International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2017; 3(4): 865-870

www.orthopaper.com
Received: 29-08-2017
Accepted: 30-09-2017

Dr. Kamal Kumar Arora
Assistant Professor, Department of Orthopaedics GMC, Amritsar, DRME, Punjab, India

Dr. Simran Jit singh
Senior Resident GMC, Amritsar, DRME, Punjab, India

Dr. Priti chaudhary
Professor Head, Department of Anatomy, GGSMC, Faridkot, DRME, Punjab, India

Dr. Rajesh Kapila
Professor, Department of Orthopedics, GMC, Amritsar, DRME, Punjab, India

Dr. Rakesh Sharma
Professor, Department of Orthopedics, GMC, Amritsar, DRME, Punjab, India

Correspondence
Dr. Simran Jit singh
Senior Resident GMC, Amritsar, DRME, Punjab, India

Proximal femoral nail: A boon for peritrochanteric fractures

Dr. Kamal Kumar Arora, Dr. Simran Jit singh, Dr. Priti Chaudhary, Dr. Rajesh Kapila and Dr. Rakesh Sharma

DOI: https://doi.org/10.22271/ortho.2017.v3.i4l.119

Abstract
Expected age of human race has increased, leading to increase in the number of geriatric people with osteoporotic bones and falls associated with them. In 1949, Boyd and Griffin classified fractures in the trochanteric region of femur into four types. Biomechanical studies have shown that intramedullary device with sliding screw is better. Its location & rotational stability provides better load transfer and hence provides biological fixation. This was a prospective study of 25 cases of peritrochanteric fractures of femur evaluated as per Harris Hip score. In our study, 60% of the patients had excellent to good functional score with 40% of patients had fair to poor functional score due to presence of comorbidity or affected by one of the complications mentioned further. In our study, the average Harris Hip Score was 82.12 with the range of 66.5-92.5.

Keywords: Peritrochanteric, femur, PFN

Introduction
Expected age of human race has increased, leading to increase in the number of geriatric people with osteoporotic bones and falls associated with them, which leads to significant increase in the incidence of proximal femur fractures all over the world [1]. Gullberg *et al.* in 1997 estimated the future incidence of hip fracture worldwide would double to 2.6 million by the year 2025, and 4.5 million by the year 2050. [2] Hagino *et al* reported a lifetime risk of hip fracture for individual sat 50 years of age as 5.6% for men and 20% for women. [3] These fractures are more common in women perhaps due to many risk factors like wider pelvis in women leading to tendency to coxavara, women being less active develop osteoporosis which is further enhanced by post-menopausal effects on bones. [4]

'peritrochanteric fractures' account for more than half of hip fractures caused by a trifling fall on ground. Fractures of Proximal femur carries associated risk of morbidity and mortality, viz deep vein thrombosis, pulmonary thrombo-embolism, decubitus ulcers and renal calculi formation. [5] All these factors leads to a mammoth cost on the health care system. [6, 7]

Most (90%) of the proximal femur fractures in elderly occur due to direct trauma and major portion of it is due to a trivial fall. [8]

Multiple factors which lead to falling in elderly, are poor vision, decreased reflexes, neurovascular diseases osteoporosis, associated spinal deformities. [9] Falls with a rotational component are more common with extra capsular hip fractures. [10]

Two subsets of patients are commonly observed. *first group*, comprising of older patients who sustain these fractures due to low-energy trauma & due to osteoporotic changes in their bones are sometimes known as fragility fractures.[11] These are also at risk for metastatic secondaries in the hip.

Second group, comprising of young patients with normal bone architecture; the majority of injuries are the result of almost always high-energy trauma. The attributed mechanisms include axial compression against the acetabular roof, with hip in flexion and abduction; associated injuries like pelvic and acetabular fractures, spine injuries, are time and again seen when the knee is in an attitude of flexion.

Sub-trochanteric fractures also occur in patients exposed to chronic (5 years or greater) or high dose bisphosphonate therapy, usually due to low energy trauma or spontaneous fractures in this patient group have also been reported [12].

