



## A Comparative Study of Various Methods of Internal Fixation of Inter-trochanteric Fracture in a Tertiary Care Hospital of Eastern India

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Received: 10-10-2023; Revised: 15-12-2023; Accepted: 22-12-2023; Published on: 15-01-2024.

### ABSTRACT

**Introduction:** One of the most frequent hip fractures, particularly in older people with osteoporotic bones, is an inter-trochanteric fracture. These fractures are typically brought on by low-energy trauma such as minor falls. Internal fixation is the preferred course of management of inter-trochanteric femur fractures. For trochanteric fractures, there are several types of internal fixation devices, such as PFN (proximal femoral nail), DHS (Dynamic Hip Screw) or PFLCP (proximal femoral locking compression plate).

**Aims/ objective:** To evaluate the effectiveness of DHS, PFN, and PFLCP using Harris Hip Score and investigate any potential shortcomings of these modalities, particularly PFLCP, for treating inter-trochanteric fractures.

**Materials and Method:** 68 patients with close inter-trochanteric fractures within 2 weeks of recruitment were included in our study. Internal fixation was done with the help of either PFN (proximal femoral nail), DHS (Dynamic Hip Screw) or PFLCP (proximal femoral locking compression plate). Every patient was monitored for three months at a time, after which their radiological and clinical statuses were evaluated. This process continued every three months for a total of one year. According to the Harris hip scoring method, findings were analyzed at one, three, six, and twelve months.

**Results:** Most of the patients were managed with PFN (51.47%) followed by DHS (32.35%) and PFLCP (16.18%). According to AO classification, 29 patients (42.65%) patients were stable and 39 patients (57.35%) were unstable. There was significantly better improvement with respect to Harris hip score in patients receiving PFN internal fixation as compared to other method at 3 and 6 months of follow-up ( $p < 0.0001$ ) however at 12 months of follow-up, all the group were similar with respect to Harris hip score ( $p > 0.05$ ).

**Conclusion:** Compared to DHS and PFLCP, PFN offers higher rotation stability, a lower rate of mechanical failure, shorter surgical times, early rehabilitation, and a speedier union. DHS is less expensive for implants and requires less surgical skill. In some difficult comminuted unstable osteoporotic inter-trochanteric fractures, PFLCP appears to be a viable substitute for PFN and DHS.

**Keywords:** Inter-trochanteric Fracture, Internal Fixation, Harris Hip Score, Functional Outcome.

### INTRODUCTION

Hip fractures can result in disability, a lower quality of life, and a higher mortality rate. They are a serious public health concern. Globally, hip fractures afflict about 1.5 million people annually, with Europe having the highest rates and Africa having the lowest.<sup>1,2</sup> As the number of senior individuals rises, there will likely be a rise in hip fractures. Global estimates place the incidence of hip fractures at 2.6 million by 2025 and 6.25 million by 2050.<sup>1,3</sup> There are two primary forms of hip fractures: intracapsular (cervical) and extracapsular (trochanteric or inter-trochanteric). Hip fractures are a heterogeneous collection of fractures.

The vast majority of patients with trochanteric and inter-trochanteric hip fractures are frail individuals who have a propensity to fall and a higher risk of serious illness and death.<sup>4-7</sup>

One of the most frequent hip fractures, particularly in older people with osteoporotic bones, is an inter-trochanteric fracture. These fractures are typically brought

on by low-energy trauma such as minor falls. Internal fixation is the preferred course of management of inter-trochanteric femur fractures. For trochanteric fractures, there are several types of internal fixation devices, such as PFN (proximal femoral nail), DHS (Dynamic Hip Screw) or PFLCP (proximal femoral locking compression plate).<sup>8</sup>

The dynamic hip screw (DHS) with slide plate assembly is the most widely utilized device. Many people still believe that the Dynamic Hip Screw (DHS) is the best option for managing inter-trochanteric fractures.<sup>8</sup>

The benefits and drawbacks of the DHS have been thoroughly examined in a number of previous research studies.<sup>9</sup> As a collapsible fixation device, it allows the fragment nearest to it to collapse or settle on it in search of a stable position. Numerous studies have demonstrated that treating stable fractures with a DHS alone can yield excellent outcomes. The unstable fractures are the hardest to treat with a DHS by themselves. In unstable fractures, the rates of complications such as screw cut out, limb shortening, proximal femoral varus deformity, as well as nonunion are higher than in stable fractures.



