

Research Article



INTERNATIONAL RESEARCH JOURNAL OF PHARMACY

www.irjponline.com

ISSN 2230-8407 [LINKING]

COMPARATIVE ANALYSIS OF A REDESIGNED PROXIMAL FEMORAL PLATE WITH A DYNAMIC HIP SCREW SYSTEM

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How to cite: Pidikiti SP, Bardhan S. Comparative analysis of a redesigned proximal femoral plate with a dynamic hip screw system. International Research Journal Pharmacy. 2016;7:5:53-58.

Doi: 10.7897/2230-8407.0756

ABSTRACT

Background: Stable intertrochanteric fractures have been successfully fixed with DHS (dynamic hip screw). However, the use of DHS for intertrochanteric fractures has been associated with a number of problems.

Aim: The purpose of this study was to compare the radiological and functional results of a dynamic hip screw system with a modified PFLCP (proximal femoral plate locking compression plate) in Indian patients who had intertrochanteric fractures.

Methods: The study made use of PFLCP modification, which increases the screw density for the trochanteric area and locks the screw slots with an angular stable construct that can compress the fracture site. 224 participants with intertrochanteric fractures were enrolled in the study; they were split into two groups of 112 participants each at random. The DHS group's study participants ranged in age from 30 to 88 years old, with a mean age of 65.64 years. In the PFLCP group, the mean age was 64.05 years, and the age range was 33-88 years. HHS (Harris Hip Scores) was used to compare and evaluate the mean length of surgery, intraoperative blood loss, and functional results in each participant from both groups.

Results: The PFLCP and DHS groups had mean union times of 17.4 and 18.5 weeks, respectively. According to the study's findings, 12% of participants experienced a substantial shortening during follow-up (15.66 and $p=0.57$). 5.86 and 4% of study participants had postoperative discharge from the surgery site. 3.90 and 8% of research participants experienced implant failure, with $p=0.41$. 33.3% and 14% of individuals, respectively, experienced varus collapse ($p=0.02$). With $p=0.17$, the mean HHS for the PFLCP and DHS groups was 86.1 and 82.4, respectively.

Conclusion: The current study leads to the conclusion that PFLCP may be just as effective as dynamic hip screws in achieving functional and radiological results. When treating intertrochanteric fractures in patients with severe osteoporosis, the modified PFLCP approach is a suitable substitute for DHS.

Keywords: intertrochanteric fractures, proximal femoral locking, compression plate, dynamic hip screw, Harris hip score

INTRODUCTION

Elderly individuals who have experienced traumatic exposure frequently develop intertrochanteric fractures. The elderly patients who suffer from hip fractures have a high mortality rate and a major impact on their quality of life. Osteoporosis, which is a huge global healthcare burden, is typically linked to intertrochanteric fractures.¹

Over time, DHS/dynamic hip screws are thought to be a viable option for fixation in stable intertrochanteric fractures. Nevertheless, it has been connected to a number of issues, such as implant cuts, shortening, and varus collapse. The proximal femoral locking compression plate, or PFLCP, uses combi-holes to secure the femoral shaft and locking screws to secure the proximal trochanteric area. Locked fixation aids the body's natural healing process by reducing friction with the underlying bone's periosteum. PFLCP acts as an internalized fixator, improves pullout strength, and offers rotational and angular stability.²

Numerous studies that are currently available in the literature indicate that PFLCP performs worse, similarly, or better than DHS in terms of outcomes for patients who have intertrochanteric fractures. Although PFLCP offers a fixed angular design, it takes longer to cause axial compression at the fracture site, which may result in non-union in intertrochanteric fracture cases that have been treated. Wadhwani J et al. modified the PFLCP in 2024 in order to address the drawbacks of traditional methods by a number of adjustments.³

These modifications include expanding the plate's proximal portion to accommodate the maximum trochanteric area for fixation, increasing the fixation area by increasing the number of screw holes in the proximal region from three to six, and offering a variety of fixation options, including three locking screw slots that provide angular stability to the construction, three proximal locking screw holes of 5mm with different angles to the plate's shaft, and three compression screw slots that achieve intraoperative compression across the fracture site. The angles are as follows: 110° to the second proximal locking hole, 125° to the third proximal locking hole, and 95° to the first. To secure the femoral shaft, a combi-hole of variable fixation length was left in the distal plate section.⁴

By using lag screws to achieve compression across the fracture site through the proximal enlarged section of the plate, this modification of PFLCP was made to take use of the benefits of an angular stable build.⁴ The purpose of this study was to compare the radiological and functional results of a dynamic hip screw system with a modified PFLCP (proximal femoral plate locking compression plate) in Indian patients who had intertrochanteric fractures.