Operative treatment is recommended for such type of fractures.
Two fixation techniques are popular for Intertrochanteric and subtrochanteric fractures:

- Sliding hip screws with plate
- Intramedullary fixation with sliding screws

Biomechanical studies have revealed that intramedullary device with sliding screw is a better choice. Its location & rotational stability ensures better load transfer and hence provides biological fixation. Its anatomical angle of 6º allows the nail to be inserted and positioned in the medullary canal with ease & also insertion can be done without reaming allowing a simplified, time saving surgical procedure. Its shorter lever arm tends to decrease the tensile strain on the implant, thereby decreasing the risk of implant failure. To add further it has a choice of static or dynamic interlocking slot making primary or secondary axial dynamization possible. As it incorporates a sliding hip screw, the advantage of controlled fracture impaction is maintained. The intramedullary location limits the amount of sliding and therefore limb shortening and deformity. It is inserted in minimally invasive fashion, so less soft tissue dissection, decreased blood loss, lesser hospital stay and early weight bearing, potentially lowering overall morbidity rate. The intramedullary position provides axial compression while walking & there is no fear of circuitous stress.
Arbeitsgeme inschaftfür Osteosynthese fragen (AO/ASIF) first designed it in 1996. It is a second generation cephalomedullary nail, available in stainless steel and titanium alloy. It is of two types STANDARD PFN which is universal i.e. no left or right side & 240 mm in length & LONG PFN which has anatomical 10° anteversion with two different anatomically adapted nail designs for left or right side having differentlengths i.e. 340,360, 380, 400 and 420mm. it also has anatomical 1.5m radius (ante-curvature).

Classification
Boyd and Griffin Classification: In 1949, Boyd and Griffinclassified fractures in the trochanteric region of femur into four types. [13] Their classification included all fractures from extracapsular part of the neck to a point 5 cm distal to the lesser trochanter.

Type 1: (Stable Two part): Fractures extending along the intertrochanteric line from the greater to lesser trochanter.

Type 2: (Unstable communited): Comminuted fractures, the main fracture being along the intertrochanteric line but with multiple fractures in the cortex.

Type 3: (Unstable reverse obliquity): Fractures that are basically sub -trochanteric with at least one fracture line passing across the proximal end of the shaft just distal to or at the lesser trochanter; Varying degrees of communition are associated (termed "reverse obliquity" by Wright).

Type 4: Fractures of the trochanteric region and proximal shaft, with fracture lying in at least two planes.
Other popular classifications are Evans & AO classification

Materials and Methods
This was a prospective study of 25 (twenty five) cases of peritrochanteric fractures of femur admitted in Department of orthopaedics in a tertiary care hospital of Punjab.

Inclusion criteria
Closed stable and unstable peritrochanteric fractures in adults of either sex, surgically fit, without any skeletomuscular co morbidity.

Exclusion criteria
Inter trochanteric fractures involving piriformis fossa, pathological fractures, open hip fractures, paediatric fractures.
The associated injuries were treated & necessary radiological, biochemical investigations were done preoperatively. Prophylactic antibiotic were given half an hour before surgery. Under spinal or general anesthesia, patients were operated in supine position on spica table with adduction (10°-15°) of the affected limb. Closed/open reduction of the fracture was done & confirmed under image intensifier. A skin incision of 5 cm was given extending upwards from tip of greater trochanter. Entry point was made from tip of greater trochanter with the help of bone awl & guide wire was inserted through it into the femoral canal under image intensifier control, followed by sequential reaming.
PFN was placed as per mentioned operative technique in literature. Wound was irrigated & sutured in layers.
Appropriate antibiotics (usually a 3rd generation cephalosporin), analgesics were given for first 3 days. Sutures were removed on 12th postoperative day. Muscle strengthening exercises and movements at hip and knee joint were started on 5th day. Partial weight bearing initiated after confirmation of beginning of healing process. Full weight bearing was allowed after fracture union.
All the patients were followed up clinically on the basis of Harris Hip Score equated to the near decimal, radiologically and functionally till fracture union occur.

