unusual activity; may take aspirin (30)
- ☐ Moderate Pain, tolerable but makes concession to pain. Some limitation of ordinary activity or work. May require Occasional pain medication stronger than aspirin (20)
- ☐ Marked pain, serious limitation of activities (10)
- ☐ Totally disabled, crippled, pain in bed, bedridden (0)

Limp
- ☐ None (11)
- ☐ Slight (8)
- ☐ Moderate (5)
- ☐ Severe (0)

Support
- ☐ None (11)
- ☐ Cane for long walks (7)
- ☐ Cane most of time (5)
- ☐ One crutch (3)
- ☐ Two canes (2)
- ☐ Two crutches or not able to walk (0)

Distanc Observation and results
- ☐ Unlimited (11)
- ☐ Six blocks (8)
- ☐ Two or three blocks (5)
- ☐ Indoors only (2)
- ☐ Bed and chair only (0)

Sitting
- ☐ Comfortably in ordinary chair for one hour (5)
- ☐ On a high chair for 30 minutes (3)
- ☐ Unable to sit comfortably in any chair (0)

Enter public transportation
- ☐ Yes (1)
- ☐ No (0)

Stairs
- ☐ Normally without using a railing (4)
- ☐ Normally using a railing (2)
- ☐ In any manner (1)
- ☐ Unable to do stairs (0)

Put on Shoes and Socks
- ☐ With ease (4)
- ☐ With difficulty (2)
- ☐ Unable (0)

Absence of Deformity (All yes = 4; Less than 4 =0)
- Less than 30° fixed flexion contracture ☐ Yes ☐ No
- Less than 10° fixed abduction ☐ Yes ☐ No
- Less than 10° fixed internal rotation in extension ☐ Yes ☐ No
- Limb length discrepancy less than 3.2 cm ☐ Yes ☐ No

Range of Motion (*Indicates normal)
- Flexion (*140°) _____
- Abduction (*40°) _____
- Adduction (*40°) _____
- External Rotation (*40°) _____
- Internal Rotation (*40°) _____

Range of Motion Scale

211° - 300° (5)	61° - 100 (2)
161° - 210° (4)	31° - 60° (1)
101° - 160° (3)	0° - 30° (0)

Range of Motion Score _____

Total Harris Hip Score _____

Excellent	90-100
Good	80-89
Fair	70-79
Poor	<70

Fig 1: Visual Analogue Scale (VAS)

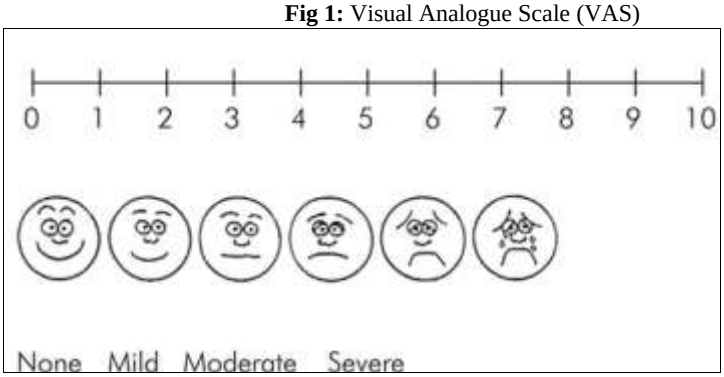


Fig 2: TFN and PFN

Fig 3: Loaded Nail

Observation and Result

A total number of 30 cases of stable and unstable inter trochanteric fractures were treated with closed/ open reduction and internal fixation with short PFN and TFN. In our study the mean age for short PFN candidates was 67.46 years, it was 69.66 years for the TFN group. Our study has a total female predominance of 2:1 while there was no such affection for either of the groups as in short PFN group 11 females and 4 males and in TFN group 8 females and 7 males. There was an equal distribution of cases with respect to sides as 15 were affected by right sided involvement while the other 15 with left sided in the total study. Amongst the groups 7 right short PFN and 8 Left short PFN while in TFN 8 right sided and 7 left sided.

