

**BIPOLAR HEMIARTHROPLASTY VERSUS
PROXIMAL FEMORAL NAILING IN
ELDERLY PATIENTS WITH UNSTABLE
INTERTROCHANTERIC FRACTURES: A
SYSTEMATIC REVIEW AND META-
ANALYSIS.**

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Abstract

Introduction and Objectives

Unstable intertrochanteric femoral fractures in the elderly is either treated by fixation or joint replacement surgery. Bipolar hemiarthroplasty (BHA) and proximal femoral nail (PFN) are the two most common interventions in current practice and PFN is generally considered to be most ideal. However, hemiarthroplasty is advocated to facilitate early mobilization in recent practice. Currently there is no consensus on the superiority between these two interventions and this review was performed to resolve that uncertainty. Our aim is to answer the question of whether PFN is a better alternative to BHA for unstable intertrochanteric femur fractures in the elderly. Hence the main objective of conducting the present systematic review and meta-analysis was to determine the superiority of PFN over BHA by comparing the postoperative outcomes like mortality rate and harris hip scores (HHS). Additionally, secondary outcomes like injury to surgery time, rate of revision surgery, intra-operative blood loss, period of immobilization, and period of hospitalization were compared.

Methodology

Four electronic databases of PubMed, Scopus, Web of Science, and the Cochrane Library were searched for relevant articles that directly compared BHA and PFN in unstable intertrochanteric femur fractures in the elderly.

Results

We analyzed a total of 13 studies published between the years 2012 to 2022. There were 11 retrospective cohort and two randomized controlled studies. The number of patients in these studies ranged from 44 to 308. There was a significant difference in HHS between

two groups with standard mean difference (MD) of – 7.60 (range – 10.83 to –4.36), favouring the PFN group. The BHA group had a greater mortality rate with odds ratio (OR) of 1.47 (range 1.14 to 1.90). Moreover intraoperative blood loss (MD: 206.86) and period of immobilization (MD: 0.35) were lower in the PFN group. There were no difference in the rate of revision surgery (OR- 0.76), period of hospitalisation and injury to surgery time (MD: -1.35).

Conclusion

Treatment of unstable intertrochanteric femoral fractures in the elderly with proximal femoral nailing is superior to bipolar hemiarthroplasty as PFN had overall lower mortality rate and higher functional results. This is attributed to the PFN procedure being quicker and reduced intraoperative blood loss. Proximal femoral nail is superior to bipolar hemiarthroplasty for unstable intertrochanteric femoral fractures in the elderly. PFN imparts better functional outcomes and has lower rates of overall mortality. Additionally, it is faster surgery, with lesser blood loss contributing to better results.

Key words:

Proximal femoral nail, PFN, Bipolar hemiarthroplasty, BHA, HHS, Unstable

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

Proximal femoral fractures, commonly known as 'hip fractures' can be classified with the involvement of the hip capsule into two types, intra-capsular fracture, and extra-capsular fracture. Intra-capsular fractures comprise femoral neck fracture and the extra-capsular fracture comprises intertrochanteric fracture. Intertrochanteric (IT) fractures are commonly classified according to AO/OTA and Evans-Jensen classification systems [1].

Hip fractures are one of the most common injuries that orthopedic surgeons encounter, with a global prevalence of 1.3 million in 1990 to an estimated 4.5 million cases worldwide by the year 2050. They continue to be of great interest to the surgical and research communities in terms of fixation and outcomes. The surgical approach employed to treat displaced subcapital fractures is directly influenced by the patient's age, severity of fracture and pre-operative functional status [1,2].

Earlier research suggested that the femoral head should be retained in patients younger than 65 years old due to high success rate and potential for long-term complications of a possible arthroplasty, while taking into consideration the risk of avascular necrosis of the femoral head. There are a variety of factors that affect surgical treatment, some of which are related to the patient such as age, physical condition, comorbidities, fracture location and pattern, while others are attributable to the surgeon's training and experience, country of treatment, and institutional facilities [2-6].

Presently, there is an increase in the prevalence of fractures among older individuals and the general population, which has become a major public health concern due to increasing of aging population [4]. Due to the association of comorbidities with morbidity and mortality, these patients typically have a poor prognosis and endure deterioration in their

general health after surgery. Almost 30% of these patients die within the first year after surgery, and most who survive have limited mobility [5].

