

ORIGINAL RESEARCH

A Comparative Analysis between Proximal Femur Locking Compression Plate and Dynamic Hip Screw for Inter-trochanteric Fracture Management

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ABSTRACT

Background: Intertrochanteric fractures frequently occur in the elderly, imposing considerable financial strain on both patients and their families. The anatomically contoured proximal femur locking compression plate (PFLCP) represents a recent advancement in addressing these fractures, forming an angular stable construct. Theoretically, this innovation aims to reduce the likelihood of failure due to issues such as screw cut-out and varus collapse, which are commonly associated with Dynamic Hip Screw (DHS) failures. **Methods:** This study aimed to conduct a prospective comparison of various factors, including the union rate, complications, operative risks, and functional outcomes, in the treatment of intertrochanteric fractures using Dynamic Hip Screw (DHS) versus Proximal Femur Locking Compression Plate (PFLCP). Additionally, the research sought to assess the effectiveness of PFLCP compared to DHS in managing intertrochanteric fractures. The data for this investigation were gathered from the examination of 60 cases of intertrochanteric fractures, with 30 cases treated using PFLCP and another 30 cases treated with DHS. **Results:** The assessment of functional outcomes was quantified using the Harris Hip Score. Within the Proximal Femur Locking Compression Plate (PFLCP) group, 14 cases (46.67%) achieved an excellent result, 10 cases (33.33%) showed a good outcome, and 6 cases (20%) demonstrated a fair result, with no instances of poor outcomes. The average score in the PFLCP group was 86.4. In contrast, within the Dynamic Hip Screw (DHS) group, 14 cases (46.67%) exhibited an excellent result, 8 cases (26.67%) displayed a good outcome, 4 cases (13.33%) indicated a fair result, and another 4 cases (13.33%) reported poor results. **Conclusion:** The Proximal Femur Locking Compression Plate (PFLCP) emerges as a favorable choice for intertrochanteric fracture management, showcasing a noteworthy combination of a high union rate, a low incidence of complications, and excellent functional outcomes. Additionally, there is the notable advantage that PFLCP procedures may potentially be conducted without the need for a C-Arm, enhancing the feasibility and accessibility of this treatment approach.

Keywords: Inter-trochanteric fracture, proximal femoral locking compression plate, dynamic hip screw.

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INTRODUCTION

Intertrochanteric (IT) fractures present a significant health concern, particularly in individuals aged 70 years and older. The prevalence of these fractures has seen an increase, attributed to the growing life expectancy and the adoption of more sedentary lifestyles associated with urbanization.¹ In younger populations, IT fractures are often the result of high-velocity trauma, whereas in the elderly, they tend to occur due to seemingly minor incidents. Comprising 45% of all hip fractures, IT fractures hold a central position as a major contributor to mortality and

disability in the elderly population.² Among these fractures, approximately 35-40% take on unstable three and four-part configurations, characterized by displacement of the posteromedial cortex. Fixing these unstable fractures with sliding hip screws has shown a variable failure rate, ranging from 6% to 32%. Historically, conservative methods were the primary treatment approach until the 1960s, before the advent of innovative fixation devices. However, the use of conservative methods was associated with elevated mortality rates and various complications, including decubitus ulcers, urinary tract infections,

pneumonia, and thromboembolic events.^{3,4} The introduction of advanced fixation devices marked a significant shift in treatment paradigms, rendering conservative methods less favorable. Contemporary practice favors operative methods for IT fractures, leveraging modern fixation devices and surgical techniques. Operative approaches have demonstrated improved outcomes in terms of both mortality and complications. Nevertheless, conservative methods still find relevance in specific cases, particularly for elderly individuals with high medical risks associated with anesthesia and surgery. In conclusion, the management of IT fractures has evolved over time, reflecting advancements in surgical techniques and fixation devices. While operative methods have become the mainstream approach, the consideration of conservative methods remains pertinent, particularly in situations where surgical intervention poses a heightened medical risk.