Table 1: Age, sex and side comparison between TFN and short PFN groups

	TFN	PFN
Age	69.66	67.46
Sex (F:M)	11:4	8:7
Side (R:L)	8:7	7:8

The post-operative pain was assessed using a visual analogue scale (VAS). Our study suggests that most of the patients had slight pain in the either groups while none had any marked or severe pain and only 1 patient had moderate pain in the short PFN group.

Table 2: Pain score comparison between TFN and short PFN groups

Pain Score	Group		Total
	TFN	PFN	
Moderate Pain	0	1	1
Mild	3	1	4
Slight	10	12	22
None	2	1	3
Total	15	15	30

In our study we found that 12 patients (of the whole study) had no limp, 8 patients of the TFN group had a slight limp while 7 patients of the short PFN group had a slight limp, 2 patients of the TFN group had moderate limp while 1 patient of short PFN group had moderate limp.

Table 3: Comparison of Limp between TFN and short PFN groups

Limp Score	Group		Total
	TFN	PFN	
Moderate	2	1	3
Slight	8	7	15
None	5	7	12
Total	15	15	30

On the basis of the use of walking aid our study found that 15 patients in the total study required no support to walk post operatively, 4 patients of the TFN group used canes
for long walks while 6 of short PFN group used canes for long walk, 2 patients of the TFN group needed to use cane most of the time while only 1 Patient of short PFN group needed cane most of the time, one 1 patient of TFN group needed to use one crutch for walking whereas none in the short PFN group and no patient needed two canes in the TFN group but 1 patient requires two canes in the short PFN group.

Table 4: Walking aid usage amongst TFN and short PFN groups

Support	Group		Total
	TFN	PFN	
Two Canes	0	1	1
One Crutch	1	0	1
Cane most of time	2	1	3
Cane for long walks	4	6	10
None	8	7	15
Total	15	15	30

ROM grade (Circumduction of the hip in degrees) is calculated by assessing the range of motion of the hip in all planes and corresponding to that range a number is allotted as per the Harris Hip score, for each patient in each group at 6 weeks, 3 months and 6 month as a form of assessment for bony union post operatively. The results showed for all patients ROM grade subsequently improving with each follow up and maximum at the 6 months and thereafter no noticeable change observed.
Average Harris Hip Score for TFN group was 80.66 of which 2 had good outcome, 2 had fair outcome,9 had good outcome and 2 had excellent outcome and PFN was 79.80 of which 2 had poor outcome, 5 had fair outcome, 3 had good outcome, 5 had excellent outcome.

Table 5: Comparison of Harris Hip score between TFN and short PFN groups

Group	N	Mean	SD	T-Value	P-Value	Decision
TFN	15	80.6667	11.81202	0.190	0.850	Not Significant
PFN	15	79.8000	13.10507			

Table 6: Comparison of functional outcomes amongst TFN and short PFN groups

		Group		Total
		TFN	PFN	
Outcome	Poor	2 13.3%	2 13.3%	4 13.3%
	Fair	5 33.3%	2 13.3%	7 23.3%
	Good	3 20.0%	9 60.0%	12 40.0%
	Excellent	5 33.3%	2 13.3%	7 23.3%
Total		15 100.0%	15 100.0%	30 100.0%

With respect to complications 6 of the PFN patients had anterior thigh pain, 1 had screw migration and 1 had screw cut out with varus collapse.

Complications

Table 7: Complications between TFN and short PFN

Complication	TFN	Short PFN
Peri Implant Fracture	00	00
Anterior thigh pain	00	06
Screw migration	00	01
Infection	00	00
Varus collapse and screw cut out	00	01
Z effect	00	00
Reverse Z effect	00	00
Avascular necrosis	00	00
Mortality	00	00
Sciatic Nerve Palsy	00	00
Non-Union	00	00

The TFN group has no anterior thigh pain whereas 40% (6 out of 15) patients from short PFN group shows anterior thigh pain and shows a statistical significance. In the total of 15 short PFN patients 6 had anterior thigh pain, of which 4 were females.