The proximal femoral nail (PFN), a novel medullary device created in 1996 by Arbeitsegmenin Schaftfur Osteo Synthes Fragen (AO/ASIF), is likewise collapsible, centra-medullary, bio-mechanically sounder, and has increased rotational stability. Numerous studies demonstrate the limitations of PFN, as evidenced by the fact that implant failure in complex unstable inter-trochanteric fractures (fracture of the greater trochanter in combination with comminution of proximal femur lateral wall) can manifest as non-union, secondary varus collapse, proximal screw cutout, or revision surgery.<sup>10</sup>

Proximal femoral locking compression plate (PFLCP), the newest implant, is presently being used in clinical settings. Numerous studies demonstrate its advantages over DHS and PFN, particularly in cases that involve comminuted osteoporotic unstable fractures with shattered lateral wall support.<sup>11</sup>

Our study aims to evaluate the effectiveness of DHS, PFN, and PFLCP using Harris Hip Score and investigate any potential shortcomings of these modalities, particularly PFLCP, for treating inter-trochanteric fractures.

## MATERIALS AND METHODS

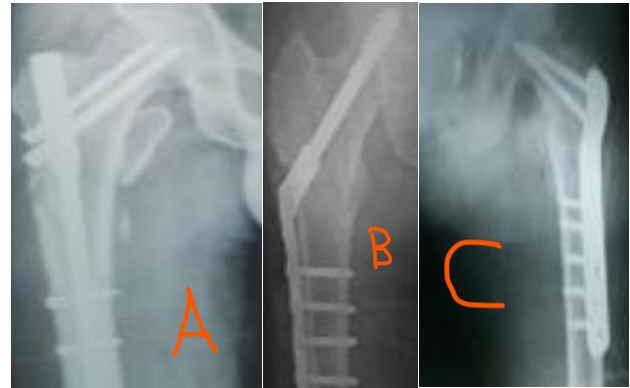
This was an observational and prospective study conducted on patients of closed inter-trochanteric fracture at Department of Orthopaedics of SKMCH, Muzaffarpur from September 2021 to August 2022. Study was started after approval from institutional ethics committee and patients were enrolled after taking written informed consent from the patients of closed inter-trochanteric fracture after providing them participant information sheet in their local language as per the guidelines of good clinical practice and declaration of Helsinki.

**Inclusion Criteria:** Patients of either sex with age greater than or equal to 18 years with close inter-trochanteric fractures within 2 weeks of recruitment were included in our study.

**Exclusion Criteria:** Patients with any medical contraindication to general or regional anaesthesia or patients with pathological or compound fracture or patients with multiple trauma or patients with neuropathy or patients on chemotherapy or radiotherapy were excluded from the study.

Every patient had a history obtained, including the type of injury and the amount of time since it occurred. Every patient had a comprehensive investigation and clinical evaluation. Patients underwent pre-anesthesia examinations the day before surgery, surgical sites were prepped, and informed consent was obtained from each patient or their companions. Thirty minutes before to the induction of anesthesia, each patient was administered a single dose of antibiotic. Internal fixation was done with the help of either PFN (proximal femoral nail), DHS (Dynamic Hip Screw) or PFLCP (proximal femoral locking compression plate). Every patient received an IV antibiotic for seven days. Analgesic was used to ease pain. In

accordance with protocol, wound dressings were applied on the third post-operative day or as needed to ensure proper care. After surgery, on days 10 and 12, stitches were taken out.