The standard treatment approach for intertrochanteric fractures has long been characterized by rigid internal fixation coupled with early mobilization.⁵ Despite the prevalence of this fracture type, spanning the last five decades of surgical advancements, there has been a notable absence of significant improvement or enhanced functional recovery in the methods employed. Surgeons, in their quest for effective treatment, have focused on controlling critical factors such as the quality of reduction, implant selection, and precise placement. Notably, from the 1980s to 2000, the sliding compression hip screw emerged as the gold standard for fixing hip fractures. However, the use of dynamic hip screws in treating unstable fractures has been associated with a complication rate ranging from 3% to 15%. Among the commonly reported complications are primary or secondary varus collapse and hardware failure, particularly the occurrence of "cut-out" of the femoral head screw. While postoperative fracture impaction in hips treated with sliding screws can facilitate early healing, ensuring a high union rate and minimizing hardware failure, the challenge lies in addressing the potential for excessive collapse. Recognizing these concerns, the most recent innovation in the management of intertrochanteric fractures comes in the form of the proximal femoral locking compression plate (PF-LCP; Synthes, West Chester, PA). Biomechanical studies have demonstrated that the PF-LCP exhibits strength equal to or greater than other fixation methods when applied to fractures of the femoral neck and subtrochanteric femur fractures.⁶ This implant not only represents a technological leap forward but also holds the promise of improving treatment outcomes and mitigating challenges associated with prior fixation techniques. As research continues to unfold, the PF-LCP stands as a testament to the ongoing pursuit of enhancing the efficacy of surgical interventions for intertrochanteric fractures.

The Proximal Femoral Locking Compression Plate (PFLCP) distinguishes itself with its mechanical

advantages, particularly in providing three-dimensional and angular stable fixations.⁷ This innovation addresses a significant concern in the realm of orthopedic surgery – the occurrence of 'cut-out' of the femoral head screw, a complication frequently reported in traditional implants, leading to implant failure. The PFLCP introduces a pivotal improvement by reducing the likelihood of this complication, thereby enhancing the overall reliability and durability of the implant. The unique feature of the PF-LCP lies in its role as a fixed-angle device. Despite providing a similar or even greater degree of variability when compared to the dynamic condylar screw, it accomplishes this without the necessity for excessive bone removal during the surgical procedure. This is particularly crucial as it preserves bone integrity and minimizes the invasiveness of the surgery, contributing to a more favorable postoperative recovery. The study, therefore, was designed with the specific goal of comparing the PFLCP with the dynamic condylar screw, two implants utilized in the management of intertrochanteric fractures. The emphasis of the research extended beyond merely evaluating clinical parameters; it sought to comprehensively analyze the functional outcomes associated with these implants. By delving into the real-world implications of these innovative devices, the study aimed to provide a nuanced understanding of their efficacy and impact on the overall success of intertrochanteric fracture treatments. The choice to focus on intertrochanteric fractures is particularly significant, as this fracture type is often encountered in the elderly population and poses unique challenges in terms of stability and functional recovery.⁸ Investigating these implants in the context of intertrochanteric fractures contributes valuable insights that could potentially shape future practices in orthopedic surgery. The research, by aiming to bridge the gap in our understanding of clinical and functional outcomes, aspires to provide a foundation for evidence-based decision-making in intertrochanteric fracture management, ultimately benefiting both patients and healthcare practitioners alike.