Fig 4: Pre op

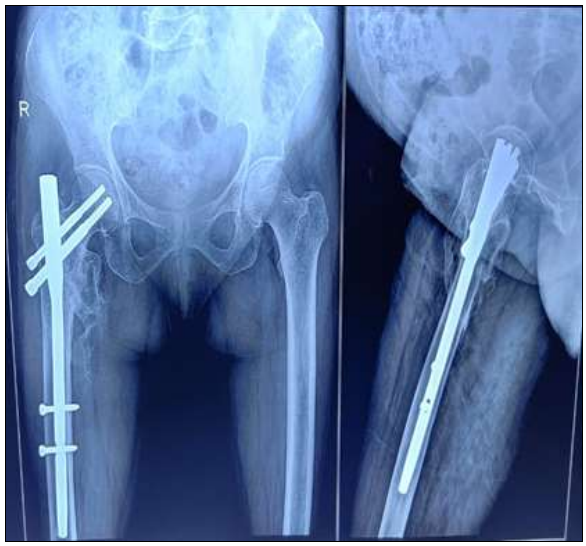


Fig 5: 6 months Follow up (short PFN)

Fig 6: Pre-op

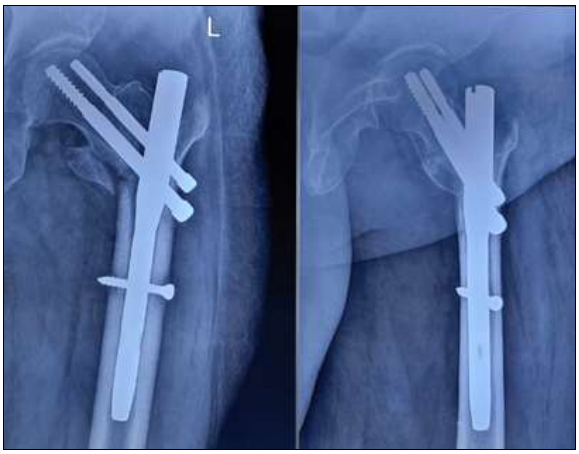


Fig 7: 6th month post op (TFN)

Discussion

As the elderly population is at a higher risk for falls due to muscle weakness, use of excess prescription medications, use of an assistive device, arthritis, depression, age older than 80 years, impairment in gait, balance, cognition, vision and activities of daily living [1].

These fractures are so far the most frequent cause of hospitalization after a fall in the elderly population and the treatment is highly expensive, even though due to good infrastructure and medical advancements the fracture incidence has slowed down in the developed countries but the

global incidence is still rising [2]. The incidence of trochanteric fractures is more in the female population compared to the male due to osteoporosis. In a Swedish study of more than 20,000 patients, the incidence of hip fractures in women doubled every 5.6 years after the age of 30 years [5]. While the average length of femur in the Chinese Population has been reported as 428mm the anterior curvature is located in the middle of the femur on the other hand the Japanese population averaged to be around 395.7mm in terms of femur length, no sex wise demarcation was assessed in these studies [3]. The average length of femur in the Indian population is 433.8+/-31.4mm [4] hence the short PFN being 250mm in length is expected to impinge at the anterior bow of the femur which is more or same likely to be at this point causing anterior thigh pain which can be avoided by the use of TFN which is calibrated at 180mm. It can be successfully inserted below the distal isthmus not only without jamming but also without reaming. Furthermore, TFN reduces stress concentration at the tip and the smaller distal diameter prevents femoral shaft fractures. Previously the sliding hip screw or D.H.S. was considered as the Gold standard for treating stable trochanteric fractures, but excessive collapse with shortening and high failure rates are concerns about their use in unstable trochanteric fractures [3]. In unstable trochanteric fractures, intramedullary devices have an advantage of load sharing with smaller bending moments allowing early weight bearing and preventing excessive collapse and have biomechanical advantage over their extra medullary counterparts [3]. They act as a buttress to prevent medialisation of the shaft and provides more efficient load transfer and is designed to provide linear intraoperative compression of head neck segment to shaft along with rotational stability which minimises malunion of neck. Both TFN and short PFN works on controlled collapse at the fracture site which have load sharing ability, short lever arm provides relative stability and secondary bone healing [9]. The most important technical aspects of screw insertion are (1) placement within 1cm of subchondral bone to provide secure fixation and [2] central position in the femoral head (tip-apex distance).The tip apex distance can be used to determine lag screw position within the femoral head. This measurement is expressed in millimetres, the sum of the distances from the tip of the lag screw to the apex of the femoral head on both AP and lateral radiographic views [10]. The sum should be <25mm to minimize the risk of lag screw cut out. The minimum is reported to be 10mm [6]. We chose Harris Hip score for evaluating the functional outcome of this study which has been an excellent tool for inferring the prognosis of the functional ability of the patients managed with surgery with either of the implants [12]. our study testify that both short PFN and TFN have similar favourable outcome rate irrespective of patients age or sex and has normal bony union rates when compared to the older generation implants Like DHS, and the long PFN with the added benefit of decrease surgery duration, decreased blood loss, decreased C arm exposure and a probable early ambulation to the patients [13].

