Original Research Article

Comparison of the clinical effectiveness and intraoperative and postoperative complications of proximal femur locking compression plate (PFLCP) with dynamic hip screw (DHS) in the management of inter-trochanteric fracture

Samuel Lakra[1], Manju Boipai[2], Jaiwant Joshua Murmu[3*], Lal Bahadur Manjhi[4], Vijay Kumar[5], Govind Kumar Gupta[6]

[1]Senior Resident, Department of Orthopedics, Rajendra Institute of Medical Sciences, Bariatu, Ranchi 834009 Jharkhand, India

[2]Assistant Professor, Department of Microbiology, Hazaribagh Medical College, Hazaribagh 825319, Jharkhand, India

[3]Senior Resident, Department of Anesthesiology, Sheikh Bhikhari Medical College, Hazaribagh 825301, Jharkhand, India

[4]Professor&Head, Department of Orthopaedics, Rajendra Institute of Medical Sciences, Bariatu, Ranchi Jharkhand, India

[5]Associate Professor, Department of Orthopaedics, Rajendra Institute of Medical Sciences, Bariatu, Ranchi, Jharkhand, India

[6]Associate Professor, Department of Orthopaedics, Rajendra Institute of Medical Sciences, Bariatu, Ranchi, Jharkhand, India

Received: 12-07-2021 / Revised: 16-08-2021 / Accepted: 14-10-2021

Abstract

Background: Intertrochanteric femur fractures are a very common injury seen in the elderly. Understanding the pathophysiology as well as the proper treatment options will significantly decrease the risk of mortality and morbidity of this injury. Anatomically contoured proximal femur locking compression plate (PFLCP) is the latest addition to deal with these fractures, which creates an angular stable construct. It will theoretically lessen the risk of failure by screw cut-out and varus collapse, the common mode of DHS failure. Hence here we intended to study these two implants in inter-trochanteric fracture management regarding its clinical effectiveness and intraoperative and postoperative complications. **Materials & Methods:** This study was done to prospectively compare, the rate of union, complications, operative risks and functional outcomes in inter-trochanteric fractures treated with dynamic hip screw (DHS) and Proximal femur locking compression plate (PFLCP). It also determined the effectiveness of PF-LCP in comparison to DHS in treatment of inter-trochanteric fractures. The data collected during the study of 30 cases of inter-trochanteric fractures, 15 cases were treated using PFLCP and other 15 group of cases were treated using DHS in the Department of Orthopaedics in Rajendra Institute of Medical Sciences, Ranchi from December 2012 to December 2014. **Results:** The functional outcome was measured with Harris Hip Score. In PFLCP group 7 (46.67%) cases had excellent result, 5 (33.33%) cases had good result, and 3 (20%) cases had fair result with no poor result. The mean score in PFLCP group was 86.4. In DHS group 7 (46.67%) cases had excellent result, 4 (26.67%) cases had good result, 2 (13.33%) cases had fair result and 2 (13.33%) cases had poor result. The mean score in DHS group was 83.4, although the PFLCP had better results but the difference between the two groups was not statistically significant P-value >0.05. In PFLCP group there was varus malunion in 3 (20%) cases, shortening >2cm in 2 (13.33%) cases. Delayed union was seen in 2 (13.33%) cases. No case of non union was seen. No case had Infection, bed sore, deep venous thrombosis and death. In 5 (33.33%) cases we failed to accommodate all three screws. There was no incidence of plate breakage or screw cut out. In DHS study group there were 4 (26.67%) cases with improper placement of the lag screw, shortening in 4(26.67%) cases and rotational deformity in 2(13.33%) case. Post operative superficial infection was seen in 2(13.33%) case. No case had deep venous thrombosis or death. Varus malunion was seen in 3(20%) cases and delayed union in 2(13.33%) cases, no case of non union was seen. Implant failure was seen in 1 case with screw breakage. **Conclusion:** PFLCP is a good option for the management of inter-trochanteric fracture with high union rate and low rate of complication with high functional outcome and with a possibility that it can be done without C-Arm.

Keywords: Inter-trochanteric fracture, proximal femoral locking compression plate (PFLCP), dynamic hip screw (DHS), Harris Hip Score, outcome, complications

Introduction

Intertrochanteric fractures are defined as extracapsular fractures of the proximal femur that occur between the greater and lesser trochanter.

The intertrochanteric aspect of the femur is located between the greater and lesser trochanters and is composed of dense trabecular bone. The greater trochanter serves as an insertion site for the gluteus medius, gluteus minimus, obturator internus, piriformis, and site of origin for the vastus lateralis. The lesser trochanter serves as an insertion site for the iliacus and psoas major, commonly referred to as the iliopsoas. The calcar femorale is the vertical wall of dense bone that extends from the posteromedial aspect of the femur shaft to the

*Correspondence
Dr. Jaiwant Joshua Murmu
Senior Resident, Department of Anesthesiology, Sheikh Bhikhari Medical College, Hazaribagh 825301, Jharkhand, India
E-mail: jaiwant.joshua@gmail.com

posterior portion of the femoral neck. This structure is important because it determines whether or not a fracture is stable. The vast metaphyseal region has a more abundant blood supply, contributing to a higher union rate and less osteonecrosis compared to femoral neck fractures [1, 2].