MATERIALS AND METHODS

The admission and subsequent management of patients with intertrochanteric fractures were conducted with a meticulous approach, involving the careful documentation of pertinent clinical details in a specifically designed proforma. This proforma served as a structured tool to systematically capture essential information for the study. Following the completion of in-hospital treatment, a well-organized system of regular outpatient follow-ups was established. These follow-up sessions were designed to provide ongoing clinical assessments and radiological evaluations, allowing for a comprehensive understanding of the patients' recovery trajectory. In instances where a patient presented with a suspected intertrochanteric

fracture, an expeditious and thorough clinical and radiological assessment was initiated. Upon confirmation of the diagnosis, the patient underwent necessary resuscitation measures and received skeletal traction for splinting before being admitted to the ward. Preoperative investigations played a crucial role in establishing baseline health parameters, encompassing a range of blood tests including Hb%, bleeding time, clotting time, blood grouping, cross-matching, fasting and postprandial blood sugar, blood urea, and serum creatinine. Radiological assessments were completed with pelvis and both hips AP view, supplemented by chest X-ray PA view when deemed necessary. Concurrently, any associated injuries were identified and addressed as part of a comprehensive treatment plan.

Elective surgery was undertaken after meticulously addressing and overcoming any avoidable anesthetic risks. Postoperatively, a well-structured follow-up schedule was implemented, featuring assessments at 6 weeks, 3 months, and 6 months intervals. These assessments were designed to monitor various aspects of patient recovery, including pain management, early detection of sepsis, and a comprehensive evaluation using the Harris Hip Score (HHS). The Harris Hip Score, a creation of Dr. William Harris, a distinguished Orthopedist based in Massachusetts, serves as a robust tool for evaluating patient outcomes post hip replacement. It covers critical aspects such as pain levels, functional abilities, absence of deformity, and range of motion, providing a holistic and standardized approach to assessing the effectiveness of the treatment strategies employed in the management of intertrochanteric fractures. This multi-faceted and systematic approach ensures a thorough and nuanced understanding of patient outcomes, contributing valuable insights to the ongoing refinement of intertrochanteric fracture management practices.

RESULTS

The study involved a comprehensive examination of 60 cases presenting with intertrochanteric fractures. In the course of this investigation, two distinct treatment approaches were employed to address these fractures.

Specifically, 30 cases were treated using the proximal femoral locking compression plate (PFLCP), and an additional 30 cases underwent treatment with the Dynamic Compression Hip Screw (DHS). The utilization of the proximal femoral locking compression plate (PFLCP) marked one group of patients, emphasizing a specialized approach that involves securing the fracture site with a plate designed for optimal stability and compression. On the other hand, the second group of 30 cases received treatment through the application of the Dynamic Compression Hip Screw (DHS), a method known for its dynamic compression mechanism aimed at promoting healing and stability in intertrochanteric fractures. By employing these distinct treatment modalities, the study sought to compare and analyze the outcomes, efficacy, and potential advantages or disadvantages associated with each approach in managing intertrochanteric fractures. The careful evaluation of these two treatment groups contributes valuable insights to the broader understanding of optimal strategies for addressing intertrochanteric fractures based on clinical outcomes and patient responses.

The age distribution in the study was specifically confined to individuals within the 40-80 years range. Within the cohort treated with the proximal femoral locking compression plate (PFLCP), the majority of cases, comprising 40%, fell within the age bracket of 51-60 years, totaling 12 cases. On the other hand, in the group treated with the Dynamic Compression Hip Screw (DHS), the highest number of cases, also constituting 40%, were observed in the age range of 60-70 years, amounting to 12 cases. The mean age within the PFLCP group was determined to be 60 years, indicating the average age of individuals receiving treatment with this approach. In contrast, the mean age for the DHS group was calculated to be 61 years. These statistics provide an overview of the age-related distribution within the studied groups, shedding light on the prevalence and average age of patients undergoing treatment with proximal femoral locking compression plates and Dynamic Compression Hip Screws.