MATERIALS AND METHODS

The goal of the current prospective randomized clinical study was to compare the radiological and functional results of a dynamic hip screw system and modified PFLCP (proximal femoral plate locking compression plate) in Indian patients with intertrochanteric fractures. The study participants came from the Institute's Department of Orthopaedics. Prior to their involvement in the study, all subjects gave their written and verbal informed consent.

224 participants with intertrochanteric fractures, ranging in age from 28 to 90 years, were evaluated for the study. The primary study outcomes were the functional outcomes evaluated with HHS, while radiologic assessment was taken into consideration as a supplementary endpoint. Two groups of 112 subjects each were randomly selected from among the subjects. The fractures were categorized using the AO/OTA alphanumeric categorization system.

Adults of either gender who were 18 years of age or older and had post-traumatic intertrochanteric fractures were evaluated. AO/OTA classifications 31A2.2, 31A2.1, and 31A1 were among the fractures. Participants with AO/OTA categories 31A2.3 and 31A3 type, as well as those with open, pathological, or previously treated intertrochanteric fractures, were excluded from the study. For DHS, standard surgical procedure was employed.

After putting the patient in the supine position, the modified PFLCP method employed a standard direct lateral approach of muscle dissection and produced an 8–10 cm lateral longitudinal incision from the greater trochanter tip. The plate was positioned across the fracture location once an adequate fracture reduction was achieved. A 2.5mm guidewire was passed through the plate's proximal locking hole, and then a 2.5mm de-rotation wire was passed through a second proximal locking hole with a locking sleeve. Under fluoroscopy, wire location and fracture reduction were verified. A 6.5mm compression screw was then inserted across the fracture site through a hole in the compression plate. Depending on the situation, one or more compression screws were passed through.

The proximal femoral area was secured with two 5mm proximal locking screws. To line the plate with the bone, a 4.5mm distal cortical screw nearest the fracture site was inserted. Depending on the strength of the bone, either 2–4 5mm locking screws or 4.5mm distal cortical screws were employed. After a thorough washing, the wound was closed in layers.

There were two skilled surgeons who performed all of the procedures. After two weeks of surgery, sutures were removed, and static quadriceps workouts were initiated the next day. Heel sliding and straight leg lifting activities were then initiated. First, participants were instructed to use a walker to walk in a three-point gait. After four weeks following surgery, a two-point gait

was recommended based on compliance and condition. The minimal follow-up period was six months. All subjects had lateral and anteroposterior radiographs collected and evaluated at each follow-up of one, three, and six months.

When at least three of the four cortices in the anteroposterior and lateral views showed bridging trabeculae over the fracture site, union was considered. For conditions where the limb length disparity was greater than 2 cm, significant shortening was implemented. A 6-month follow-up and an immediate postoperative radiograph were used to measure the neck shaft angle, or NSA. When the NSA in radiographs at the 6-month follow-up and surgical times differed by more than 10°, a significant varus collapse was considered. At six months after surgery, the participants' functional status was evaluated using seven HHS scores.

RESULTS

The goal of the current prospective randomized clinical study was to compare the radiological and functional results of a dynamic hip screw system with a modified PFLCP (proximal femoral plate locking compression plate) in Indian patients who had intertrochanteric fractures. 224 participants with intertrochanteric fractures were enrolled in the study; they were split into two groups of 112 participants each at random. The study participants in the DHS and PFLCP groups ranged in age from 30 to 88 years old, with mean ages of 65.64 ± 12.02 and 64.05 ± 13.82 years, respectively. These ages were statistically non-significant ($p=0.53$). In the DHS group, there were 35.7% ($n=40$) males and 64.3% ($n=72$) females, while in the PFLCP group, there were 41% ($n=46$) males and 59% ($n=66$) females ($p=0.57$).

In 12.5% ($n=14$) and 10.7% ($n=12$) of the DHS and PFLCP groups, respectively, the cause of injury was a fall from height; in 16.07% ($n=18$) and 12.5% ($n=14$) of the subjects, RTA; and in 71.42% ($n=80$) and 76.78% ($n=86$) of the subjects, respectively, slip and fall. According to Table 1, the distribution of research participants in the two groups was statistically equivalent ($p=0.93$).

The mean surgery length for the DHS and PFLCP groups was 74.27 ± 11.94 and 77.30 ± 13.01 minutes, respectively, with $p=0.22$, according to a comparison of perioperative parameters in the two study groups. With $p=0.27$, the mean intraoperative blood loss was similar at 303.19 ± 81.86 and 319.44 ± 80.17 ml. Blood transfusions were required in 14.28% ($n=16$) and 16.07% ($n=18$) of the DHS and PFLCP study participants, respectively ($p=0.77$).