Intertrochanteric femur fractures are a very common injury seen in the elderly. Understanding the pathophysiology as well as the proper treatment options will significantly decrease the risk of mortality and morbidity of this injury [3]. Current treatment of intertrochanteric fractures involves surgical intervention. Despite acceptable healing rates with nonsurgical methods, surgical methods have replaced previous nonsurgical methods of prolonged bed rest, prolonged traction in bed, or prolonged immobilization in a full-body (spica) cast. The acceptable healing rates for nonsurgical management were accompanied by unacceptable morbidity and mortality because of frequent nonorthopedic complications associated with prolonged immobilization or inactivity, as well as malunions compromising patient function [4-6].IT fractures can be managed by conservative or operative methods. Conservative methods were the treatment of choice until 1960 before the introduction of new fixation devices, as conservative methods resulted in higher mortality rates and complications like decubitus ulcer, urinary tract infections, pneumonia, thromboembolic complications. These methods have been abandoned. Conservative methods are now indicated for elderly person with high medical risk for anesthesia and surgery. Rigid internal fixation and early mobilization has been the standard method of treatment [7].Inter-trochanteric fracture is the most frequently operated fracture type. Interestingly there has been no significant improvement or functional recovery over the past 50 years of surgical treatment [8]. Surgeon can control only the quality of reduction, choice of implant and its placement [9]. From the 1980s to 2000, sliding compression hip screw became the gold standard for hip fracture fixation. The complication rate for unstable fractures treated with a dynamic hip screw has shown to be as high as 3% to 15%. Primary or secondary varus collapse and hardware failure by "cut-out" of the femoral head screw are the most frequently reported complications [10].Early attempts at surgical management were marred by poor asepsis, lack of intraoperative imaging, poor implant design and quality, and incomplete understanding of fracture mechanics. Langenbeck was the first to internally fix an intertrochanteric fracture with a nail [11]. The modern era of hip fracture fixation began in 1925 when Smith Peterson introduced a triflanged nail [12, 13]. The real benefit of fixation lies not in improving union rates (intertrochanteric fractures rarely go into nonunion, even when treated conservatively), but in improving functional outcome and mortality rates, which are attributed to the early mobilization and better nursing care possible after surgery [13].

Pugh and Massie first developed the DHS in 1950s by modifying the sliding hip screw systems [14] and quickly became the gold standard. Even as widespread use of DHS revealed some complications, it is still considered the gold standard by many [15]. DHS is the most commonly used implant worldwide for fixation of intertrochanteric fractures.

The PF-LCP thus fulfils the role of a fixed angle device and achieves the same or greater degree of variability sought with the dynamic condylar screw while avoiding the need for excessive bone removal [16]. Hence here we intended to study these two implants in inter-trochanteric fracture management regarding its clinical effectiveness and intraoperative and postoperative complications.

Material and Methods

After the patient with inter-trochanteric fracture was admitted to hospital all the necessary clinical details were recorded in proforma prepared for this study. After the completion of the hospital treatment patients were discharged and called for follow up at outpatient level, at regular intervals for serial clinical and radiological evaluation. As soon as the patient with suspected inter-trochanteric fracture was seen, necessary clinical and radiological evaluation was done and admitted to ward after necessary resuscitation and splintage with skeletal traction.

The following investigations were done routinely on all these patients preoperatively.

Blood: Hb%, bleeding time, clotting time, blood grouping and cross matching, fasting and post prandial blood sugar, blood urea and serum creatinine

X-ray: Pelvis with both hips AP view, chest X ray PA view in necessary patientsAssociated injuries were evaluated and treated simultaneously. The patients were operated on elective basis after overcoming the avoidable anaesthetic risks. Post operatively patients were followed up at 6wks, 3 months, 6 months interval regarding pain, signs of sepsis and assessment with reference to Harris hip score and radiological assessment.The basis for the Harris Hip Score (HHS-Developed by Dr.William Harris, a prominent Orthopaedist in Massachusetts, the HHS is a tool for the evaluation of how a patient is doing after their hip is replaced. Based on a total of 100 points possible, each question is awarded a certain number of points based on how it is answered. Questions are further grouped into categories. The first category is pain. The second category is function. The third category is functional activities. Finally, the physical examination based on range of motion. The score is reported as 90-100 for excellent results, 80-90 being good, 70-79 fair, 60-69 poor, and below 60 a failed result. The final Harris Hip Score was considered for comparison and evaluation of the functional results [17].

Pre Operative Planning

PFLCP

AP and lateral radiographs of the entire femur are necessary for complete evaluation. Traction radiographs and views of the contra-lateral femur are useful adjuncts in the planning process. Use the x-ray templates to aid in planning the procedure. Determine plate length and approximate screw lengths and instruments to be used [Fig. 1-5].

Dynamic Hip Screw [Fig. 6-8]

1. Length of Richard's screw: Length of Richard's screw is measured from tip of the head to the base of greater trochanter on AP view X-ray subtracting magnification.

2. Neck shaft angle; neck shaft angle is determined using goniometer on X-ray AP view on unaffected side.

3. Length of side plate

Length of the side plate is determined to allow purchase of atleast 8 cortices to the shaft distal to the fracture.

Dynamic Hip Screw

The implant consists of lag screw, a compression screw barrel attached to the side plate. The lag screw is available in length from 60-110mm. About 19 mm compression screw allows a compression of 5mm. Barrel side plate available in angles of 125, 130, 135, 140 degrees and from 2-12 holes. The key and slot mechanism of the implant prevents rotational movements of the proximal fragments. About 4.5mm cortical screws are used to fix the side plate with shaft. Most proximal hole in the side plate allows insertion of 6.5 mm cancellous screw which can be used for fixation of lesser trochanter or a larger posterior-medial fragment. In our study we used lag screw of 60-110mm and a side plate that allowed a purchase of atleast 8 cortices with shaft of femur and 125-135 degrees angled plate depending upon the neck shaft angle determined preoperatively. A minimum of 4 cortical screws were used to fix the side plate with the shaft.

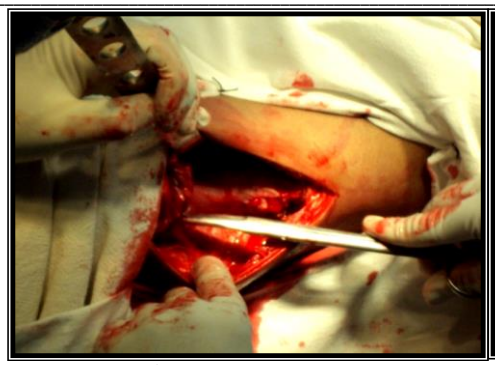

Fig 1: Exposing the proximal femur (intra-operative PFLCP)

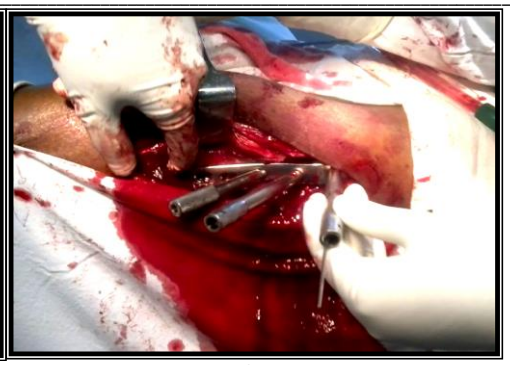

Fig 2: Placement of the plate over the lateral cortex of femur with drill sleeve (intra-operative PFLCP)