Table 1: Age distribution among study participants

Age group	Number of cases		Percentage		Total cases	
	PFLCP	DHS	PFLCP	DHS		Percentage
40-50	6	6	20%	20%	12	20%
51-60	12	6	40%	20%	18	30%
61-70	8	12	26.67%	40%	20	33.33%
71-80	4	6	13.33%	20%	10	16.67%
Total	30	30			60	

Figure 1: Age distribution among study participants

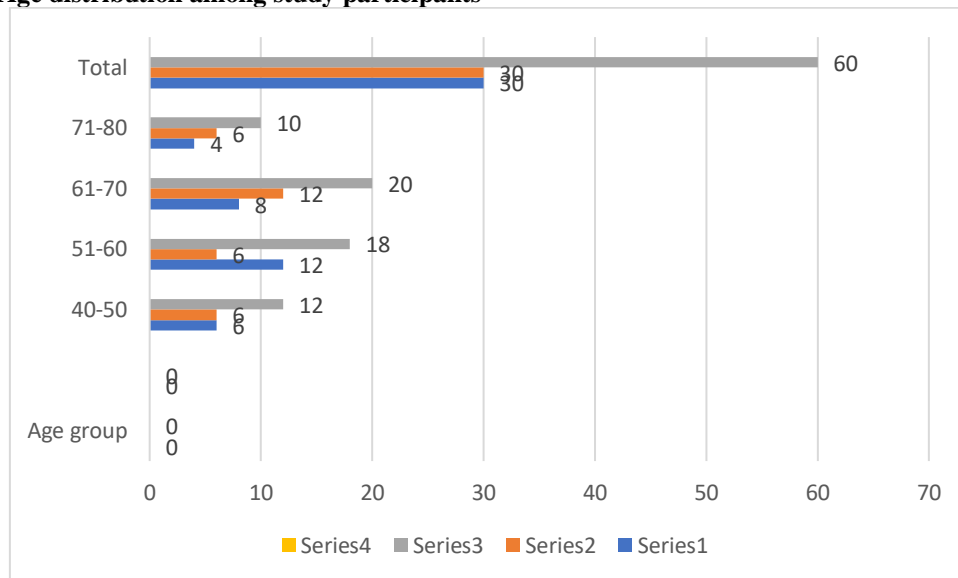


Figure 2: Gender distribution

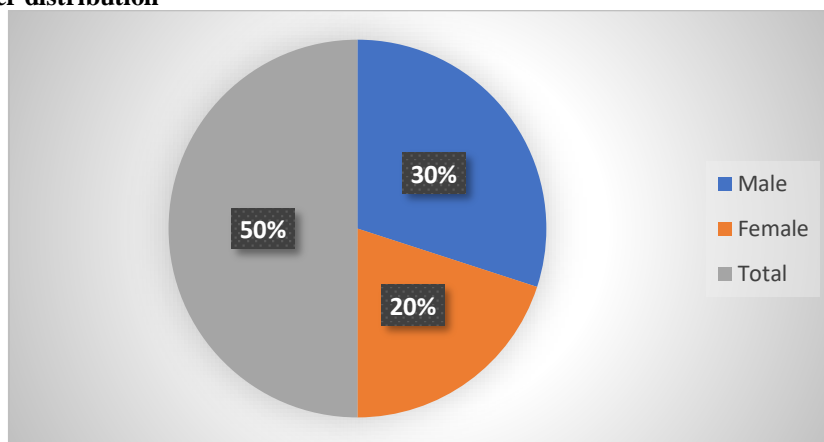


Table 2: Gender distribution

Gender	Number of cases	
	PFLCP	DHS
Male	18	16
Female	12	14
Total	30	30

Within both treatment groups, a notable trend was observed, indicating a higher prevalence of male cases compared to female cases. This gender-based distribution was consistent across the proximal femoral locking compression plate (PFLCP) group and the Dynamic Compression Hip Screw (DHS) group. The study findings reveal that in both the PFLCP and DHS groups, the number of male cases surpassed that of female cases. This gender disparity

adds an additional layer to the demographic characteristics of the study participants and may prompt further investigation into potential gender-related factors influencing the occurrence or management of intertrochanteric fractures. Understanding these gender dynamics can contribute valuable insights to the overall comprehension of fracture patterns and treatment outcomes in diverse patient populations.