An ideal treatment plan for elderly patients with unstable fractures must lead to faster healing, lower mortality, early functional restoration, and a lower re-operation rate. Since the 1980s, good success rates have been reported for fractures treated with a sliding hip screw or intra-medullary femoral nail (IMN). Furthermore, in elderly patients, comminution, osteoporosis, and instability frequently prevent the initial resumption of full weight-bearing after internal fixation of unstable fractures [6].

1.2 PROBLEM STATEMENT AND STUDY RATIONALE

It is crucial to provide effective and suitable therapy in order to overcome the limitations caused by poor bone quality, especially in older individuals [19]. Many therapeutic procedures have been used to heal these fractures, however due to low bone quality, stable fixation in these tough class fractures is extremely challenging.

There is currently no consensus on whether PFN is preferable to BHA or vice versa wherein the last meta-analysis study from 2016 had analyzed the overall surgical outcomes between intramedullary devices and hemiarthroplasty. Hence, we have undertaken this study to give more conclusive evidence as to which of the two surgical modalities of treatment for IT fracture in the elderly (PFN or BHA) was superior in terms of post-operative mortality, comorbidities, re-operation rates, and overall functional results in older (> 55 years) providing a qualitative summary of the findings of the studies that were reviewed and analyse the results quantitatively by carrying out meta-analysis.

1.3 RESEARCH QUESTIONS

1. Which surgical intervention is superior for the treatment of unstable intertrochanteric fracture in elderly population? Bipolar hemiarthroplasty or Proximal femoral nail?
2. What are the factors responsible for designating the intervention as superior to the other and can we make further improvement in the intervention by identifying the rectifiable non-favourable surgical outcomes?

1.4 OBJECTIVES

General objectives

1. To compare the post-operative outcomes in terms of mortality, pain, functionality, range of motion, disability, and Quality of Life in elderly patients with unstable intertrochanteric fractures treated with Bipolar hemiarthroplasty (BHA) versus proximal femoral nailing (PFN)
2. To provide a qualitative summary of the findings of the studies to be reviewed and to quantitatively analyse these findings by meta-analysis.

Specific objectives

1. To compare surgical complications like Survival Rates, Rate of Revision Surgery, Period of Hospitalization, Injury to Surgery Time, Intra-Operative Blood Loss with Transfusion and Period of Immobilization.

CHAPTER 2: LITERATURE REVIEW

Proximal femoral fractures, commonly known as 'hip fractures' can be classified in relation to the involvement of hip capsule into 2 types, intra-capsular fracture, and extra-capsular fracture. Intra-capsular fractures comprise of femoral neck fracture and the extra-capsular fracture comprises of intertrochanteric fracture. Our topic of interest will be that of intertrochanteric fracture (henceforth referred to as IT fracture) which is commonly classified according to AO/OTA and Evans-Jensen classification systems as illustrated in the Fig.1 below.