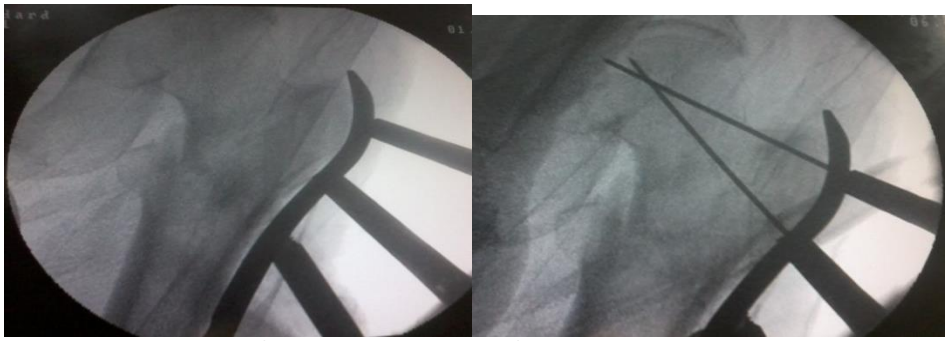

Fig 3 a/b: Confirming correct placement of plate and guide pin under C-arm

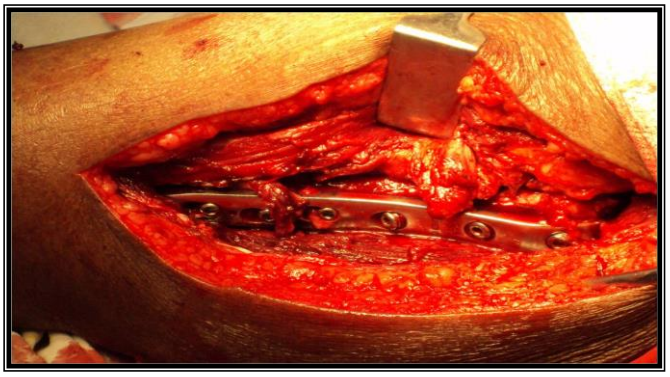

Fig 4: Fixation of plate with locking screws (PFLCP)

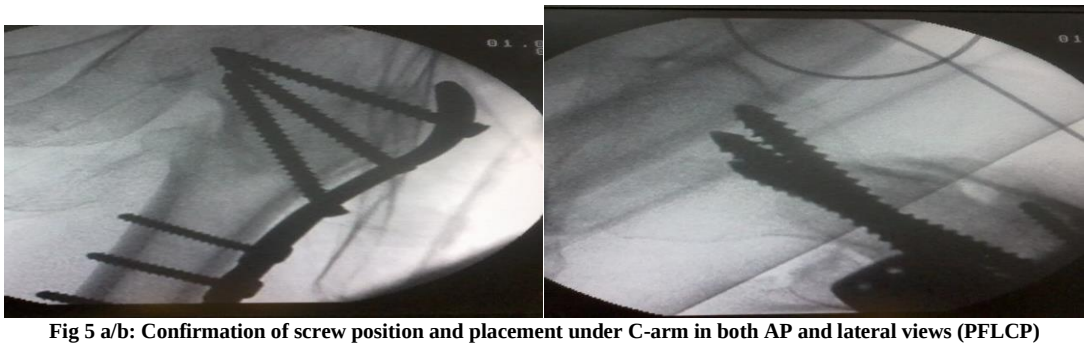

Fig 5 a/b: Confirmation of screw position and placement under C-arm in both AP and lateral views (PFLCP)

Fig 6: Exposure of proximal femur with guide pin placement in DHS case

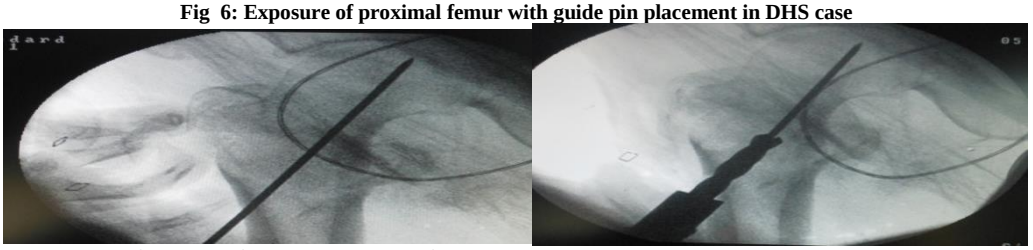

Fig 7 a/b: Confirmation of proper placement of guide pin under C-arm and reaming over guide wire in DHS case

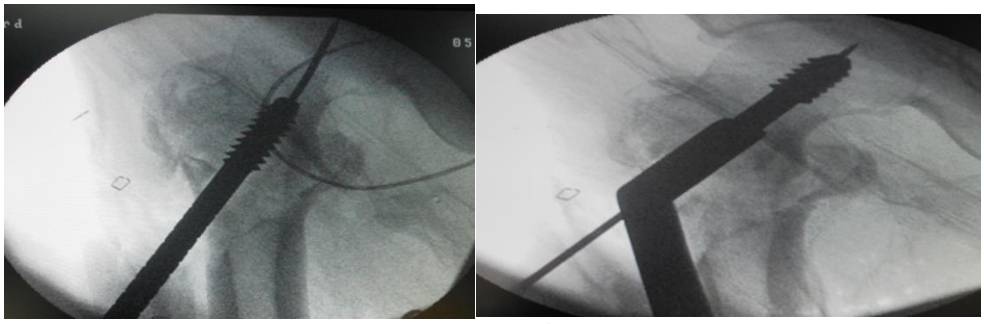

Fig 8 a/b: tapping and lag screw with barrel plate fixation over the guide pin in DHS case

Results

The following observations were made from the data collected during the study of 30 cases of inter-trochanteric fractures, 15 cases were treated using proximal femoral locking compression plate (PFLCP) and other 15 group of cases were treated using Dynamic Compression Hip screw (DHS) in the Department of Orthopaedics in Rajendra Institute of Medical Sciences, Ranchi from December 2012 to December 2014.

Age Distribution

The study was limited to age group between 40-80 years. In the PFLCP group maximum cases were in the age group between 51-60 i.e. 6 cases (40%) and in DHS group maximum number of cases were seen in age group 60-70 i.e. 6 cases (40%). Mean age group for PFLCP group was 60 years and mean age for DHS group was 61 years [Table 1].