Results and Observations

Table 1: Age Distribution

Age	Cases	Percentage (%)
31-40	07	28.0%
41-50	05	20.0%
51-60	06	24.0%
61-70	04	16.0%
71-80	03	12.0%

- 88% of the patients were in age group of 31-70 years

48% of the patients in the present study were in age group of 31 -50 years while 40% were in 51-70 years of age.

Table 2: Sex Distribution

Sex of The Patient	No. of Patients	Percentage (%)
Male	19	76.0%
Female	6	24.0%
Total	25	100%

- Males were affected more than females

76% of the patients in our study were male patients and 24% were female patients.

Table 3: Mechanism of Injury

Mechanism of Injury	No. of Cases	Percentage %
Road traffic accident (RTA)	17	68%
Falls from stairs, height or slippage etc.	8	32%
Total	25	100%

- RTA was the common (68%) cause.

Major trauma was due to road traffic accidents (64%) whereas 32% fractures occurred due to accidental falls in elderly population.

Table 4: Side Affected

Side Affected	No. of Patients	Percentage
Right	13	52%
Left	12	48%
Total	25	100%

- Fracture occurance was more on right side.

Right side was affected more commonly (52%) and left side was affected in (48%).

Table 5: Fractures Type Based On Boyd and Griffin Classification

Type of Fracture	No. of Patients	Percentage (%)
Type 1	01	11.11%
Type 2	03	33.33%
Type 3	03	33.33%
Type 4	02	22.22%
Total	09	100%

In our study, we used Boyd and Griffin classification, majority(66%) were classified as having type 2 and type 3, making this the commonest type in our study followed by 22% of type 4 then 11% of type I fractures.

Table 6: Associated Injuries

Type of Injury	No. of Patients	Percentage %
Head injuries(Concussion)	01	04%
Chest Injury	NIL	NIL
Fracture Both Bones Leg	02	08%
# Metatarsals Ipsilateral foot	01	04%
Ipsilateral Colle's Fracture	01	04%
Ipsilatateral Clavicle #	01	04%
Total	06	24%

- Patient with Head injury had no complications pre or post operatively

In our study 24% of the patients had associated injuries. 04% had fractures of metatarsals, another 04% had ipsilateral colle"s fracture and clavicle fracture, 08% had fracture of both bone leg. 04% patients had concussion injury of head.

Table 7: Trauma – Surgery Interval

Trauma-Surgery Interval	No. of Patients	Percentage %
< 2 Days	20	80.0%
3-5 Days	03	12.0%
>5 Days	02	08.0%

- 80% of patients were operated within 2 days of injury

80% of patients were operated within 2 days of injury, 12% within 3-5 days and 08% were operated more than 5days after injury.

Table 8: Average Duration of Surgery

Average Duration (Minutes)	No. of Patients	Percentage (%)
<60	13	52.0%
60-90	09	36.0%
90-120	03	12.0%
Total	25	100.0%

- Average duration of surgery was 65,7 minutes

In 52% of cases surgery was done in less than 60 minutes and in 36%, lasted between 60-90minutes.

Table 9: Blood Transfusion

No. of Unit	No. of Cases	Percentage (%)
1	03	12.0%
2	01	04.0%
Total	04	16.0%

- 12.0% cases each required one unit of blood.per operatively

16% cases required blood transfusion out of which 12.0% cases required only one unit of blood.

Table 10: Exposure of Radition from Image Intensifier

Exposure To Radiations	No. of Cases	Percentage (%)
90-120	16	64.0%
120-150	06	24.0%
150-180	03	12.0%
Total	25	100.0%

- Mean exposure was 91.7 seconds in our series

64% patients were exposed for 90-120 seconds followed by 24% between 120-150seconds.