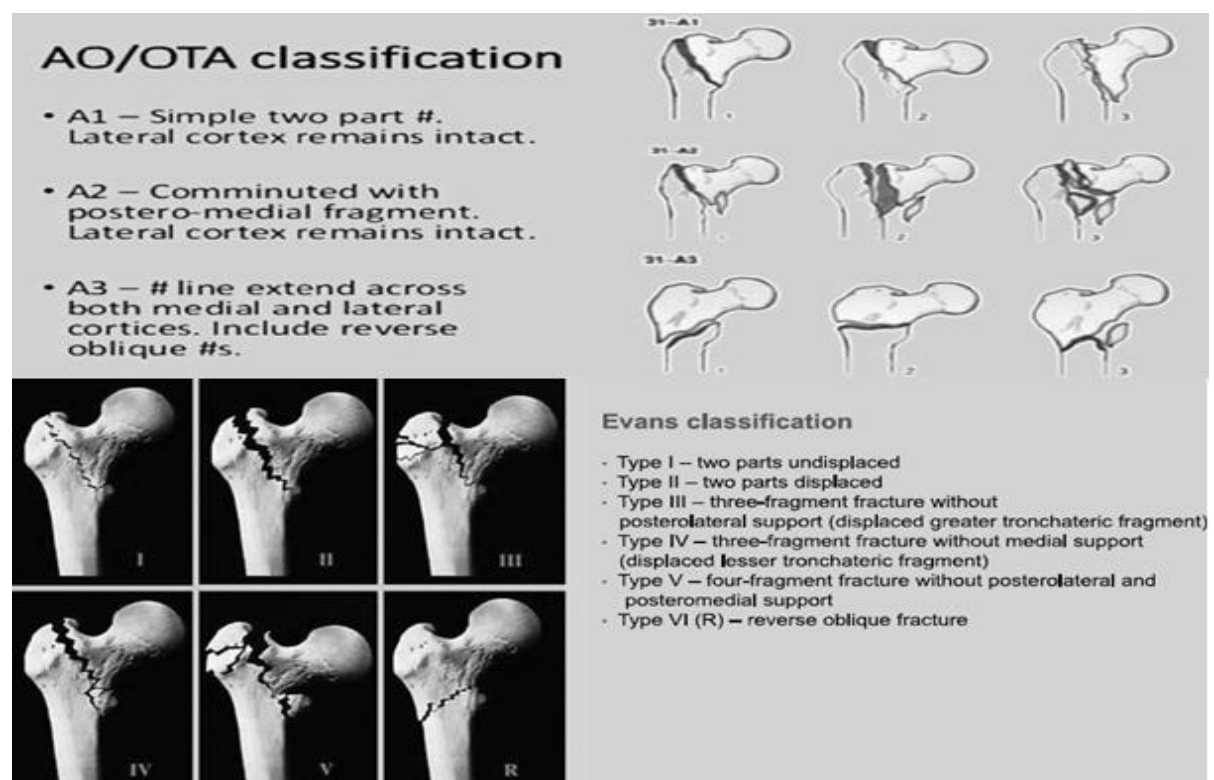


Figure 1. AO and Evans classification of intertrochanteric fractures.

At present day, there is an increase in the prevalence of fracture among older individuals and general population which has become a major public health concern [1]. Due to the association of comorbidities with morbidity and mortality, these patients typically have a poor prognosis and endure deterioration in their general health after surgery [2,3]. Indeed,

almost 30% of these patients die within the first year after surgery, and the majority of those who survive have limited mobility [4].

While most intertrochanteric fractures are treatable with internal fixation, the difficulty of the fracture or other patient-related factors may lead the orthopaedic surgeon to recommend bipolar hemiarthroplasty (BHA) [7,8]. Hemiarthroplasty, which incorporates core replacement, is not recommended as a principal treatment option, but it can be used to treat unstable fractures [9].

Nonetheless, it has several advantages over internal fixation, such as avoiding complications associated with lag screw cut-out, the absence of the threat of fracture non-union, and the ability to endure weight immediately [10]. In terms of post-operative mortality rates, inconsistent results have been observed depending on the type of surgery [11,12]. Compared to proximal femoral nail (PFN) surgery, BHA has the drawbacks of more intraoperative blood loss, a greater need for blood transfusion, a longer surgical duration, and cementing.

Based on these findings, we presumed that progressive post-operative risk of complications is more common in BHA patients. However, in terms of early functional recovery, BHA may be beneficial as it allows patients to have instant weight-bearing capability [13]. Intertrochanteric fractures occur for 50% of hip fractures, and mortality within a year of the fracture can be as high as 15% to 20% [14]. Hip fractures in the elderly are frequently accompanied by underlying conditions including diabetes, chronic lung disease, hypertension and severe osteoporosis and often have poor general health and limited surgical tolerance. As a result, individuals are more likely to experience post-surgery bed rest difficulties.

The management of older patients with unstable intertrochanteric fractures has long been controversial. For the management of unstable intertrochanteric femoral fractures, most authors suggest the use of PFN in conjunction with a kind of IMN [9,13, 15, 18, 22-28].

Growth in the older population leads to an increase in the occurrence of fractures; essential to use an efficient and suitable treatment strategy for such patients. It is extremely difficult to acquire and ensure a sustainable fixation in older patients because of their low bone quality [3,14]. Many treatment approaches, like a dynamic hip screw (DHS), PFN, unipolar and BHA, and external fixation, have been utilized to manage intertrochanteric fractures over the past 2 decades [8-10].