Table 3: Nature of injury

Nature of violence	Number of cases		Percentage	
	PFLCP	DHS	PFLCP	DHS
Fall	16	20	26.67%	33.33%
Road traffic accident	14	10	23.33%	16.67%
Total	30	30	50%	50%

The primary cause of fractures in both treatment groups was identified as falls. Irrespective of whether patients were treated with the proximal femoral locking compression plate (PFLCP) or the Dynamic Compression Hip Screw (DHS), a commonality emerged in the nature of the injury, with falls being the predominant factor leading to intertrochanteric fractures. This shared observation underscores the

significance of falls as a leading cause of such fractures and highlights the importance of preventive measures and interventions to address fall-related risks. The consistency of this finding across both treatment groups reinforces the notion that addressing fall prevention strategies is crucial in the broader context of managing intertrochanteric fractures.

Figure 3: Type of fractures: Boyd & Griffin classification

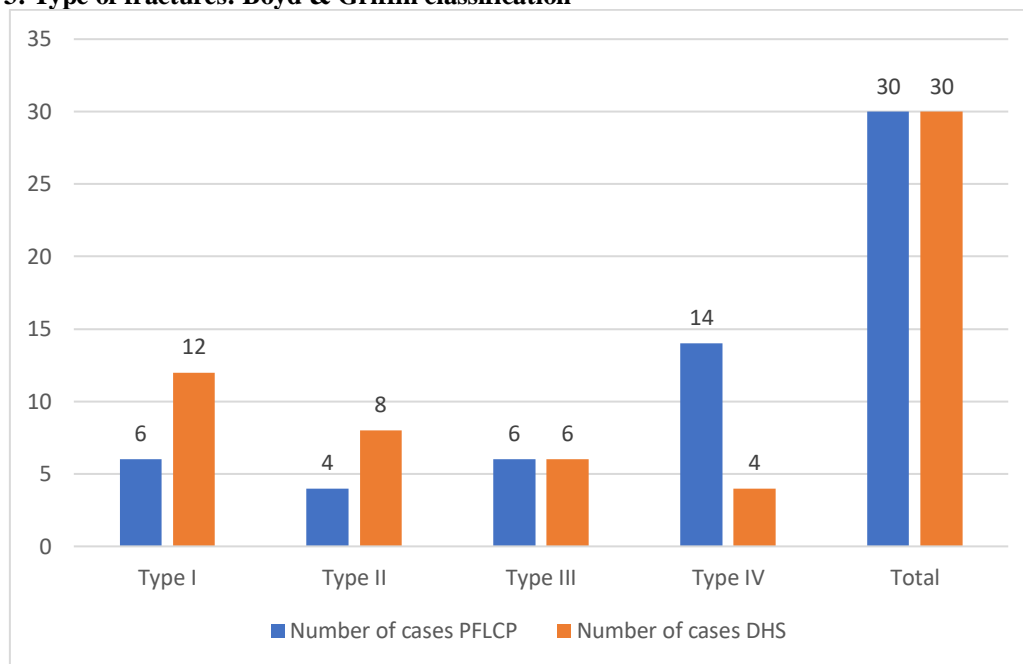


Table 4: Type of fractures: Boyd & Griffin classification

Type of fracture	Number of cases		Percentage	
	PFLCP	DHS	PFLCP	DHS
Type I	6	12	20%	40%
Type II	4	8	13.33%	26.67%
Type III	6	6	20%	20%
Type IV	14	4	46.67%	13.33%
Total	30	30	100%	100%

Trochanteric fractures were classified using the BOYD and GRIFFIN Classification system in this study. Notably, within the proximal femoral locking compression plate (PFLCP) group, the majority of cases belonged to Type IV according to the classification. In contrast, within the Dynamic Compression Hip Screw (DHS) group, the maximum

number of cases fell under Type I. This distinction in the distribution of fracture types between the two treatment groups suggests variability in the nature and severity of trochanteric fractures and emphasizes the importance of tailoring treatment approaches based on specific fracture classifications.