Table 11: Post-Operative Complications

Complications	No. of Patients	Percentage (%)
Early		
Superficial Wound Infection	02	08.0%
Shortening	01	04.0%
Mortality	Nil	Nil
Late		
Malunion	01	04.0%
Deep wound infection	01	04.0%
Delayed union	02	08.0%
Non union and implant failure	Nil	Nil
Knee stiffness	01	04.0%

08% had superficial wound infection, were cured after proper I/V antibiotics and sterile dressing. 04% had deep wound infection, 04% patient had varus malunion and 08% went into delayed union. Only 04% developed knee stiffness.

Table 12: Radiological Union Time

Time For Radiological Union	No. of Patients	Percentage (%)
< 26 weeks	20	80.0%
20-28weeks	04	16.0%
>28 weeks	2	08.0%

- The average radiological union time was < 26 weeks

Successful fracture union was defined as complete bridging callus in 3 cortices along with painless full weight bearing. Above table shows that in our study 80% of patients showed fracture union within < 26weeks followed by 16% of patients in 26-28weeks and remaining 28% in more than 28 weeks.

Table 13: Time Taken For Weight Bearing (In Weeks)

At 4 Weeks			At 8 Weeks			At 16 Weeks			At 24 Weeks		
No wt bearing 05	Partial wt bearing	Full wt bearing	No wt bearing	Partial wt bearing	Full wt bearing	No wt bearing	Partial wt bearing	Full wt bearing	No wt bearing	Partial wt bearing	Full wt bearing
05	20	-	03	22	-	0	02	23	0	02	23

- In our study only 08% had to be on partial weight bearing due to complications

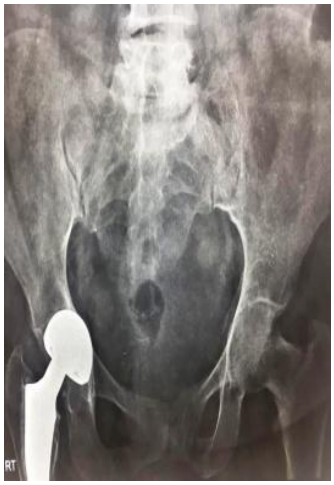
Table 14: Harris Hip Scoring (HHS)

Functional Score	Umber	Percentage
Excellent (90-100)	03	12%
Good (80-89)	12	48%
Fair (70-79)	09	36%
Poor (<70)	01	04%

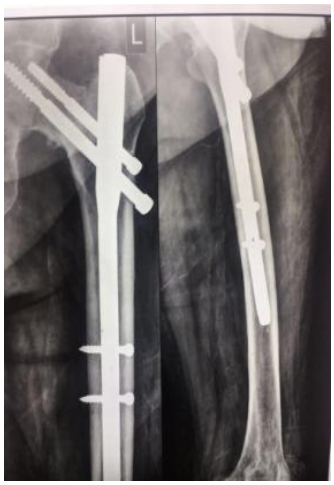
In our study, assessment of the patients of their functional outcome was done as per Harris hip Score. The average Harris Hip Score was 82.12 with the range of 66.5-92.5.60% of the patients had excellent to good functional score with 40% of patients had fair to poor functional score due to presence of comorbidity or affected by one of the complications mentioned further.

Table 15: Functional Outcome

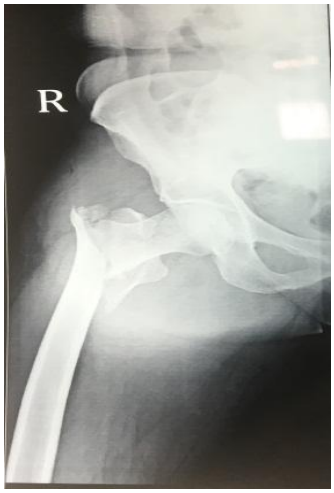
Criteria	Duration (Weeks)					
	3 Wks	6 Wks	9 Wks	12 Wks	18 Wks	24 Wks
Pain	02	02	-	-	-	-
Range of movements						
Limp	02	02	02	02	02	02
Ability to walk without support	--	--	--	23	23	23
Use of stairs	--	--	--	23	23	23
Shortening	02	02	02	02	02	0