However, low bone quality makes it hard to obtain and creates a constant fixation in senior patients. [16,17]. The primary aims of surgery are early mobility and swift recovery to pre-fracture activity levels. The management of this fracture continues to be difficult for surgeons, and there is still debate over the best treatment strategy for hip fractures in older individuals [18].

It is crucial to provide effective and suitable therapy to overcome the limitations caused by poor bone quality, especially in older individuals. Many therapeutic procedures have been used to heal these fractures; however, due to low bone quality, stable fixation in these tough class fractures is extremely challenging [8,19]. An ideal treatment plan for elderly patients with unstable fractures must lead to faster healing, lower mortality, early functional restoration, and a lower reoperation rate. Ever

Furthermore, in elderly patients, comminution, osteoporosis, and instability frequently prevent initial resumption of full weight-bearing after internal fixation of unstable fractures [6]. While the majority of intertrochanteric fractures may be treated with internal fixation, the

complexity of the fracture or other patient-related considerations may lead to hemiarthroplasty (HA) [7,8].

The dynamic hip screw (DHS) has long been thought to be the gold standard for stable fractures, however failure rates in unstable patterns have been shown to be higher [6,8]. This resulted in the development of intramedullary nail designs that provide enhanced biomechanical stability in fracture patterns that are unstable. PFN, on the other hand, has been documented to fail in patients with osteoporosis and significant comminution, necessitating arthroplasty [7,8].

Primary bipolar hemiarthroplasty (BHA) has been recommended as an alternative to osteosynthesis for IFF in the elderly because it allows for early complete weight bearing, avoids osteosynthesis failures, and gives satisfactory functional results [14, 15]. Subsidence and failure rates, on the other hand, are high, particularly in cases of postero-medial comminution. Cement use has been linked to higher intra-operative and post-operative morbidity and death [16].

CHAPTER 3: METHODOLOGY

3.1 METHODOLOGY

Research design

Systematic Review and Meta-Analysis.

Study location

The studies were searched consistently in four electronic databases: PubMed, Scopus, Web of Science, and the Cochrane Library. Two reviewers will search the databases simultaneously.

Study population

Elderly patients aged 60 years and above of either sex and of any ethnicity with unstable intertrochanteric femur fractures

3.2 SUBJECT CRITERIA

The inclusion criteria are as follows:

- The articles that dealt with both PFN and Bipolar hemiarthroplasty (either cemented or cementless) techniques.
- The journal articles which presented unstable intertrochanteric femur fractures based on the AO/OTA classification and/or Evans classification.
- Studies comprised of Datasets that are utilized to evaluate the Bipolar hemiarthroplasty and PFN methods that have been appropriately mentioned.
- Randomized Clinical Trial and retrospective cohort studies on unstable intertrochanteric fracture fixation.
- Patients aged 60 years and above of either sex and of any ethnicity.

The exclusion criteria are as follows:

- The articles including the fracture fixation by techniques other than PFN and BHA.
- Studies with patients having severe head or spine or multiorgan injuries.
- Unpublished manuscripts.
- Articles which are published in languages other than English.
- Editorials, simple narrative reviews, case reports, case series, book chapters, and conference proceedings.

3.3 SEARCH STRATEGIES

A systematic review and meta-analysis of studies were performed to review the post-surgical outcomes associated with PFN and BHA for unstable IT fracture in the elderly. The study utilized the latest guidelines from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [56].

Two reviewers search the databases simultaneously. The keywords and search strings (Appendix 1) were used to search in the above databases. All the articles published from the inception of these databases until May 2022 were searched and retrieved to assess their eligibility for inclusion while restricting the publications to the English language only. To identify other potentially eligible studies, the reference lists of the included studies were cross-checked. We also checked the reference list of identified studies in order to identify the unpublished trials or trials not found by electronic searches. We searched for ongoing trials through the World Health Organization and International Clinical Trials Registry Platform.

3.4 TRIAL SELECTION

Two reviewers scanned the titles and abstracts from the searches and obtained the full-text articles when they appeared to meet the eligibility criteria. The eligibility of the trials was assessed independently, and the possible reasons for exclusion have been documented. Any disagreements between the review authors were resolved through discussion.