Table 5: Harris Hip score Functional scoring results

	PFLCP	DHS
Excellent	14	14
Good	10	8
Fair	6	4
Poor	0	4

DISCUSSION

In the realm of orthopedic surgery, the year 1950 marked a milestone with Earnes Roll of Germany

introducing the pioneering concept of sliding hip screws. This innovative approach aimed to enhance the stability and fixation of hip fractures, laying the

foundation for subsequent advancements in fracture management. The utilization of sliding hip screws became a pivotal technique in orthopedic surgery, particularly for addressing fractures in the proximal femur. In 1952, Schumpelick et al. contributed to the evolving landscape by describing an implant design featuring a sliding cannulated system with a side plate.⁹ Their work not only introduced a novel approach to fracture fixation but also highlighted challenges associated with implant telescoping, leading to the collapse of fractures. This observation, in turn, prompted further refinements in implant design and surgical techniques to mitigate complications and improve patient outcomes. Moving forward to 1984, S.P. Mohanty and V. Chacko from Manipal, India, conducted a comprehensive analysis comparing operative and nonoperative management of trochanteric fractures in 135 cases. Their findings underscored the superiority of operative treatment over simple nonoperative methods, emphasizing the importance of surgical interventions in achieving better outcomes for patients with trochanteric fractures. This study significantly influenced the evolving paradigm in the management of hip fractures. In 1994, Blatter G et al. contributed to the growing body of knowledge by studying the treatment of pertrochanteric and subtrochanteric fractures of the femur, focusing on the application of the Dynamic Compression Screw (DCS).¹⁰ This implant, characterized by dynamic compression, aimed to provide enhanced stability and promote optimal fracture healing. The year 1995 witnessed another breakthrough with Tepic & Perren reporting on the "internal fixator" or PC-Fix, a novel principle of fracture fixation. This approach introduced the concept of a point contact fixator, wherein the stability of the implant was dependent on the stiffness of the plate-screw construct. Such innovations in fixation principles have played a crucial role in advancing fracture management techniques, emphasizing the importance of stability in promoting successful outcomes. These historical developments collectively demonstrate the dynamic and evolving nature of orthopedic surgery, with continuous efforts to refine techniques, improve implant designs, and enhance patient care in the realm of hip fractures and their management.

In 1995, a comprehensive review of 101 pertrochanteric fractures was conducted by an author, examining various factors that could influence the outcomes of these fractures. The study specifically focused on risk factors such as age, fracture pattern, and the level of the fracture. This endeavor aimed to deepen the understanding of the complexities associated with pertrochanteric fractures and provided valuable insights into the variables influencing their clinical outcomes.¹¹ The following year, in 1996, the AO/ASIF (Arbeitsgemeinschaft für Osteosynthesefragen/Association for the Study of Internal Fixation) made a significant contribution to

orthopedic surgery by introducing the proximal femoral nail (PFN). This innovative implant was designed with the specific intent of reducing the risk of femoral shaft fractures that could be associated with intra-medullary devices. The introduction of the PFN marked a noteworthy advancement in the treatment of pertrochanteric fractures, offering a solution to address potential complications associated with existing fixation methods. The proximal femoral nail (PFN) incorporated several modifications aimed at enhancing its performance. Notable features included the inclusion of a 6mm antirotation screw to augment rotational stability.^{12,13} Additionally, the implant featured a 6-degree valgus bend in the coronal plane, contributing to optimal alignment during fixation. The PFN also boasted a narrow diameter, a design element intended to minimize stress concentration on the femoral shaft. Furthermore, the incorporation of distal flexibility in the PFN design was aimed at reducing tension on the femoral shaft, thereby mitigating potential complications and promoting better overall stability. These developments in the mid-1990s reflect the ongoing efforts within the orthopedic community to refine and innovate fracture management techniques. The introduction of the proximal femoral nail (PFN) not only addressed specific challenges associated with femoral shaft fractures but also showcased the importance of continuous improvement in implant design to enhance the overall efficacy and safety of orthopedic interventions.