Out of the complications anterior thigh pain, screw back out and varus collapse are the most common. Anterior thing pain more common with cases managed with short PFN due to impingement of tip of the nail at the isthmus and level of anterior bowing of the femur [11], considerably more common in females owing to shorter and thinner anatomy of the femur bone than males. Intramedullary nails with two lag screws were designed to improve rotational control and bony purchase within the femoral head, thus resisting cut out and subsequent fixation failure [5]. This implant design, however, has led to the recognition of a new failure pattern—the Z-effect phenomenon— which manifests as collapse of the head/neck fragment resulting in protrusion of the superior lag screw and migration of the inferior lag screw lateral to the nail [14, 15, 16]. In our study we had one case of screw backout in the short PFN Group which was compensated by the patient using walking cane on the opposite side for all the activities but bony union was achieved on radiograph indicative of the overall risk of the complication associated with any kind of intramedullary device used to fix intertrochanteric fractures of the femur and is not pertaining to any specific implant group [7]. In our study we had one patient with varus collapse with screw cut out from the short PFN group which occurred secondary to another trauma and not due to the implant itself, patient was non ambulatory for the most part but could stand and walk with limp up to 5 blocks with support with moderate pain, there was 2cm of supratrochanteric shortening of the affected limb. The patient was advised for revision with implant removal and refixation but did not comply upon studies by Dr Anandsrinivas A. Sowlee *et al*. [7] and PK Jangde *et al*. [8] suggests no significant difference between the either groups rather it is a factor dependent upon peroperative reduction and have similar rates in both the groups.

Conclusion

Pertrochanteric fractures are one amongst the notorious conditions debilitating the elderly. The current regimen is to surgically intervene with any choice of implant being extra medullary and/or intramedullary. For unstable IT fractures Intramedullary nailing is the preferred option as it creates biomechanically a stable construct. The functional outcome for both TFN and short PFN are similar in terms of pain relief, range of movements, which was assessed by Harris hip score. The complications associated were independent of the implant choice rather the nature of the intramedullary fixation biomechanics and intra-operational techniques. The standard short PFN group presented with complication of femoral nail impingement and hence is associated with anterior thigh pain, predominantly more common in females. Most of the previous studies have compared the short PFN with the long PFN but not sufficient data is available for comparison between TFN and short PFN. A small sample size is the main limitation of the current study and a more sufficiently powered, multicentre, adequately randomised prospective cohort with a longer follow up would determine a better data analysis.