Table 1: Age distribution among study participants

Age group	Number of cases		Percentage		Total cases	
	PFLCP	DHS	PFLCP	DHS		Percentage
40-50	3	3	20%	20%	6	20%
51-60	6	3	40%	20%	9	30%
61-70	4	6	26.67%	40%	10	33.33%
71-80	2	3	13.33%	20%	5	16.67%
Total	15	15			30	

Sex Distribution

In both groups there were more male cases (PFLCP 30%; DHS 26.67%) than female cases (PFLCP 20%; DHS 23.33%) [Fig 1].

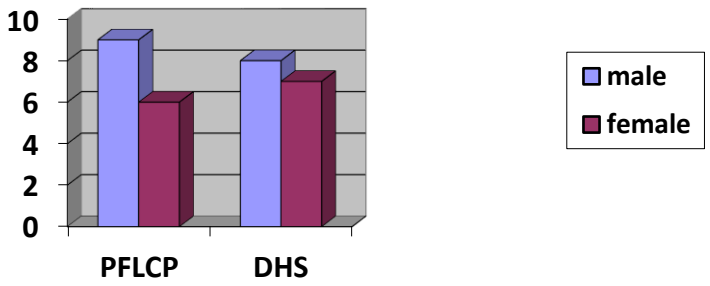

Fig 1: Sex distribution among study participants

Nature of Injury

Fall was the major cause of fracture in both the groups (PFLCP 26.67%; DHS 33.33%) [Fig. 2].

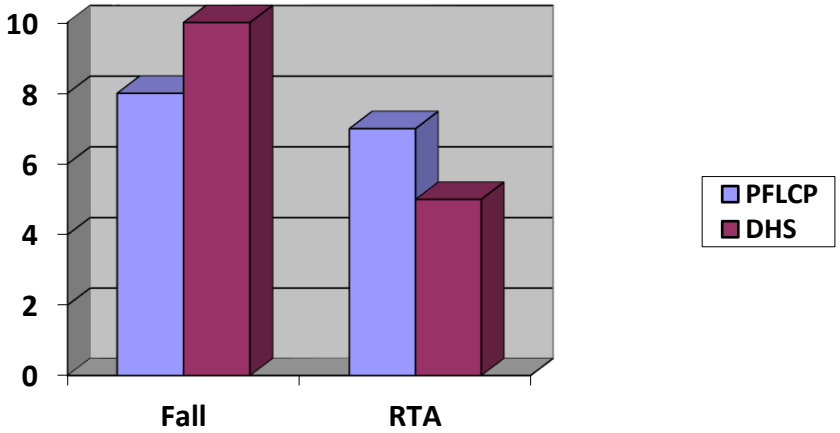

Fig 2: Nature of injuries in both the study groups

Side Affected

In PFLCP there were 8 cases affecting right side and 7 affecting left side. In DHS group there were 6 cases affecting right side and 9 affecting left side [Table 2].

Table 2: Side affected in both the study groups

Side affected	Number of cases		Percentage	
	PFLCP	DHS	PFLCP	DHS
Right	8	6	26.67%	20%
Left	7	9	23.33%	30%
Total	15	15	50%	50%

Type of Fracture

Trochanteric fractures were classified according to Boyd and Griffin classification. Maximum numbers of cases were Type IV in PFLCP group and Type I in DHS group [Table 3].

Table 3: Type of fractures: Boyd & Griffin classification

Type of fracture	Number of cases		Percentage	
	PFLCP	DHS	PFLCP	DHS
Type I	3	6	20%	40%
Type II	2	4	13.33%	26.67%
Type III	3	3	20%	20%
Type IV	7	2	46.67%	13.33%
Total	15	15	100%	100%

Functional scoring with Harris Hip Score

There were 7 excellent, 5 good and 3 fair results in PFLCP group with no poor results. In DHS group, there were 7 excellent, 4 good, 2 fair and 2 poor results. Although there were better functional results (Harris Hip Score) in PFLCP group when compared to DHS group the difference was not statistically significant with P value= 0.05. The mean Functional score (HHS) for PFLCP group was 86.4 and in DHS group was 83.4 [Fig. 3].

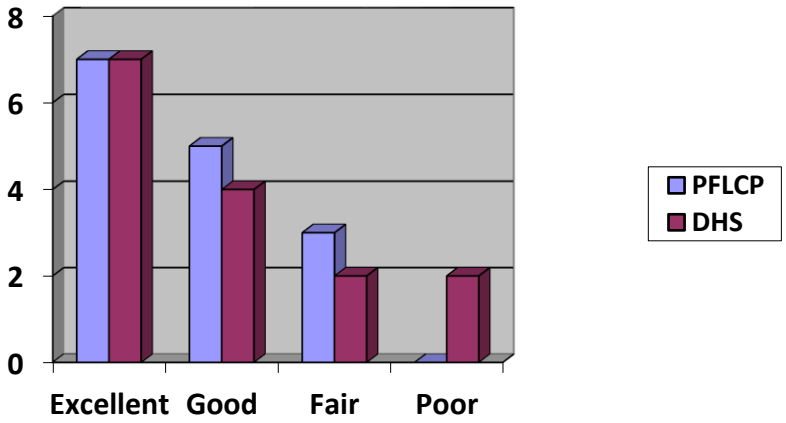

Fig 3: Harris Hip score Functional scoring results

Intraoperative Complications

PFLCP

About 5 of 15 cases, there was failure to put all three locking screw in neck and head, the third screw could not be accommodated in the neck after putting 2 neck screws. Fracture displacement after screw insertion was in 1 case. There were no instances of drill bit breakage or guide wire breakage [Table 4].

Table 4: Intra-operative complications of PFLCP

Complications	Number of cases	Percentage
Fracture displacement after screw insertion	1	6.67%
Drill bit breakage	0	0%
Guide wire breakage	0	0%
Failure to accomodate all three screws in neck and head	5	33.33%

DHS

Insufficient reduction was observed in 2 out of 15 cases with fixation in varus. In 4 out of 15 cases there was improper placement of Lag screw. The screw was placed superiorly. Screw placement was assessed with Tip Apex Distance (TAD) measurement. Improper placement was defined as TAD > 25mm. Drill breakage or guide wire breakage was seen in 1 case in DHS group [Table 5].