The DHS and PFLCP groups' hospital stays lasted 5.62 ± 3.37 and 6.02 ± 4.14 days, respectively, which was comparable ($p=0.64$). The DHS and PFLCP groups had comparable mean radiological union times of 18.36 ± 3.68 and 17.24 ± 3.41 weeks, respectively, with $p=0.11$. The DHS and PFLCP groups' respective mean HHSs were 82.4 ± 27.05 and 86.1 ± 30.38 , which were not statistically significant ($p=0.17$).

In terms of functional outcomes, 50.98% ($n=52$) and 62% ($n=62$) of the individuals in the DHS and PFLCP groups, respectively, had good results. 21.56% ($n=22$) and 20% ($n=20$) of the participants from the DHS and PFLCP groups, respectively, showed good results. The DHS group had 21.56% ($n=22$) and the PFLCP group had 10% ($n=10$) patients with fair performance. 5.88% ($n=6$) and 8% ($n=8$) of the individuals from the DHS and PFLCP groups, respectively, had poor outcomes. With $p=0.43$, the functional result distribution was similar between the two research groups (Table 2).

According to the study's findings, 5.88% ($n=6$) and 8% ($n=8$) of the DHS and PFLCP groups, respectively, required revision surgery for postoperative problems in two study individuals ($p=0.73$). Subjects from the DHS and PFLCP groups experienced significant shortening in 15.68% ($n=16$) and 12% ($n=12$), respectively, with $p=0.57$. Following surgery, 13.72% ($n=14$) and 12% ($n=12$) of the DHS and PFLCP groups, respectively, had muscle wasting ($p=0.77$). Postoperative discharge and implant failure/screw cutoff were similar in the two groups ($p=0.41$ and 1.00, respectively). With 33.3% ($n=34$) research subjects, varus collapse was considerably more common in the DHS group than in the PFLCP group, where it was observed in 14% ($n=14$) study subjects ($p=0.02$) (Table 3).

DISCUSSION

In this study, 224 participants with intertrochanteric fractures were split into two groups of 112 participants each at random. The study participants in the DHS and PFLCP groups ranged in age from 30 to 88 years old, with mean ages of 65.64 ± 12.02 and 64.05 ± 13.82 years, respectively. These ages were statistically non-significant ($p=0.53$).

In the DHS group, there were 35.7% ($n=40$) males and 64.3% ($n=72$) females, while in the PFLCP group, there were 41% ($n=46$) males and 59% ($n=66$) females ($p=0.57$). In 12.5% ($n=14$) and 10.7% ($n=12$) of the DHS and PFLCP groups, respectively, the cause of injury was a fall from height; in 16.07% ($n=18$) and 12.5% ($n=14$) of the subjects, RTA; and in 71.42% ($n=80$) and 76.78% ($n=86$) of the subjects, respectively, slip and fall. With $p=0.93$, the distribution of research

participants in the two groups was statistically comparable. These findings were similar to those of earlier research by Dhamangaonkar AC et al. (2013) and Chinmoy D et al. (2016), in which the authors evaluated participants with similar demographics and intertrochanteric fractures to those observed in this study.

The mean surgery length in the DHS and PFLCP groups was 74.27 ± 11.94 and 77.30 ± 13.01 minutes, respectively, with $p=0.22$, according to the study results comparing the perioperative parameters in the two study groups. With $p=0.27$, the mean intraoperative blood loss was similar at 303.19 ± 81.86 and 319.44 ± 80.17 ml. Blood transfusions were required in 14.28% ($n=16$) and 16.07% ($n=18$) of the DHS and PFLCP study participants, respectively ($p=0.77$). The DHS and PFLCP groups' hospital stays lasted 5.62 ± 3.37 and 6.02 ± 4.14 days, respectively, which was comparable ($p=0.64$). The DHS and PFLCP groups had comparable mean radiological union times of 18.36 ± 3.68 and 17.24 ± 3.41 weeks, respectively, with $p=0.11$. The DHS and PFLCP groups' respective mean HHSs were 82.4 ± 27.05 and 86.1 ± 30.38 , which were not statistically significant ($p=0.17$).

These findings were in line with those of Asif N et al. (2010) and Zang W et al. (2018), who reported perioperative parameters and fracture type distribution in intertrochanteric fractures that were comparable to the current study in their respective investigations.