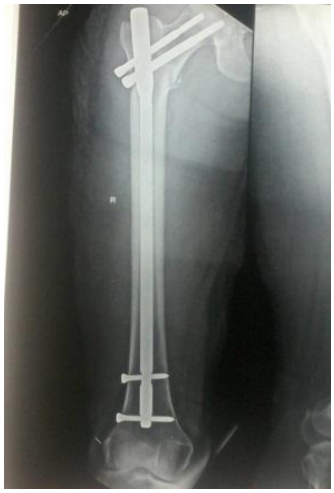
Pre-Operative Roentgenogram



Post Operative Roengenogram



PRE-Operative Roentgenogram



Post Operative Roengenogram

Discussion

Operative treatment hip fractures in the form of internal fixation permits early healing and offers almost full functional recovery, and hence has become the treatment of choice for virtually all trochanteric fractures. Amongst the various types of implants available the compression hip screw is most common but the uncontrolled collapse in comminuted fractures resulted in varus union with short neck & a high incidence of screw cut out which forced the surgeons to look for intramedullary device as an alternative. Minimal invasion & biomechanical advantage beleaguered to gain in popularity of closed cephalomedullary nailing. In recent times PFN is the device designed accurately for fixation of such fractures overcoming the previous shortcoming of the cephalomedullary nail.

In this study an attempt was made to survey, evaluate, document and quantify our success in the management of such fractures by using proximal femoral nail (PFN).

Out of study of 25 patients, 76% were males and 24% were females comparable to the study of Celebie al [21] series in which 72.7% were malesand27.3% were females.

The mechanism of injury in 68% was road traffic accidents (RTA) and 32% suffered due to fall. Males are more prone to road traffic accidents due to outdoor activities. Sadowski *et al* in his series had reported 95% cause of high velocity trauma which is quite high as compared to our studies. [15]

Mean age of patients was 40.2 years. 44% of the patients were in the age group of 30-50 (youngest 21, oldest 78) years; young were drawn in RTA and the elderly group encountered trivial trauma. In Celebi *et al* series average age was 39.1years. [14]

Majority of cases (66%) were classified as type II &III as per Boyd and Griffith classification which was comparable to the previous studies done on peritrochanteric fractures. [13]

80% of patients were operated within 2 days of injury, 12%

patients within 3-5 days and 08% of patients were operated more than 05 days after injury; improved to a study done by Sadoski *et al.* [15] In a study done by Boldin C *et al*, 35% and 33% cases respectively were operated on 6th day& thereafter after trauma. [16] The shorter lag period was in our series was in all probability due to better post traumatic management.

Only 24% had associated injuries of which, 04% had head injury 08% had fractures both bone leg, 04% had ipsilateral metatarsal fractures, 04% had ipsilateral fracture clavicle & colles' fracture was seen in 04% patients comparable to series of Sadowskie al. [15]

Average duration of surgery was 65.7 minutes (less than 60 minutes in 52%, 60 to 90 minutes in 36% and 90-120minutes in 12%). Cases with comminution, lasted longer because of having difficulty in making the entry point and inserting the proximal screws. In a prospective study evaluating a group of 41 patients by Kostal R *et al*, the average duration of surgery was inthe whole group of 41 patients 61 minutes (30-100 minutes). [17] In the study of Xiong *et al* in the group of high sub trochanteric fractures, it was 58 minutes (30-80 minutes). [18]

Of the 16% patients who were transfused blood, 04% patients needed 2 units depending upon duration and intra-operative blood loss. Among them 2 cases required open reduction, Results were corroborative with the study by Sadowskie al. [15]

Exposure to image intensifier

Mean usage time for image intensifier was 91.2 seconds, as compared to the series of Kostal R *et al* of 80 sec and was more than Pavelka T *et al* 2003 of 90sec. [17, 19] Newer technique to start with it initially was probably the cause of higher radiation exposure in comparison with other studies.