3.5 RESEARCH TOOL

The instrument that was used in this study are as below:

- Electronic searches
- RevManager 5.4.1
- the Z-test
- chi-square test and the I² statistic values
- estimated relative risk (RR) at 95% confidence interval (CI)

3.6 DATA COLLECTION METHOD

Two authors extracted the data separately from the registration records using customized data collection forms. All the discrepancy between the two authors were resolved by the third author. Patient age, sample size, fracture types, first author, publication year, country, follow-up period, operating technique, and postoperative clinical outcome data were obtained.

The risk of bias and applicability of the included studies were assessed using assessment criteria based on the Cochrane risk of bias assessment tool. On a three-point scale, low (+), high (-), and unclear (?) indicate concerns about applicability and bias risk, respectively.

3.7 ETHICAL CONSIDERATION

1. Subject vulnerability

- *Not Applicable*
- Therefore, applied for the letter of exemption from ethical approval, as this dissertation is a systematic review and meta-analysis.

2. Declaration of absence of conflict of interest

I declare no conflicts of interest, as the study is done independently with no financial aids or benefits of any form from any party in relation to this study.

3. Privacy and confidentiality

All forms and data entry are anonymous. Only research team members can access the data. Data will be presented as grouped data and will not identify the subjects individually.

4. Community sensitivities and benefit

This study aims to identify the superior surgical management for unstable intertrochanteric fractures in elderly population, which in turn benefits the community, as it leads to safer and more efficient surgical technique. This study doesn't involve any questionnaire or interview question, hence there is no issue of sensitivities to the patient or society.

5. Honorarium and incentives

This study is not bound to any form of research grant and any minor portion of spending will be borne by the principal researcher.

CHAPTER 4: MANUSCRIPT

4.1 ABSTRACT

Introduction and Objectives

Unstable intertrochanteric femoral fractures in the elderly is either treated by fixation or joint replacement surgery. Bipolar hemiarthroplasty (BHA) and proximal femoral nail (PFN) are the two most common interventions in current practice and PFN is generally considered to be most ideal. However, hemiarthroplasty is advocated to facilitate early mobilization in recent practice. Currently there is no consensus on the superiority between these two interventions and this review was performed to resolve that uncertainty. Our aim is to answer the question of whether PFN is a better alternative to BHA for unstable intertrochanteric femur fractures in the elderly. Hence the main objective of conducting the present systematic review and meta-analysis was to determine the superiority of PFN over BHA by comparing the postoperative outcomes like mortality rate and harris hip scores (HHS). Additionally, secondary outcomes like injury to surgery time, rate of revision surgery, intra-operative blood loss, period of immobilization, and period of hospitalization were compared.

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two groups with standard mean difference (MD) of -7.60 (range -10.83 to -4.36), favouring the PFN group. The BHA group had a greater mortality rate with odds ratio (OR) of 1.47 (range 1.14 to 1.90). Moreover intraoperative blood loss (MD: 206.86) and period of immobilization (MD: 0.35) were lower in the PFN group. There were no difference in the rate of revision surgery (OR- 0.76), period of hospitalisation and injury to surgery time (MD: -1.35).

Conclusion

Treatment of unstable intertrochanteric femoral fractures in the elderly with proximal femoral nailing is superior to bipolar hemiarthroplasty as PFN had overall lower mortality rate and higher functional results. This is attributed to the PFN procedure being quicker and reduced intraoperative blood loss. Proximal femoral nail is superior to bipolar hemiarthroplasty for unstable intertrochanteric femoral fractures in the elderly. PFN imparts better functional outcomes and has lower rates of overall mortality. Additionally, it is faster surgery, with lesser blood loss contributing to better results.

Key words:

Proximal femoral nail, PFN, Bipolar hemiarthroplasty, BHA, HHS, Unstable

4.2 INTRODUCTION

Proximal femoral fractures, commonly known as 'hip fractures' can be classified with the involvement of the hip capsule into two types, intra-capsular fracture, and extra-capsular fracture. Intra-capsular fractures comprise femoral neck fracture and the extra-capsular fracture comprises intertrochanteric fracture. Intertrochanteric (IT) fractures are commonly classified according to AO/OTA and Evans-Jensen classification systems [1].

Hip fractures are one of the most common injuries that orthopedic surgeons encounter, with a global prevalence of 1.3 million in 1990 to an estimated 4.5 million cases worldwide by the year 2050. They continue to be of great interest to the surgical and research communities in terms of fixation and outcomes. The surgical approach employed to treat displaced subcapital fractures is directly influenced by the patient's age, severity of fracture and pre-operative functional status [1,2].