Excellent functional outcomes were observed in 50.98% ($n=52$) and 62% ($n=62$) of the individuals from the DHS and PFLCP groups, respectively. 21.56% ($n=22$) and 20% ($n=20$) of the participants from the DHS and PFLCP groups, respectively, showed good results. The DHS group had 21.56% ($n=22$) and the PFLCP group had 10% ($n=10$) patients with fair performance. 5.88% ($n=6$) and 8% ($n=8$) of the individuals from the DHS and PFLCP groups, respectively, had poor outcomes.

There was no significant difference in the distribution of functional outcomes between the two research groups ($p=0.43$). These results were consistent with those of Kivi MM et al. (2013) and He S et al. (2018), who found a correlation between the functional outcomes reported in their research and the current study's findings.

Additionally, it was observed that 5.88% ($n=6$) and 8% ($n=8$) of the study participants from the DHS and PFLCP groups, respectively, required revision surgery due to postoperative problems ($p=0.73$). Subjects from the DHS and PFLCP groups experienced significant shortening in 15.68% ($n=16$) and 12% ($n=12$), respectively, with $p=0.57$.

Following surgery, 13.72% ($n=14$) and 12% ($n=12$) of the DHS and PFLCP groups, respectively, had muscle wasting ($p=0.77$). Postoperative discharge and implant failure/screw cutoff were similar in the two groups ($p=0.41$ and 1.00, respectively). With 33.3% ($n=34$) of the trial patients in the DHS group and 14% ($n=14$) in the PFLCP group, varus collapse was substantially more common in the DHS group ($p=0.02$). These findings were consistent with reports of postoperative problems similar to the current study by Shah MD et al. (2016) and Fulkerson E et al. (2006).

CONCLUSIONS

Within its limitations, the present study concludes that PFLCP has the potential of providing functional and radiological outcomes with equal efficacy as dynamic hip screws. The modified PFLCP technique can be used as an acceptable alternative to DHS in intertrochanteric fracture in subjects with severe osteoporosis. However, this modified PFLCP technique is a newer technique that needs further exploration with a larger sample size and longer monitoring to assess the efficacy of this modification.

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S. No	Characteristics	DHS	PFLCP	p-value
1.	Mean age (years)	65.64±12.02	64.05±13.82	0.53
2.	Age range (years)	30-88	33-88	
3.	Gender			
a)	Males	40 (35.7)	46 (41)	0.57
b)	Females	72 (64.3)	66 (59)	
4.	Injury cause			
a)	Fall from height	14 (12.5)	12 (10.7)	0.82
b)	RTA	18 (16.07)	14 (12.5)	
c)	Slip and fall	80 (71.42)	86 (76.78)	
5.	AO classification			
a)	31A1.1	22 (19.64)	20 (17.85)	0.93
b)	31A1.2	20 (17.85)	18 (16.07)	
c)	31A1.3	18 (16.07)	12 (10.71)	
d)	31A2.1	18 (16.07)	26 (23.21)	
e)	31A2.2	16 (14.28)	16 (14.28)	
f)	31A2.3	18 (16.07)	20 (17.85)	

Table 1: Demographic and disease data in two groups of study subjects

S. No	Parameters	DHS	PFLCP	p-value
1.	Mean surgery duration (mins)	74.27±11.94	77.30±13.01	0.22
2.	Mean intraoperative blood loss (ml)	303.19±81.86	319.44±80.17	0.27
3.	Need for blood transfusion	16 (14.28)	18 (16.07)	0.77
4.	Hospital stay duration (days)	5.62±3.37	6.02±4.14	0.64
5.	Mean radiological union time (weeks)	18.36±3.68	17.24±3.41	0.11
6.	Mean HHS	82.4±27.05	86.1±30.38	0.17
7.	Functional outcomes			
a)	Excellent	52 (50.98)	62 (62)	0.43
b)	Good	22 (21.56)	20 (20)	

c)	Fair	22 (21.56)	10 (10)	
d)	Poor	6 (5.88)	8 (8)	

Table 2: Perioperative parameters comparison in two study groups

S. No	Parameters	DHS	PFLCP	p-value
1.	Need for revision surgery	6 (5.88)	8 (8)	0.73
2.	Significant shortening	16 (15.68)	12 (12)	0.57
3.	Muscle wasting	14 (13.72)	12 (12)	0.77
4.	Varus collapse	34 (33.3)	14 (14)	0.02
5.	Implant failure/screw cutout	4 (3.92)	8 (8)	0.41
6.	Postoperative discharge	6 (5.88)	4 (4)	1.00

Table 3: Postoperative complications in two groups of study subjects