Complications

12% patients had superficial wound infection. In 01% patient, infection was controlled with I/V antibiotics, in remaining 08% patients it led to deep infection. 04% of these patients had resorption of head of femur at later stage. One patient had screw cut out at 10 weeks post operatively, as the fracture was uniting, the neck screw was removed. Patients with deep infection and screw cut out were the ones who went into delayed union. In literature, Sahu *et al* in their series of 302 patients, 05 (2%) patients had non union, 12 patients had complications related to proximal screws. Superficial infection was common but only 05 (02%) patients developed deep infection [20].

84% of patients showed union within 24 weeks while 12% had union in 24-28 weeks. 08% went into delayed union; despite this union was seen at 1-1 ½ years interval. In a prospective study of Kostal R *et al*, 41 patients of trochanteric fractures fixed with PFN, the fracture healed in 21 patients within 6 months, i.e. in 95% of the followed-up patients, of this in 20 cases (91%) in anatomical position. [17] Lenich *et al* and Ekstrom *et al* reported no case of non-union in their series & so is in our series also. [21, 22]

By 24 weeks 92% of the patients were bearing full weight. 08% patients were partially weight bearing. Veeragandham *et al* in a study of 108 patients with a peritrochanteric femoral fracture, fixed using the proximal femoral nail, observed that the patients had regained their pre-operative walking ability significantly ($p = 0.04$) by the four-months [23].

Only 12% patient had moderate pain and only 04% had severe pain. In a study by Sahu *et al* eighty-eight (41.7%) of the 211 patients who were evaluated at one year after the injury had some degree of hip discomfort, only two described the pain as severe and disabling. [20]

At final follow up, 80% of the patients had good range of movement at hip i.e. > 90° of flexion and > 35° of abduction and resumed their pre injury walking ability. 16% had fair range of movements i.e. flexion 60-90° and abduction 20-35° and were using a walking aid. Only 04% patient had poor range of movements. Strauss *et al*. showed that in 49 patients treated with PFN, the walking ability and squatting ability was completely restored in almost all the cases at 6 months follow up post operatively [24].

No limp was present in 92% of patients in our series at final follow up & were able to use the stairs without any problem. 04% patient had gross limp and another 04% patients were not even able to walk. Gross limp was present in patient who had resorption of head of femur comparable to all previous studies.

Conclusion

With good understanding of fracture biomechanics, good preoperative planning, accurate instrumentation and surgical technique, PFN is an excellent implant in the management of peri trochanteric fractures of femur. It offers several potential advantages:

- Its intramedullary location provides better load share hence provides biological fixation.
- The shorter lever arm decreases the tensile strain on the implant, thereby decreasing the risk of implant failure.
- This design incorporates a sliding hip screw, the advantage of controlled fracture impaction is maintained.
- The intramedullary location limits the amount of sliding and thus prevents limb shortening and deformity.
- Inserted in minimally invasive fashion, so less soft tissue dissection, decreased blood loss, decreased hospital stay and early weight bearing, potentially decreasing overall morbidity.

Thus it is an advantageous and superior method as compared to previous methods of fixation for type II and III (Boyd and Griffith) fractures. Only 08% patients were having shortening; 04% patient had shortening of 1.5 cm and 04% due to resorption of femoral head, had shortening of 2.5 cm. In terms of functional outcome we had 23 patients with good to fair outcome and only 2 patients with poor outcome which compares well with series in literature. In peritrochanteric fractures fixed PFN, according to the patients and/or their attendents; outcome was described as good or very goods it can be a boon for the surgeons in fixation of peritrochanteric fractures due to high velocity road traffic accidents in young and osteoporotic fractures of geriatric patients.