Table 5: Intra-operative complications of DHS

Complications	Number of cases	Percentage
Insufficient reduction	2	13.33%
Improper positioning of Lag screw	4	26.67%
Drill bit breakage/Guide wire	1	6.67%
Fracture of lateral cortex or Distal fracture fragment	0	0%

Post Operative Complications

PFLCP

The post operative complications were categorized into early and late. In Early complication shortening was noted in 3 out of 15 cases (20%). There were no cases with rotational deformity, infection, bed sore, deep venous thrombosis and death. Late complications there were 3 (20%) cases with varus malunion and 2 (13.33%) cases with delayed union. No cases with non union [Table 6].

Table 6: Post-operative complications of PFLCP

Complications	Number of cases	Percentage
Early		
Shortening > 2cm	2	13.33%
Rotation deformity	1	6.67%
Superficial Infection	2	13.33%
Deep Infection	0	0%
Bed sore	0	0%
Deep Venous Thrombosis	0	0%
Death	0	0%
Late		
Non union	0	0%
Varus malunion	3	20%
Delayed Union	2	13.33%
Implant Failure		
Breakage of Plate	0	0%
Screw breakage	0	0%
Screw Cut out	0	0

DHS

The post operative complications were categorized into early and late. In Early complication shortening was noted in 4 out of 15 cases (26.67%). There was 2(13.33%) case with rotational deformity, superficial infection was seen in 2(13.33%) case, No cases of Deep infection, bedsore, deep venous thrombosis and death. Late complications there were 3(20%) cases with varus malunion and 2(13.33%) cases with delayed union. No cases with non union. In 1(6.66%) cases there was implant failure due to screw breakage [Table 7].

Table 7: Post-operative complications of DHS

Complications	Number of cases	Percentage
Early		
Shortening > 2cm	4	26%
Rotation deformity	2	13.33%
Superficial Infection	2	13.33%
Deep Infection	0	0%
Bed sore	0	0%
Deep Venous Thrombosis	0	0%
Death	0	0%
Late		
Non union	0	0%
Varus malunion	3	20%
Delayed Union	2	13.33%
AVN	0	0%
Implant Failure		

Cut out phenomenon	0	0%
Plate lift off	0	0%
Plate or screw breakage	1	6.66%

Averages follow up of cases

The average follow up in the PFLCP group was 12.9 months and Range was from 8-18 months. The average follow up in the DHS group was 14.6 months and range was from 6-19 months.

Rate of union

Union was defined radiologically with AP and LATERAL view of the affected Hip. Fracture was said to be united when the fracture gap was bridged. Delayed union was considered if time taken to fill fracture gap exceeds 20 weeks. The Mean duration for union in PFLCP group was 17 Weeks with range from 12-24 weeks. The Mean duration for union in DHS group was 16.4 Weeks with range from 12-28 weeks.

Discussion

DHS is the most commonly used implant worldwide for fixation of intertrochanteric fractures. The two important complications related to DHS are uncontrolled collapse and lag screw cut-out (with or without varus collapse) [18]. Others include medialization of shaft, uncontrolled lateralization of proximal fragment. Although intramedullary nails are fast becoming the preferred choice for unstable fractures, their use is also associated with many complications: screw cut-out/blade cut-out (including Z effect and reverse Z effect), varus deformity, lateral wall blowout during reaming, difficult insertion in curved femurs, peri-implant fracture (subtrochanteric fractures in short nails), and implant breakage [19, 20]. Anatomically contoured locking plates (proximal femur locking compression plate [PFLCP]) have been developed to provide an angular stable construct and prevent screw cut-out and varus failure [13].

In 2010, Sun JF et al published minimally invasive treatment of inter-trochanteric fractures with locking compression plate in the elderly. Minimally invasive approaches with LCP could treat the elder inter-trochanteric fractures with the advantages such as minimal invasive, stable fixation and less blood loss. According to an evaluation standard of HUANG Gong-yi, the results were excellent in 20 cases, good in 4 cases and poor in 1 case [21].

In 2011 Glassner PJ, Tejwani NC published seven cases of failure of proximal femoral locking compression plate, Of the seven cases, two were acute peri-trochanteric fractures, one was a peri-prosthetic fracture at the site of a prior hip fusion, one was an early failure of a compression hip screw, and three were non-unions. The failure mode was implant fracture in four cases and loss of fixation in three cases resulting from varus collapse and implant cut-out [22].

In 2011 Zha GC, Chen ZL, Qi XB, Sun JY studied a total of 110 patients (72 females and 38 males) with per-trochanteric femoral fractures who were subjected to PFLCP treatment. The mean age of the patients was 75 (48-93) years. The patients healed satisfactorily and had no complications, such as cut-out in most cases. However, there was one case of breakage of the implant and one case of non-union at the 3-month period during the follow-up check-up. The PFLCP can be a feasible alternative to the treatment of per-trochanteric fractures [23].

2011 Luo XP, et al inter-trochanteric hip fractures treated with locking plate and DHS were retrospective analyzed. The outcome measures collected for statistical analysis on the following aspects: operative time, blood loss, drainage, healing time, complications and Harris scores. There were no significant differences in the healing time, complications and Harris scores between two groups (P > 0.05), but there were significant differences in the operative time, blood loss, drainage between two groups (P< 0.05). Comparing with DHS group, the locking plate group was of shorter operative time, fewer blood loss and drainage [24].

In this study 30 patients with intertrochanteric fracture were selected and divided in two groups; 15 were treated with dynamic hip screw and other 15 were treated with proximal femur locking compression plate and their results were compared. The average operating time for PFLCP was 92.6 min while for DHS was 54.67 min. this observation was different from the observation made by Ma J et al (2012) [25] and Luo XP et al (2011) [24]. This difference may be due to the different technique. We used open reduction technique while they used the technique of percutaenous fixation. The average blood loss in PFLCP 376 ml and in DHS was 267 ml. This observation also differed from by Ma J et al (2012) [25] and Luo xp et al (2011) [24], due to difference in technique. Most common complication in PFLCP is failure to accommodate all 3 screws in neck and head. Three patients had varus malunion. The varus malunion was the most common mode of failure in Streubel PN (2012) [26] and also Glassner PJ (2011) [22]. The overall complication rate was less in case of PFLCP than in DHS. This was consistent with the observation made by Luo XP et al (2011) [24] and Ma J et al (2012) [25]. The mean duration of union was 17 weeks for PFLCP and 16 weeks for DHS. The mean fuctional score (Harris Hip Score) for PFLCP was 86.4 and DHS group was 83.4 but this difference was statistically not significant P>0.05. This observation was similar to Luo XP et al (2011) [24].