**Figure 1:** A) PFN; B) DHS & C) PFLCP Methods of Internal Fixation on Inter-Trochanteric Fracture

Every patient was monitored for three months at a time, after which their radiological and clinical statuses were evaluated. This process continued every three months for a total of one year. According to the Harris hip scoring method, findings were analyzed at one, three, six, and twelve months. Harris hip scoring is based on following four parameters:

- Pain relief: 44 points
- Function: 47 points
- Range of motion: 5 points
- Absence of deformity: 4 points

Total score is 100 and patients with score less than 70 is rated poor, 70-79 is fair outcome, 80-89 is considered good result and score of 90-100 is excellent result.<sup>12</sup>

## Statistical Analysis:

Data collected from patients with close inter-trochanteric fracture was represented in tabular form using Microsoft Excel 365 and then transferred to SPSS version 24 for further statistical analysis. Chi-square test was used to check statistical significance of difference between various groups with respect to mode of injury, type of fracture and type of internal fixation. One-way ANOVA was used to test statistical significance between various groups with respect to Harris Hip Score with P-Value of less than 0.05 as measure of statistical significance.

## OBSERVATIONS & RESULTS

There were 68 patients in our study out of which 37 (54.41%) were male and 31 (45.59%) were female. Mean age of the patients were  $63.61 \pm 6.23$ . Mode of injury of the patients and type of internal fixation is summarized in Table 1.

Most of the patients were managed with PFN (51.47%) followed by DHS (32.35%) and PFLCP (16.18%). There was no significant difference between groups with respect to

age, sex or mode of injury ( $p > 0.05$ ). Mode of injury of most of the patients was domestic fall (64.71%) followed by RTA (35.29%).

According to AO classification, 29 patients (42.65%) patients were stable and 39 patients (57.35%) were unstable. There was no significant between groups of patients undergoing different type of internal fixation with respect to stability of fracture as per AO classification.

**Table 1:** Distribution of patients with respect to type of internal fixation and mode of injury

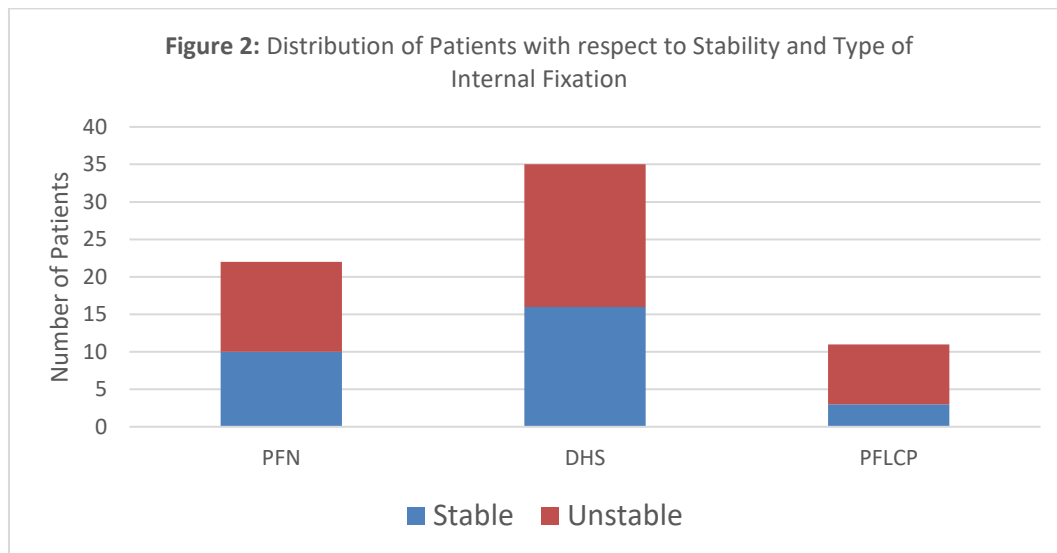
Type of Internal Fixation	Total (%) n=68	Mode of Injury		P-Value (Chi-Square Test)
		Road Traffic Accident (RTA)	Domestic Fall	
PFN	22 (32.35)	7	15	0.92
DHS	35 (51.47)	13	22	
PFLCP	11 (16.18)	4	7	
Total (%)	68 (100.00)	24 (35.29)	44 (64.71)	