Reference

1. Cooper A. A Treatise on Dislocations and on Fractures of the Joints: Fractures of the Neck of the Thigh-bone. Clinical Orthopaedics and Related Research. 1973; 92:3-5.
2. Jewett EL. One piece angle nail for trochanteric fractures. J Bone Joint Surg. 1941; 23:803-10.
3. Harvey N, Cooper C. Determinants of fracture risk in osteoporosis**.** Current Rheumatology Reports. 2003; 5:75-81.
4. Weiss NS, Liff JM, Ure CL, Ballard JH, Abbott GH, Daling JR *et al*. Mortality in women following hip fracture. J Chronic Dis. 1983; 36:879-82.
5. Cooper A. Fractures and Dislocations of the joints.10th

edition London; 1839
6. Muminagic SN. History of bone fracture: treatment and immobilization. Materia Socio-Medica. 2011; 23(2):111.
7. Heyse M. Treatment of intertrochanteric fractures of femur. JBJS. 1983; 65-B; 262-267.
8. Schumpelick W, Jantzen PM. A new principle in the operative treatment of trochanteric fractures of the femur. J Bone Joint Surg Am. 1955; 37(4):693-8.
9. Harmon PH. The fixation of fractures of the upper femur and hip with threaded, hexagon –headed stainless steel screws of fixed length. JBJS. 1945; 27:128-37.
10. Schwartland M, Bosworth DM, Thompson FR. Intertrochanteric fractures of the femur. A survey of treatment in traction and by internal fixation.J Bone Joint Surg. 1947; 29:1049-66.
11. Tinetti ME, Doucette JT, Claus EB. The contribution of predisposing and situational risk factors to serious fall injuries. J Am Geriatr Soc. 1995; 43:1207-13.
12. Clawson DK. trochanteric fractures treated by sliding plate fixation device J. Trauma, 1964; 4:737.
13. Boyd HB, Griffin LL. Classification and treatment of trochanteric fractures. Archives of Surgery 1949; 58(6):853-66.
14. Celebi L, Can M, Muratli HH, Yagmurlu MF, Yuksel HY, Bicimoğlu A. Indirect reduction and biological internal fixation of comminuted subtrochanteric fractures of the femur. Injury. 2006; 31; 37(8):740-50.
15. Sadowski C, Dieter M, Lindsmog, Michael R. Baumgaertner. Unstable Intertrochanteric Hip Fractures in the elderly J am Acd Orthop Surg May/June. 2004;12:179-190
16. Boldin C, Seibert FJ, Fankhauser F *et al*.2003 The proximal femoral ... Acta Orthop Scand 74:53–58 Bosch U, Schreiber T, Krettek C (2002)
17. Kostal R, Dousa P, Bartonicek J. The proximal femoral nail (PFN)—another alternative for osteosynthesis of trochanteric fractures, Rozhl Chir 2003; 82(1):28-31.
18. Xiong W, Li F, Xia R. Application of PFI-LN in the treatment of peritrochanteric fracture. Orthop J Chin. Sep 2003; 11(18): 1241-43.
19. Pavelka T, Kortus J, Linhart M. Osteosynthesis of trochanteric fractures using proximal femoral nails, Acta Chir Orthop Traumatol Cech, 2003; 70(1):31-8.
20. Sahu-Kostal R, Dousa P, Bartonicek J. The proximal femoral nail (PFH)--another alternative for osteosynthesis of trochanteric fractures. Rozhledy v chirurgii: mesicnik Ceskoslovenskechirurgickespolecnosti. 2003; 82(1):28-31.
21. Lenich A, Mayr E. First results with the Trochanter Fixation Nail (TFN): A report on 120 cases Springer Verlag 2006. 1
22. Ekstrom W, Karlsson-Thur C, Larsson S. Functional outcome in treatment of unstable trochanteric and Subtrochanteric fractures with the proximal femoral nail and Medoff sliding plate. J Orthop Trauma. 2007; 21:18-25.
23. Veeragandham P. Comparative study between proximal femoral nailing and dynamic hip screw with proximal femoral locking compression plates in intertrochanteric fracture of femurInt J Res Orthop. 2017; 3(3):339-349.
24. Strauss E, Frank J, Lee J, Kummer FJ, Tejwani N. Helical blade versus sliding hip screw for the treatment of unstable intertrochanteric hip fractures: A biomechanical evaluation. Injury 2006; 37(10):984-9.