Earlier research suggested that the femoral head should be retained in patients younger than 65 years old due to high success rate and potential for long-term complications of a possible arthroplasty, while taking into consideration the risk of avascular necrosis of the femoral head. There are a variety of factors that affect surgical treatment, some of which are related to the patient such as age, physical condition, comorbidities, fracture location and pattern, while others are attributable to the surgeon's training and experience, country of treatment, and institutional facilities [2-6].

Presently, there is an increase in the prevalence of fractures among older individuals and the general population, which has become a major public health concern due to increasing of aging population [4]. Due to the association of comorbidities with morbidity and mortality, these patients typically have a poor prognosis and endure deterioration in their general health after surgery. Almost 30% of these patients die within the first year after surgery, and most

who survive have limited mobility [5]. An ideal treatment plan for elderly patients with unstable fractures must lead to faster healing, lower mortality, early functional restoration, and a lower re-operation rate. Since the 1980s, good success rates have been reported for fractures treated with a sliding hip screw or intra-medullary femoral nail (IMN). Furthermore, in elderly patients, comminution, osteoporosis, and instability frequently prevent the initial resumption of full weight-bearing after internal fixation of unstable fractures [6].

4.2.1 Description of the interventions

While most intertrochanteric fractures are treatable with internal fixation, the difficulty of the fracture or other patient-related factors may lead the orthopaedic surgeon to recommend bipolar hemiarthroplasty (BHA) [7,8]. Hemiarthroplasty, which incorporates core replacement, is not recommended as a principal treatment option, but it can be used to treat unstable fractures [9]. Nonetheless, it has several advantages over internal fixation, such as avoiding complications associated with lag screw cut-out, the absence of the threat of fracture non-union, and the ability to endure weight immediately [10]. In terms of post-operative mortality rates, inconsistent results have been observed depending on the type of surgery [11,12]. Compared to proximal femoral nail (PFN) surgery, BHA has the drawbacks of more intraoperative blood loss, a greater need for blood transfusion, a longer surgical duration, and cementing.

Based on these findings, we presumed that progressive post-operative risk of complications is more common in BHA patients. However, in terms of early functional recovery, BHA may be beneficial as it allows patients to have instant weight-bearing capability [13]. Intertrochanteric fractures occur for 50% of hip fractures, and mortality within a year of the fracture can be as high as 15% to 20% [14]. Hip fractures in the elderly are frequently accompanied by underlying conditions including diabetes, chronic lung disease, hypertension

and severe osteoporosis and often have poor general health and limited surgical tolerance. As a result, individuals are more likely to experience post-surgery bed rest difficulties.

The management of older patients with unstable intertrochanteric fractures has long been controversial. For the management of unstable intertrochanteric femoral fractures, most authors suggest the use of PFN in conjunction with a kind of IMN [9,13, 15, 18, 22-28]. Growth in the older population leads to an increase in the occurrence of fractures; essential to use an efficient and suitable treatment strategy for such patients. It is extremely difficult to acquire and ensure a sustainable fixation in older patients because of their low bone quality [3,14]. Many treatment approaches, like a dynamic hip screw (DHS), PFN, unipolar and BHA, and external fixation, have been utilized to manage intertrochanteric fractures over the past 2 decades [8-10].

However, low bone quality makes it hard to obtain and creates a constant fixation in senior patients. [16,17]. The primary aims of surgery are early mobility and swift recovery to pre-fracture activity levels. The management of this fracture continues to be difficult for surgeons, and there is still debate over the best treatment strategy for hip fractures in older individuals [18]. It is crucial to provide effective and suitable therapy to overcome the limitations caused by poor bone quality, especially in older individuals. Many therapeutic procedures have been used to heal these fractures; however, due to low bone quality, stable fixation in these tough class fractures is extremely challenging [8,19].

There is currently no consensus on whether PFN is preferable to BHA or vice versa. The present systematic review and meta-analysis was carried out with the objective of determining the superiority of PFN over BHA by comparing the postoperative outcomes like mortality rate and harris hip scores (HHS). Additionally, secondary outcomes like injury to surgery time, rate of revision surgery, intra-operative blood loss, period of immobilization, and