PFN: Proximal Femoral Nail; DHS: Dynamic Hip Screw; PFLCP: Proximal Femoral Locking Compression Plate

**Table 2:** Stability of fracture with respect to AO classification in different groups

Type of Internal Fixation	Stable		Unstable	P-Value (Chi-Square Test)
	A1	A2	A3	
PFN	04	06	12	0.59
DHS	03	13	19	
PFLCP	1	2	8	
Total (%)	8 (11.76)	21 (30.88)	39 (57.35)	

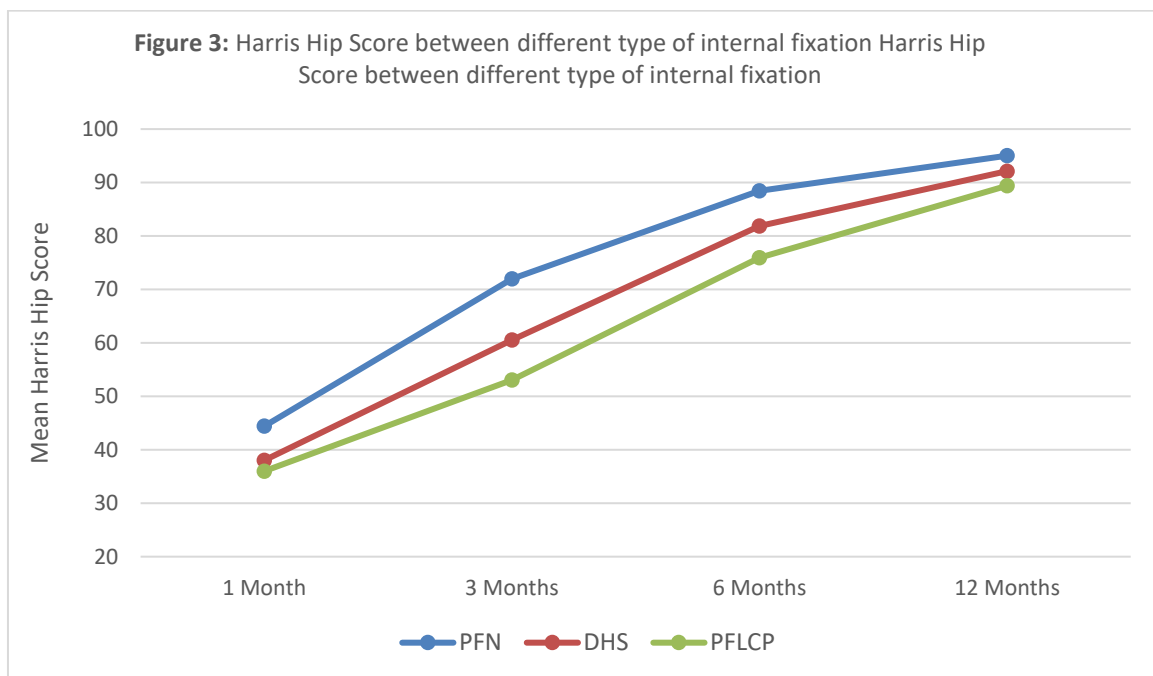
PFN: Proximal Femoral Nail; DHS: Dynamic Hip Screw; PFLCP: Proximal Femoral Locking Compression Plate



**Table 3:** Comparison of Harris Hip Score between different type of internal fixation

Time	PFN	DHS	PFLCP	P-Value (One way ANOVA)
1 Month	44.42 ± 7.84	38.03 ± 6.17	36.01 ± 6.08	0.007
3 Months	71.96 ± 10.93	60.53 ± 9.19	53.05 ± 7.31	<0.0001
6 Months	88.47 ± 5.14	81.87 ± 6.55	75.93 ± 8.26	<0.0001
12 Months	95.02 ± 6.20	92.13 ± 6.48	89.39 ± 8.23	0.07
P-Value (Repeated Measure ANOVA)	<0.0001	<0.0001	<0.0001	

PFN: Proximal Femoral Nail; DHS: Dynamic Hip Screw; PFLCP: Proximal Femoral Locking Compression Plate



There was significantly better improvement with respect to Harris hip score in patients receiving PFN internal fixation as compared to other method at 3 and 6 months of follow-up ( $p < 0.0001$ ) however at 12 months of follow-up, all the group were similar with respect to Harris hip score ( $p > 0.05$ ).