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References

1. Dr. Krishnaswamy B, Dr. Gnanasambandam Usha. Assistant Professor, Department of Geriatric Medicine Madras Medical College and Government General Hospital Chennai City, Tamil Nadu State, India, Falls In Older People, National/Regional Review India. who.int/ageing/projects/SEARO.pdf
2. Natasa Radosavljevic, Dejan Nikolic, Milica Lazovic, Aleksandar Jeremic. Hip Fractures in a Geriatric Population - Rehabilitation Based on Patients Needs, aging and disease, Published online 2014 Jun 1. Pre published online 2013 Oct 23. 2014 Jun;5(3):177-182.
3. Wasudeo Gadegone M, Bhaskaran Shivashankar, Vijayanad Lokhande, Yogesh Salphale. Augmentation of proximal femoral nail in unstable trochanteric fractures, SICOT J. 2017;3:12.
4. Rajendran HSR, Raamabarathi K, Sundaramurthi I, Gnanasundaram V, Balaji T. Anthropometric Analysis of Femur in South Indian Population. Biomed Pharmacol J. 2020;13(1).
5. Naganur, Ravikumar, Basavaraddi BR. Clinical profile of patients with intertrochanteric fracture of femur. International Journal of Orthopaedics. 2019:5(3):726-728.
6. Kenneth Egol A, Kenneth Koval J, Joseph Zuckerman D, (Baumgaertner MR, CHrostowski JH, Levy RN. Handbook of fractures, 5th edition, 2015, 350.
7. Dr Anandsrinivas Sowlee A, *et al*. Comparison between Functional Outcome of Intertrochanteric Fractures treated with Trochanteric Fixation Nail versus short Proximal Femoral Nail JMSCR. 2016;4(11).
8. Sonu Mehta, Shoaib Shaikh, Sachin Bhonsle, Rahul Agrawal, Abhinav Bhatnagar, Sameer Rathore. Comparison of Intertan Nail Vs. Proximal Femoral Nail in Proximal Femoral Fractures – A Prospective Comparative Study, Journal of Research in Medical and Dental Science. 2017;5(2).
9. Mandal Masuraj Atal Bihari, *et al*. Comparative study of PFN vs PFNA 2 in intertrochanteric fractures: A randomised control trial. International Journal of Orthopaedics. 2020;6(4):461-465.
10. Geller Jeffrey A, *et al*. Tip-apex distance of intramedullary devices as a predictor of cut-out failure in the treatment of peritrochanteric elderly hip fractures. International orthopaedics. 2010;34(5):719-722.
11. Parmar Dipak S, Milind Porecha M, Shilpa Chudasama L. Long proximal femoral nails versus short proximal femoral nails for the management of proximal femoral fractures: a retrospective study of 124 patients. European Journal of Orthopaedic Surgery & Traumatology. 2011;21.3:159-164.
12. Karthik Vishwanathan, Keyur Akbari, Amit Patel J. Is the modified Harris hip score valid and responsive instrument for outcome assessment in the Indian population with pertrochanteric fractures? Journal of Orthopaedics. 2018 March;15(1):40-46.
13. Sellan Michael, *et al*., Short Versus Long Inter TAN Fixation for Geriatric Intertrochanteric Hip Fractures, A Multicentre Head-to-Head Comparison. Journal of Orthopaedic Trauma. 2019 April;33(4):169-174.
14. Kubiak EN, Bong M, Park SS, Kummer F, Egol K, Koval KJ. Intramedullary fixation of unstable intertrochanteric hip fractures: one or two lag screws. Journal of orthopaedic trauma. 2004;18(1):12-17.
15. Boldin C, Seibert FJ, Fankhauser F, Peicha G, Grechenig W, Szyszkowitz R. The proximal femoral nail (PFN)-a minimal invasive treatment of unstable proximal femoral fractures: a prospective study of 55 patients with a follow-up of 15 months. Acta Orthopaedica Scandinavica. 2003;74(1):53-58.
16. Tyllianakis M, Panagopoulos A, Papadopoulos A, Papasimos S, Mousafiris K. Treatment of extracapsular hip fractures with the proximal femoral nail (PFN): long term results in 45 patients. Acta orthopaedica belgica. 2004;70(5):444-54.