In the present study there were 7 excellent, 5 good and 3 fair results in PFLCP group with no poor results. In DHS group, there were 7 excellent, 4 good, 2 fair and 2 poor results. Although there were better functional results (Harris Hip Score) in PFLCP group when compared to DHS group the difference was not statistically significant with P value= 0.05. The mean Functional score (HHS) for PFLCP group was 86.4 and in DHS group was 83.4. The average amount of blood loss in PFLCP was 376 ml (maximum- 480ml, minimum-300 ml) while in DHS was 267 ml (maximum- 330ml, minimum-200 ml).

Shen G et al study (2012) revealed that the incision length, operation time, and blood loss in PFNA group were significantly less than those in DHS group (P < 0.05). The average follow-up time was 13.6 months in PFNA group and was 13.8 months in DHS group. The fracture healing time was (11.80 +/- 1.32) weeks in PFNA group and was (12.21 +/- 1.26) weeks in DHS group, showing no significant difference (t=1.23, P=0.29). The complication rate was 0 in PFNA group and was 12.5% (4/32) in DHS group, showing no significant difference (P=0.06). After 1 year, Harris hip score of PFNA group (86.55 +/- 10.32) was higher than that of DHS group (80.36 +/- 11.18) (t=2.28, P=0.03). There are two surgical methods to treat intertrochanteric fractures in the elderly patient: PFNA and DHS, and each have advantages; for unstable intertrochanteric fractures, PFNA treatment is the first choice [27].

Two cases of PFLCP were done without image intensifier (C- arm) due to technical difficulties. Due to pre-contoured plate, 2 screws were placed in neck and head of femur without C-arm and in both the cases screw were placed correctly. Thus PFLCP provide a feasible option for management of inter-trochanteric fracture without C- arm. In this study although statistically not significant, PFLCP had better functional outcome than DHS and thus PFLCP is better than DHS in management of inter-trochanteric fracture which can be even done without C-arm.

Huang SG et al study (2017) was conducted to compare the clinical effectiveness of proximal femoral locking compression plate (PFLCP), dynamic hip screw (DHS), and proximal femoral nail antirotation (PFNA) for unstable intertrochanteric femoral fracture treatment. Ninety patients diagnosed with unstable intertrochanteric femoral fracture were enrolled in this study and were classified according to Tronzo-Evans classification, and the patients were randomly divided into 3 groups, PFLCP, DHS, and PFNA, with 30 patients in each group. The length of incision, operative time, intraoperative blood loss, postoperative drainage, postoperative weight-bearing ambulation time, and duration of fracture union were significantly lower in patients who underwent PFNA and PFLCP compared to patients treated with DHS. Furthermore, when the same clinical parameters were used for comparison, the PFNA group showed markedly lower values compared with the PFLCP group. The total incidence of postoperative complications was significantly

different among the PFNA, PFLCP, and DHS groups, with the PFNA group exhibiting markedly lower complication rates compared with PFLCP and DHS groups. However, PFLCP and DHS groups did not show significant differences in the incidence of postoperative complications. Notably, the Harris hip score of PFNA group was markedly higher than the DHS group. In conclusion, our results provide convincing evidence that PFNA may be the most effective internal fixation treatment of unstable intertrochanteric femoral fracture [28].

The treatment of unstable intertrochanteric fracture with dynamic hip screw (DHS) fixation results in better outcomes. In Lakho MT et al study (2019), they observed acceptable outcomes in a vast majority, 81.1%, of patients after three months of DHS fixation of the unstable intertrochanteric fracture [29].

In the present study union was defined radiologically with AP and lateral view of the affected Hip. Fracture was said to be united when the fracture gap was bridged. Delayed union was considered if time taken to fill fracture gap exceeds 20 weeks. The Mean duration for union in PFLCP group was 17 Weeks with range from 12-24 weeks. The Mean duration for union in DHS group was 16.4 Weeks with range from 12-28 weeks. Zhong B et al study (2014) revealed that patients with stable intertrochanteric fractures who underwent PFLCP fixation demonstrated shorter bone union time than the DHS fixation group (3.3 ± 0.2 vs. 4.3 ± 0.1 month; P<0.0001); however, both groups had 100% bone union and good to excellent scores on Sanders' traumatic hip rating scale (P=1.000). Patients with unstable intertrochanteric fractures who underwent PFLCP fixation experienced greater blood loss (619.0 ± 23.9 vs. 474.1 ± 19.8 ml; P<0.0001), which was mainly due to the need for open reduction (64.3% vs. 12.5%; P=0.003), compared to the DHS fixation group. No differences were identified with respect to bony union, functional level, or complications. Patients with subtrochanteric fractures who underwent PFLCP fixation demonstrated significantly shorter operative times (82.1 ± 4.3 vs. 102.2 ± 2.2 minutes; P<0.0001), less blood loss (751.8 ± 25.4 vs. 987.6 ± 32.0 ml; P<0.0001), shorter bone union times (5.2 ± 0.4 vs. 8.8 ± 1.0 month; P=0.006), more good to excellent Sanders' traumatic hip rating scale scores (92.9% vs. 55.5%; P=0.009), and fewer complications (14.2% vs. 66.6%; P=0.005) than the DHS fixation group. PFLCP fixation offers better functional outcomes and fewer complications for subtrochanteric femoral fractures but not for intertrochanteric femoral fractures [30].