## DISCUSSION

The preferred course of therapy for inter-trochanteric fractures nowadays involves either closed or opened reduction and internal fixation. Conservative methods of treating these fractures are now obsolete and should only be considered in the most severe cases of morbidity. The optimal internal fixation device for inter-trochanteric fractures remains a matter of controversy despite a large number of research, particularly in the case of unstable complex comminuted type fractures.

In our study, patients mostly belonged to the fifth and seventh decade. Cleveland et al. noted that senile osteoporosis, limited muscle mass for absorbing trauma energy, and poor vision all contribute to an increased risk of inter-trochanteric fractures in the elderly.<sup>13</sup> Male average age was reported by Ahrengart L, Tornkvist H, Fornander P, et al. to be 80 years, while female average was 78 years.<sup>14</sup> 71.3 years was the average age reported by Tyllionksi M et al.<sup>15</sup> The average age of the population in our study is 63.61 years, which is lower than the average age in the studies stated above. This is likely due to factors such as early osteoporosis, reduced life expectancy, and a poorer quality of life among Asians, particularly in developing nations like India.

The male to female ratio in our study was 1.2:1, which is different from the majority of the published literature. In this age range, girls in this region of India are primarily restricted to their homes.<sup>16-19</sup>

Accurately classifying the type of injury is exceedingly challenging. RTA and home fall are the two main groups into which we separated the modes of injury. The highest number of instances was recorded in domestic fall based on this classification. Cummings and Nevit state that elderly patients lack strength, insufficient local shock absorbers, and insufficient defensive reflexes to lessen the energy of falls.<sup>20</sup> According to Keneth J. Koval and Joseph D. Zuckerman, simple falls account for 90 percent of hip fractures in elderly people.<sup>21</sup>

The fracture pattern in the current investigation was categorized using the AO classification system. Stable fracture configuration was present in 10 out of 22 instances in the PFN group, 16 out of 35 cases in the DHS, and 3 out of 11 cases in the PFLCP. In the current study, 39 (57.35%) of the 68 patients had unstable fractures, while 42.65% of the 62 patients overall had stable fractures. Larsson S., Friberg S. et al. reported a series of 35% stable and 65% unstable inter-trochanteric fracture; Wolfgang et al. reported 79% stable and 21% unstable type fracture whereas Neilson, B.P. et al. documented 28% stable and 72% unstable inter-trochanteric fracture.<sup>22-24</sup>

According to our research, the average operating time for the PFN group was 61 minutes, the DHS group was 47 minutes, and the PFLCP group was 74 minutes. This is consistent with earlier research. The average PFLCP operating time for 13 cases of multi-fragmentary unstable inter-trochanteric fractures, as described by Wie Ting Lee et al., was 151.3 minutes, whereas the mean operating time for stable fractures was 116 minutes.<sup>25</sup> Nayer asif et al. found that the average operating duration for 27 patients undergoing PFLCP procedures was roughly 75 minutes.<sup>26</sup>

For comparison in the current study, we employed the Harris Hip Score. The PFN group's mean score at three and six months demonstrates a considerable improvement

when compared to the other groups. However, at one year of follow-up, the Harris Hip Score for patients from different groups reveals little differences in their functional condition.