In the year 2000, there was a resurgence in recognizing the importance of rotational instability in hip fractures. In response to this, Gottfried developed the Percutaneous Compression Plate (PCCP) system. This innovative system was designed to optimize rotational stability in hip fractures while minimizing damage to the greater trochanter, the lateral wall of the femur. The PCCP system represented a significant step forward in addressing rotational instability issues associated with hip fractures, providing a more tailored and effective solution.^{14,15} Seven years later, in 2007, Hasenboehler EA et al. published findings on the treatment of complex proximal femoral fractures using the Proximal Femur Locking Compression Plate (PF-LCP). This publication highlighted the PF-LCP as a feasible alternative for the treatment of unstable inter- and sub-trochanteric fractures. The PF-LCP's locking compression design offered enhanced stability, particularly in cases involving complex fractures, contributing to improved clinical outcomes. In 2010, Sun JF et al. published on the minimally invasive treatment of intertrochanteric fractures using the Locking Compression Plate (LCP) in elderly patients. This study emphasized the advantages of minimally invasive approaches with LCP, including stable fixation, reduced blood loss, and minimal invasiveness. The evaluation, according to HUANG Gong-yi's standards, reported excellent results in 40 cases, good outcomes in 8 cases, and

poor outcomes in 2 cases, showcasing the effectiveness of this approach in the elderly population. However, in 2011, Glassner PJ and Tejwani NC published cases documenting failures of the Proximal Femoral Locking Compression Plate. Seven cases were reported, encompassing acute peritrochanteric fractures, a peri-prosthetic fracture at the site of a prior hip fusion, early failure of a compression hip screw, and non-unions.^{16,17,18} The failure modes included implant fracture in four cases and loss of fixation in three cases, attributed to varus collapse and implant cut-out. This highlighted the importance of continuous monitoring, research, and improvement in orthopedic implant designs to address potential complications and failures. These developments from 2000 to 2011 underscore the dynamic nature of orthopedic research and the ongoing efforts to refine surgical techniques and implant designs for the treatment of proximal femoral fractures, with a particular focus on rotational stability, minimally invasive approaches, and addressing potential failure modes.

CONCLUSION

In our prospective study, we conducted a comparative analysis of two implant systems for the management of acute traumatic intertrochanteric fractures. The study involved a cohort of 60 patients presenting with intertrochanteric fractures, with 30 cases treated using the proximal femoral locking compression plate (PFLCP) and another 30 cases treated with the dynamic hip screw (DHS). The demographic distribution in the PFLCP group comprised 18 males and 12 females, while the DHS group consisted of 16 males and 14 females. The age range of the participants was between 40 and 80 years, with a mean age of 60 years for the PFLCP group and 61 years for the DHS group. Throughout the study, patients were systematically monitored with regular intervals, undergoing clinical, functional, and radiological assessments. The evaluation included mean scores, and in the DHS group, the mean score was determined to be 83.4. While the PFLCP group exhibited better results, it's noteworthy that the statistical analysis indicated that the difference between the two groups was not statistically significant, with a P-value greater than 0.05. The findings suggest that while the PFLCP showed superior outcomes, both implant systems demonstrated effective management of intertrochanteric fractures. Notably, the PFLCP exhibited a high union rate, a low complication rate, and favorable functional outcomes. An additional advantage highlighted in the study is the potential feasibility of performing PFLCP procedures without the need for a C-Arm, enhancing the practicality and accessibility of this approach. In conclusion, based on our study, the proximal femoral locking compression plate (PFLCP) emerges as a viable and effective option for the management of intertrochanteric

fractures. Its favorable outcomes, combined with the possibility of performing the procedure without a C-Arm, make it a compelling choice in the clinical setting.

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