Nine randomized controlled trials met the requirement with a total of 779 patients, of whom 383 were fixed with PFNA and 396 with DHS. Meta-analysis demonstrated that PFNA was associated with smaller surgical incision length [MD=-7.43, 95%CI (-9.31, -5.55), P<0.05], shorter operation time [MD=-22.76, 95%CI (-29.57, -11.95), P<0.05], less intraoperative blood loss [MD=-216.34, 95%CI (-275.18, -157.49), P<0.05], earlier weight bearing after surgery [MD=-12.34, 95%CI (-17.71, -6.97), P<0.05], shorter fracture healing time [MD=-5.00, 95%CI (-7.73, -2.26), P<0.05], higher postoperative Harris hip score [MD=12.22, 95%CI (3.88, 20.55), P<0.05], higher rate of excellent Harris hip score [OR=3.56, 95%CI (1.44, 8.81), P<0.05] and lower incidence rate of postoperative complications [OR=0.48, 95%CI (0.33, 0.70), P<0.05], such as hip varus, wound infection, urinary tract infection, pulmonary infection, pressure sore, deep vein thrombosis, pulmonary embolism, heart failure and cerebral infraction when compared with DHS. No statistical difference was shown between the groups when it came to subgroup analysis by age. However, there was no significant difference (P>0.05) in the duration of hospitalization and the complications resulting in the occurrences of internal fixation loosening, such as femoral shaft fracture (during or post operation), internal fixation fracture, cut-out, displacement or retraction. Current published evidence supports the superiority of PFNA to DHS for unstable intertrochanteric fractures in terms of clinical efficacy. The conclusion was limited because of the relatively low quality of evidence with low strength of confidence. Large scale and high-quality randomized controlled trials are required to validate the safety of PFNA and DHS for unstable intertrochanteric fractures [31].

Jonnes C et al study (2016) revealed that the average age of the patients was 60 years. In our series we found that patients with DHS had increased intraoperative blood loss (159ml), longer duration of surgery (105min), and required longer time for mobilization while patients who underwent PFN had lower intraoperative blood loss (73ml), shorter duration of surgery (91min), and allowed early mobilization. The average limb shortening in DHS group was 9.33 mm as compared with PFN group which was only 4.72 mm. The patients treated with PFN started early ambulation as they had better Harris Hip Score in the early post-op period. At the end of 12th month, there was not much difference in the functional outcome between the two groups. PFN is better than DHS in type II intertrochanteric fractures in terms of decreased blood loss, reduced duration of surgery, early weight bearing and mobilization, reduced hospital stay, decreased risk of infection and decreased complications [32].

Dynamic hip screws (DHS) have been considered as the standard fixation for extracapsular femoral fracture and yielded good results in the patients with stable intertrochanteric fractures. However, its value for comminuted and highly unstable intertrochanteric and subtrochanteric fractures remains uncertain. High failure rate and excessive impaction have been reported [33, 34]. In addition, the long incision required for the DHS fixation can lead to significant blood loss and soft-tissue damage, which may worsen existing comorbidities in elderly patients [30, 35].

Proximal femoral locking compression plate (PFLCP) has been developed recently, which merges locking screw technology with conventional plating techniques. Theoretically, this technique could offer optimum fixation of comminuted and highly unstable fractures that are associated with more shearing and pull-out forces [36]. Several studies have reported success with PFLCP fixation for the treatment of complex femoral fractures and for revision operations after the failure of other implants [23, 37].

Conclusion

In our study we prospectively compared two implants in management of acute traumatic inter-trochanteric fractures. In our series of 30 patients with inter-trochanteric fractures, there were 15 cases treated with proximal femoral locking compression plate (PFLCP), group comprising 9 male and 6 female and 15 cases were treated with dynamic hip screw (DHS), group comprising 8 male and 7 female cases.

The functional outcome was measured with Harris Hip Score. In PFLCP group 7 (46.67%) cases had excellent result, 5 (33.33%) cases had good result, and 3 (20%) cases had fair result with no poor result. The mean score in PFLCP group was 86.4. In DHS group 7 (46.67%) cases had excellent result, 4 (26.67%) cases had good result, 2 (13.33%) cases had fair result and 2 (13.33%) cases had poor result. The mean score in DHS group was 83.4, although the PFLCP had better results but the difference between the two groups was not statistically significant P-value >0.05.

In PFLCP group there was varus malunion in 3 (20%) cases, shortening >2cm in 2 (13.33%) cases. Delayed union was seen in 2 (13.33%) cases. No case of non union was seen. No case had Infection, bed sore, deep venous thrombosis and death. In 5 (33.33%) cases we failed to accommodate all three screws. There was no incidence of plate breakage or screw cut out. In DHS study group there were 4 (26.67%) cases with improper placement of the lag screw, shortening in 4(26.67%) cases and rotational deformity in 2(13.33%) case. Post operative superficial infection was seen in 2(13.33%) case. No case had deep venous thrombosis or death. Varus malunion was seen in 3(20%) cases and delayed union in 2(13.33%) cases, no case of non union was seen. Implant failure was seen in 1 case with screw breakage.

PFLCP is a good option for the management of inter-trochanteric fracture with high union rate and low rate of complication with high functional outcome and with a possibility that it can be done without C-Arm.