A prospective study was conducted by Domingo LJ, et al. on 295 patients who received PFN treatment for inter-trochanteric fractures. At one, three, and six months, clinical and radiological controls were carried out. They demonstrated that 71% of the former walking ability was regained.<sup>27</sup> Mean Harris Hip Scores of 80.10 for stable fractures and 69.10 for unstable multi-fragmentary fractures managed by PFLCP were reported by Wei Ting Lee et al. in their study.<sup>25</sup> In 18 patients undergoing treatment with PFLCP, Govindasamy et al. found a mean Harris Hip Score of 85.5 (83-94) with no unsatisfactory results.<sup>6</sup> According to Mohsen Mardani et al., patients undergoing treatment with DHS had a Harris Hip Score of 87.08 for stable fractures and 84.61 for unstable fractures whereas patients managed with PFLCP had a score of 85.43 for stable fractures and 81.20 for unstable fractures.<sup>28</sup>

## CONCLUSION

Management with PFN had good to outstanding results. Compared to DHS and PFLCP, PFN offers higher rotation stability, compression at the fractured site, a shorter lever arm, a lower rate of mechanical failure, fewer days in the hospital, quick mobilization, reduced blood loss, shorter surgical times, early rehabilitation, and a speedier union. In comparison to PFN and PFLCP, DHS is less expensive for implants, exposes patients to less radiation, and requires less surgical skill. In some difficult comminuted unstable osteoporotic inter-trochanteric fractures, proximal femoral locking plate appears to be a viable substitute for PFN and DHS because it locks the fracture in the reduced position that the surgeon accomplished without requiring controlled collapse.

**Acknowledgement:** We are thankful to the healthcare workers of Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India.

**Presentation at a meeting:** Nil

**Ethical clearance:** Institutional Ethics Committee of Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India.

**Source of Support:** The author(s) received no financial support for the research, authorship, and/or publication of this article.

**Conflict of Interest:** The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## REFERENCES

- Cooper C, Campion G, Melton LJ., 3rd Hip fractures in the elderly: a world-wide projection. *Osteoporos Int.* 1992;2(6):285–289. doi: 10.1007/BF01623184. [PubMed] [CrossRef] [Google Scholar]
- Cheng SY, Levy AR, Lefavre KA, Guy P, Kuramoto L, Sobolev B. Geographic trends in incidence of hip fractures: a comprehensive literature review. *Osteoporos Int.* 2011;22(10):2575–2586. doi: 10.1007/s00198-011-1596-z. [PubMed] [CrossRef] [Google Scholar]
- Gullberg B, Johnell O, Kanis JA. World-wide projections for hip fracture. *Osteoporos Int.* 1997;7(5):407–413. doi: 10.1007/PL00004148. [PubMed] [CrossRef] [Google Scholar]
- Brunner LC, Eshilian-Oates L, Kuo TY. Hip fractures in adults. *Am Fam Physician.* 2003;67(3):537–542. [PubMed] [Google Scholar]
- Endo Y, Aharonoff GB, Zuckerman JD, Egol KA, Koval KJ. Gender differences in patients with hip fracture: a greater risk of morbidity and mortality in men. *J Orthop Trauma.* 2005;19(1):29–35. doi: 10.1097/00005131-200501000-00006. [PubMed] [CrossRef] [Google Scholar]
- Hagino H, Endo N, Harada A, Iwamoto J, Mashiba T, Mori S, et al. Survey of hip fractures in Japan: recent trends in prevalence and treatment. *J Orthop Sci.* 2017;22(5):909–914. doi: 10.1016/j.jos.2017.06.003. [PubMed] [CrossRef] [Google Scholar]
- Matsuo M, Yamagami T, Higuchi A. Impact of age on postoperative complication rates among elderly patients with hip fracture: a retrospective matched study. *J Anesth.* 2018;32(3):452–456. doi: 10.1007/s00540-018-2494-8. [PubMed] [CrossRef] [Google Scholar]
- Wang J, Ma XL, Ma JX, Xing D, Yang Y, Zhu SW, Ma BY, Chen Y, Feng R, Jia HB, Yu JT. Biomechanical analysis of four types of internal fixation in subtrochanteric fracture models. *Orthop Surg.* 2014 May;6(2):128-36. doi: 10.1111/os.12109. PMID: 24890295; PMCID: PMC6583598.
- Evans EM. The treatment of trochanteric fractures of the femur. *J Bone Joint Surg Br* 1949;31B(2):190-203.
- Canale TS, Beaty JH. *Campbell's Operative orthopaedics.* 11th edn. Elsevier 2008: p. 3239.
- Govindasamy R, Gnanasundaram R, Kasirajan S, et al. Proximal femur locking compression plate in complex proximal femoral fractures: a retrospective analysis. 2016;2(3):104-8.
- Nilsson A, Bremander A. Measures of hip function and symptoms: Harris Hip Score (HHS), Hip Disability and Osteoarthritis Outcome Score (HOOS), Oxford Hip Score (OHS), Lequesne Index of Severity for Osteoarthritis of the Hip (LISOH), and American Academy of Orthopedic Surgeons (AAOS) Hip and Knee Questionnaire. *Arthritis Care Res (Hoboken).* 2011 Nov;63 Suppl 11:S200-7. doi: 10.1002/acr.20549. PMID: 22588745.
- Cleveland M, Bosworth DM, Thompson FR, et al. A ten year analysis of intertrochanteric fractures of the femur. *J Bone Joint Surg* 1959;41-A:1399-408.
- Ahrengart L, Tornkvist H, Fornander P, et al. A randomized study of the compression hip screw and Gamma nail in 426



- fractures. *Clinical Orthopaedics and Related Research* 2002;(401):209-22.
15. Tyllianakis M, Panagopoulos A, Papadopoulos A. et al. Treatment of extracapsular hip fractures with the proximal femoral nail: long term results in 45 patients. *Acta Orthop Belg* 2004;70(5):444-54.
  16. Harrington P, Nihal A, Singhania AK, et al. Intramedullary hip screw versus sliding hip screw for unstable intertrochanteric femoral fractures in the elderly. *Injury* 2002;33(1):23-8.
  17. Kulkarni GS, Limaye R, Kulkarni M, et al. Treatment of trochanteric fractures of the hip by modified Richard's compressing and collapsing screw. *Indian Journal of Orthopaedics* 1984;18(1):30-4.
  18. Kuderna H, Bohler N, Collon DJ. Treatment of intertrochanteric and subtrochanteric fractures of the hip by Ender method. *J Bone Joint Surg* 1976;58(5):604-11.
  19. Poigenfurst J, Schnabl P. Multiple intramedullary nailing of pertrochanteric fractures with elastic nails: operative procedure and results. *Injury* 1977;9(2):102-13.
  20. Cumming SR, Nevitt MC, Browner WS, et al. Risk factors for hip fracture in white women. Study of Osteoporotic Fractures Research Group. *N Eng J Med* 1995;332(12):767-73.
  21. Koval KJ, Zuckerman JD. Intertrochanteric fractures. Chapter – 39. In: Buckholz RW, Heckman JD, eds. *Rockwood and Green's Fracture in adults*. Vol. 2. 5th edn. Philadelphia: Lippincott Williams & Wilkins 2001: p. 1635-63.
  22. Wolfgang GL, Bryant MH, O'Neill JP. Treatment of intertrochanteric fracture of the femur using sliding screw plate fixation. *Clin Orthop Relat Res* 1982;(163):148-58.
  23. Nielsen BP, Jelnes R, Rasmussen LB, et al. Trochanteric fractures treated by the McLaughlin nail and plate. *Injury (IJCI)* 1985;16(5):333-6.
  24. Larsson S, Friberg S, Hansson LI. Trochanteric fractures: influence of reduction and implant position on impaction and complications. *Clin Orthop Relat Res* 1990;(259):130-9.
  25. Lee WT, Murphy D, Kagda FH, et al. Proximal femoral locking compression plate for proximal femoral fractures. *J Orthop Surg (Hong Kong)* 2014;22(3):287-93.
  26. Asif N. Unstable IT fractures fixation – is proximal femoral locked compression plate better than dynamic hip screw. *J Orthop* 2012;20(6):350-2.
  27. Domingo LJ, Cecilia D, Herrera A, et al. Trochanteric fractures treated with a proximal femoral nail. *Int Orthop* 2001;25(5):298-301.
  28. Mardani-Kivi M, Mirbolook A, Jahromim KS, et al. Fixation of intertrochanteric fractures: dynamic hip screw versus locking compression plate. *Trauma Mon* 2013;18(2):67-70.

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