References

1. Karakus O, Ozdemir G, Karaca S, Cetin M, Saygi B. The relationship between the type of unstable intertrochanteric femur fracture and mobility in the elderly. J Orthop Surg Res. 2018 Aug 22;13(1):207.
2. Sharma A, Sethi A, Sharma S. Treatment of stable intertrochanteric fractures of the femur with proximal femoral nail versus dynamic hip screw: a comparative study. Rev Bras Ortop. 2018 Jul-Aug;53(4):477-481.
3. Attum B, Pilson H. Intertrochanteric Femur Fracture. [Updated 2021 Aug 11]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan. Available from: https://www.ncbi.nlm.nih.gov/books/NBK493161/
4. Rang M. Story of Orthopaedics. Philadelphia: WB Saunders; 2000. 373-95.
5. Kaplan K, Miyamoto R, Levine BR, Egol KA, Zuckerman JD. Surgical management of hip fractures: an evidence-based review of the literature. II: intertrochanteric fractures. J Am Acad Orthop Surg. 2008 Nov. 16 (11):665-73.
6. Anglen JO, Baumgaertner MR, Smith WR, Tornetta Iii P, Ziran BH. Technical tips in fracture care: fractures of the hip. Instr Course Lect. 2008. 57:17-24.
7. Singh A K. Management of trochanteric fractures. Indian J Orthop 2006; 40: 100-2.
8. Robert W. Bucholz,Charles M. Court-Brown, James D. Heckman Rockwood and Green's fracture in Adults, 7th edition, volume 3,Pages 1597-1640.
9. S. Terry Canale, James H. Beaty. Campbell's Operative Orthopedics. Volume 3, 11th edition; Pages 3237-3285.
10. Simpson AH, Varty K, Dodd CA. Sliding hip screws: modes of failure. Injury. 1989; 20:227-231.
11. Langenbeck B. Description of transfixion of femoral head by a transtrochanteric nail (transl) Verh Dtsch Ges Chir. 1878;1:92.
12. Smith-Petersen M. Treatment of fractures of the neck of the femur by internal fixation. Surg Gynecol Obstet. 1937;64:287.
13. Agrawal P, Gaba S, Das S, Singh R, Kumar A, Yadav G. Dynamic hip screw versus proximal femur locking compression plate in intertrochanteric femur fractures (AO 31A1 and 31A2): A prospective randomized study. J Nat Sci Biol Med. 2017;8(1):87-93.
14. Pugh WL. A self-adjusting nail-plate for fractures about the hip joint. J Bone Joint Surg Am. 1955;37-A:1085–93.
15. Kulkarni GS, Limaye R, Kulkarni M, Kulkarni S. Intertrochanteric fractures. Indian J Orthop. 2006;40:16–23.
16. Hasenboehler EA, Agudelo JF, Morgan SJ, Smith WR, Hak DJ, Stahel PF. Treatment of complex proximal femoral fractures with the proximal femur locking compression plate. Orthopedics. 2007 Aug;30(8):618-23.
17. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. J Bone Joint Surg Am 1969; 51: 737–55.
18. Russel TA. Rockwood and Green's Fractures in Adults. 8th ed. Philadelphia: Lippincott Williams and Wilkins; 2015. Intertrochanteric fractures of the hip; p. 2086.
19. Müller M, Seitz A, Besch L, Hilgert RE, Seekamp A. Proximal femur fractures: Results and complications after osteosynthesis with PFN and TGN. Unfallchirurg. 2008;111:71–7.
20. Uzun M, Ertürer E, Oztürk I, Akman S, Seçkin F, Ozçelik IB. Long-term radiographic complications following treatment of unstable intertrochanteric femoral fractures with the proximal femoral nail and effects on functional results. Acta Orthop Traumatol Turc. 2009;43:457–63.
21. Sun JF, Li ZB, Shen YY, Han B, Deng L, Gu MQ. [Minimally invasive treatment of intertrochanteric fractures with locking compression plate in the elderly]. Zhongguo Gu Shang. 2010 May;23(5):337-9.
22. Glassner PJ, Tejwani NC. Failure of proximal femoral locking compression plate: a case series. J Orthop Trauma. 2011 Feb;25(2):76-83.
23. Zha GC, Chen ZL, Qi XB, Sun JY. Treatment of pertrochanteric fractures with a proximal femur locking compression plate. Injury. 2011 Nov;42(11):1294-9. Epub 2011 Feb 26.
24. Luo XP, He SQ, Li ZA. [Case-control studies on locking plates and dynamic hip screw in treatment of intertrochanteric hip fractures]. Zhongguo Gu Shang. 2011 Mar;24(3):242-4.
25. Ma J, Xing D, Ma X, Xu W, Wang J, Chen Y, Song D. The percutaneous compression plate versus the dynamic hip screw for treatment of intertrochanteric hip fractures: a systematic review and meta-analysis of comparative studies. Orthopaedics and Traumatology: Surgery and Research 2012; 98(7): 773-783.
26. Streubel PN, Moustoukas MJ, Obremskey WT. Mechanical failure after locking plate fixation of unstable intertrochanteric femur fractures. J Orthop Trauma. 2013 Jan;27(1):22-8.
27. Shen G. [Effectiveness comparison of proximal femoral nail antirotation and dynamic hip screw for intertrochanteric fractures in the elderly patients]. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi. 2012 Jun;26(6):671-4.
28. Huang SG, Chen B, Zhang Y, Nie FF, Ju L, Li M, Zhang YH. Comparison of the Clinical Effectiveness of PFNA, PFLCP, and DHS in Treatment of Unstable Intertrochanteric Femoral Fracture. Am J Ther. 2017 Nov/Dec;24(6):e659-e666.
29. Lakho MT, Jatoi AA, Azfar MK, Ali A, Javed S, Bhatti A, Karim M. Functional and Radiological Outcome of Unstable Intertrochanteric Fracture Post Dynamic Hip Screw Fixation. Cureus. 2019 Apr 1;11(4):e4360.
30. Zhong B, Zhang Y, Zhang C, Luo CF. A comparison of proximal femoral locking compression plates with dynamic hip screws in extracapsular femoral fractures. Orthop Traumatol Surg Res. 2014 Oct;100(6):663-8.
31. Zhang YR, Rao F, Pi W, Zhang PX, Jiang BG. [Proximal femoral nails antirotation and dynamic hip screws for fixation of unstable intertrochanteric fractures of femur: A meta-analysis]. Beijing Da Xue Xue Bao Yi Xue Ban. 2019 Jun 18;51(3):493-500.
32. Jonnes C, Sm S, Najimudeen S. Type II Intertrochanteric Fractures: Proximal Femoral Nailing (PFN) Versus Dynamic Hip Screw (DHS). Arch Bone Jt Surg. 2016 Jan;4(1):23-8.
33. Saudan M, Lübbeke A, Sadowski C, Riand N, Stern R, Hoffmeyer P. Pertrochanteric fractures: is there an advantage to an intramedullary nail?: a randomized, prospective study of 206 patients comparing the dynamic hip screw and proximal femoral nail. J Orthop Trauma. 2002 Jul;16(6):386-93.
34. Haq RU, Dhammi IK. Clinical outcome following treatment of stable and unstable intertrochanteric fractures with dynamic hip screw. Ann Acad Med Singap. 2012 Jun;41(6):275-6.
35. National Consensus Conference on Improving the Continuum of Care for Patients with Hip Fracture. May 3-4, 2001, Washington, DC. Rehabil Nurs. 2002 May-Jun;27(3):83-6, 88.
36. Frigg R. Development of the Locking Compression Plate. Injury. 2003 Nov;34 Suppl 2:B6-10.
37. Hasenboehler EA, Agudelo JF, Morgan SJ, Smith WR, Hak DJ, Stahel PF. Treatment of complex proximal femoral fractures with the proximal femur locking compression plate. Orthopedics. 2007 Aug;30(8):618-23.

Conflict of Interest: Nil Source of support: Nil